General Catalog 501

FISHER

General Catalog 501 is designed to guide you quickly and easily toward the Fisher products that may solve your particular control problem.

Finding What You Want

Quick Reference and Selection Guides

The Quick Reference Guide on the adjacent page will guide you to the product section(s) of interest. The Selection Guides located at the beginning of each product section will direct you to the appropriate product description(s).

Subject and Type Number Indexes

The indexes at the front of the catalog also can help you find product information in a hurry. If you know the common name of the product you're looking for, the Subject Index will guide you directly to the appropriate selection guide. If you know the Fisher product type number, the Type Number Index will refer you directly to its product description.

Product Descriptions

You will find that each product description contains enough specification details for you to evaluate the general product capabilities relative to your needs. But not enough information is provided to enable you to specify and order products. This is where your Fisher Sales Office or Sales Representative can help you—in final product selection.

Ordering What You Need

After reviewing the appropriate selection guide information and product description(s), let your Fisher Sales Office or Sales Representative help you select the specific product variation you need. Simply provide your applications details. To help you develop this information, listings of typical application considerations are provided just preceding many of the selection tables.

Requesting Additional Information

You can obtain detailed information on any product by requesting the bulletin number listed at the end of its description. Request this literature from your Fisher Sales Office or Sales Representative, or you can utilize the information request card found within the back pages of this catalog.

Sales Offices and Sales Representatives

See the section "About Fisher Controls" for the location of the Fisher Sales Office or Sales Representative near you. Or contact:

Fisher Controls International, Inc.
P.O. Box 190
Marshalltown, Iowa 50158
U.S.A.
Phone: 515/754-3011
FAX: 515/754-2830

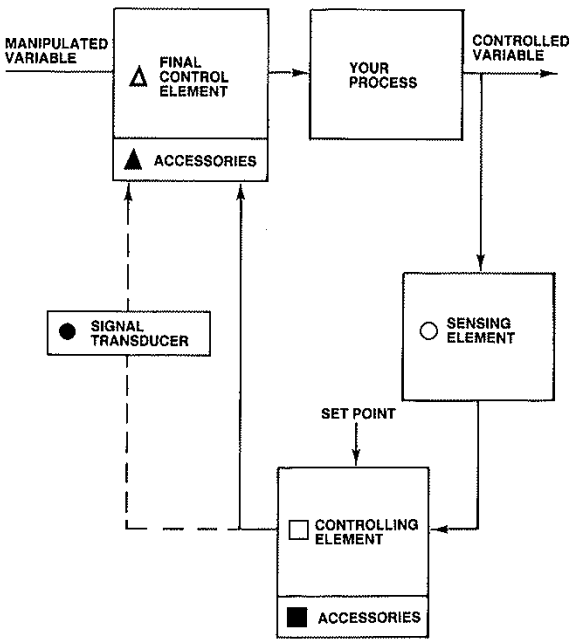
Fisher Controls S.A.
Rue Paul-Baudry
B.P.10
68700 Cernay
France
Phone: + 33 () 89 75 48 00
FAX: + 33 () 89 75 69 57

The Fisher Total Loop Involvement

Total loop involvement means that Fisher products find application throughout the process control loop.

As shown below, a total control loop consists of three basic elements plus your process. The sensing element measures the variable that is to be controlled and sends its value to the controlling element via a mechanical linkage or a standard transmission signal (pneumatic or electronic.) The controlling element compares the variable with a desired value called set point and produces a signal that operates the final control element to counteract deviations between set point and the controlled variable. In some loops, the controlling element signal operates the final control element directly. In other loops, a signal transducer converts the signal into another level or form of energy to operate the final control element. In either case, the final control elements acts upon the manipulated variable—such as flow—which in turn controls the controlled variable—such as pressure or level.

The loop diagram below and the catalog section titles at right on the adjacent page contain symbol coding. After identifying from the diagram which portion(s) of the total loop you are interested in, you can use the coding to select the catalog section(s) that describe the appropriate products.



Section

Catalog 501

5th Edition

FISHER®

Fisher Controls

Trademark Acknowledgment

The following are registered tradenames of Fisher Controls International, Inc.:

PROVOX®plus instrumentation systems
Vee-Ball® characterized ball valve
easy-e® globe style control valve
Level-Trol® liquid level controller
Cavitrol® trim for cavitation control
Whisper Trim® cages for noise abatement
ēdisc® eccentric disc control valve
Hi-Ball® full-bore ball valve
Fishtail® butterfly valve disc
Easy-Joe® pressure-reducing regulator
Wizard® series pressure controllers

Phoenix III® is a registered tradename of Posi-Seal International.

Other registered tradenames used within Catalog 501 include:

Tradename	*Registered by*
Carpenter 20	Carpenter Technology Corp.
Dacron	E.I. DuPont de Nemours Co.
Durimet	Duriron Co., Inc.
Kel-F	3M Company
K-Monel	International Nickel Company
Hastelloy	Stellite Division, Cabot Corp.
Hypalon	E.I. DuPont de Nemours Co.
Inconel	International Nickel Co.
Monel	International Nickel Co.
Ni-Span C	International Nickel Co.
Tefzel	E.I. DuPont de Nemours Co.
Thiokol	Thiokol Chemical Co.
Viton	E.I. DuPont de Nemours Co.

Subject Index

The Subject Index is an alphabetical listing of products by their common names. Generally, the index refers you to one or more Selection Guide tables which help you select a specific product within the common name category. However, in instances where only one product exists within the common name category, the index directs you to the product description, enabling you to bypass the Selection Guide information.

A

B

C

D

E

F

G

H

I

J

L

Subject Index

Type Number Index

The Type Number Index provides a quick reference from type numbers to the page(s) where you will find the products described. However, not all of Fisher Controls' products have their own product description—some are only mentioned briefly in one or more descriptions of other products. If you cannot find the detailed information you require, contact your Fisher Sales Office or Sales Representative for assistance.

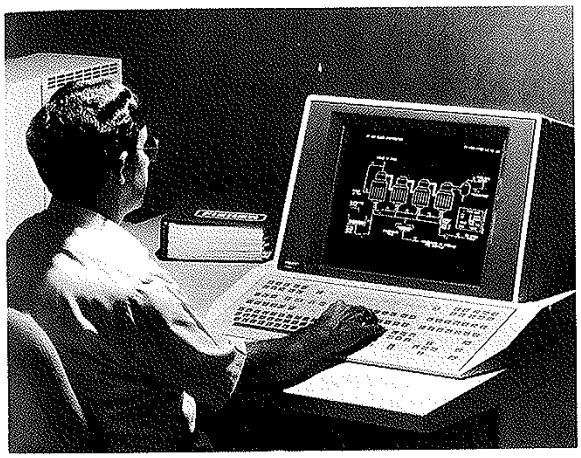
Type Number Index

The Fisher difference: Solutions

Fisher Controls International, Inc. is a process controls company with a difference: We offer solutions, not just products. We provide the process control expertise and the answers needed to increase throughput, lower operating costs, achieve product specifications, and increase return on investment.

This problem-solving ability is our strength. It's a strength that began more than 100 years ago, when William Fisher developed the world's first constant-pressure pump governor—not as a product, but as a control solution.

We've continued to provide solutions to our customers' process control problems ever since. Today, the Fisher problem-solving process works because we combine a balance of proven and new technology into each product's design. We have the manufacturing capability and methods to produce cost-effective, quality products. And every solution has our full support, including application assistance, installation service, maintenance and repair services, and user personnel education.



A commitment to technology

At Fisher Controls we've demonstrated a commitment to research and development throughout our history. Each year we make a significant investment in research efforts that are aimed at developing new products and technologies for process measurement and control.

Research and development activities take place at several Fisher locations around the world. A process instrumentation research center in Leicester, England is dedicated to the development and testing of distributed control systems. A fluid flow control laboratory can be found at the Fisher research and development center in Marshalltown, Iowa, U.S.A. A flow test facility in McKinney, Texas is utilized to develop natural gas and propane regulator products and control techniques, while a research and development center in Austin, Texas focuses on future measurement and control room instrumentation products.

Applying technology to measurement and control instruments

Quality, reliability, and simplicity of design are all exemplified by our broad range of pneumatic, electro-pneumatic, and electronic instruments that measure and control the primary process variables—flow, temperature, liquid level, and pressure.

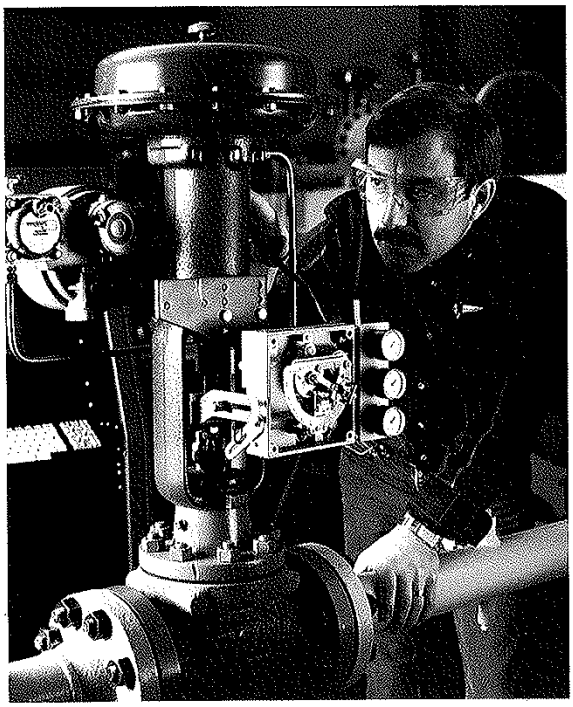
For example, our Wizard® pressure and temperature controllers and our Level-Trol® controllers are industry standards. And the Fisher temperature transmitter line offers temperature sensing capabilities at a significant economy.

Applying technology to control valves and regulators

We produce more automatic control valves and regulators for the process and energy industries, worldwide, than any other manufacturer. And we continue to develop new valve products, like the V500 eccentric plug valve that meets tough erosive flow conditions, the 585-CE corrosive service valve package specifically built for long service life in hostile environments, and the innovative Posi-Seal Trimtite™ high-performance butterfly valve which eliminates body leak paths past the disc seal.

For control of natural gas there's the revolutionary 399 Series Big Joe™ regulator which brings maintenance efforts to an absolute minimum.

By effectively utilizing our extensive fluid flow research capability, we have developed solutions to difficult flow problems, such as noise abatement and cavitation control. One result of this research is the Whisper Trim® cage, a unique product design that significantly reduces control valve noise. Another is Cavitrol® trim that helps minimize or eliminate cavitation damage, thereby extending the life of valves operating under severe service conditions.



Applying technology to digital distributed controls

In digital distributed control systems, applying technology leads to solutions like the PROVOXplus instrumentation system.

PROVOXplus instrumentation delivers sophisticated continuous, discrete, and batch process control. Based on our industry-proven PROVOX controls, this enhanced system combines advanced electronics, process-control technology, and application software to provide power, flexibility, and outstanding return on investment.

The Fisher quality process

At Fisher Controls, quality is an active process. It begins with a corporate-wide dedication to "doing the job right the first time." And it continues with each employee striving to deliver products and services that are defect-free and which meet customer requirements.

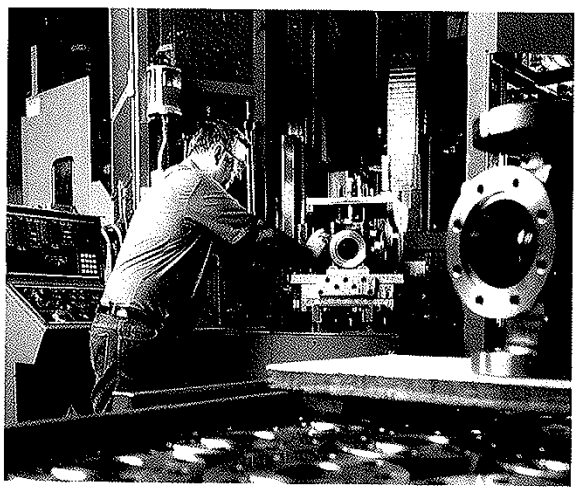
The first measure of Fisher quality is whether our products and services meet your control requirements. It's also measured by how well we process your order, meet shipment schedules, and handle the wide variety of tasks related to doing business with you.

The Fisher quality process goes beyond the personal commitment of each employee. It can be found as well in the extensive physical resources utilized by our people in bringing products and services to the marketplace.

For example, at Fisher Controls' R.A. Engel Technical Center, product development engineers combine innovative approaches to product design with the power of the computer. Design efforts often involve computer-assisted analysis of how pressure and temperature loading affects a proposed valve body configuration. Similarly, computer-aided drafting takes advantage of immediate access to the extensive Fisher technology data base, speeding overall product design efforts. Product design capabilities such as these help bring better answers to process control needs, faster.

The Fisher Controls' quality process can also be found at work at each of our manufacturing locations. Our defect-free commitment applies to all production operations, whether the part being manufactured is an electronic component small enough to hold in the palm of one hand or if it is a valve body casting weighing 20,000 lbs. One concrete example of the quality process at work is a continuing improvement in the already outstanding mean-time-between-failure for PROVOXplus controllers.

It is the Fisher commitment to quality which brings you the best in control products and services, along with the level of support you need to meet your process control demands efficiently and effectively.



World class resources at the local level

Fisher Controls is an international company with engineering, manufacturing and service operations in 22 countries. Yet more important to you is our ability to apply these resources in meeting your control needs.

We do so through our Sales Representative and sales office network which involves more than 2000 individuals located in more than 180 Fisher sales offices, worldwide.

The majority of these application experts are degreed engineers who combine their experience in solving process control problems with Fisher Controls' global resources in meeting your specific process control needs, quickly and efficiently.

Services Available to Support You

Education Fisher also offers comprehensive customer training and education programs. These programs covering a wide range of process problems and consist of structured courses that are geared to real-world situations. The instructors are qualified design and applications engineers who effectively teach how to deal with major control issues.

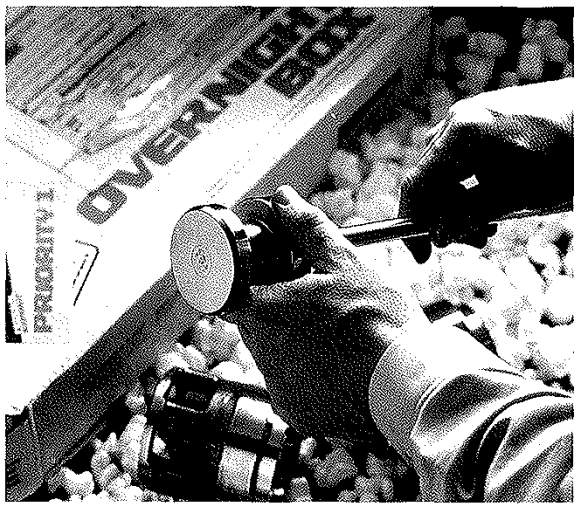
Customer training is provided at our educational facilities located in 11 countries—as well as at regional training centers and many of our local sales offices. In addition to our standard programs, individually tailored courses designed for the specific needs of an organization can be conducted on-site. Pre-packaged Fisher training courses are available in a video format, making self-training convenient and cost-efficient.

System Support Ongoing support services from Fisher Controls keep your PROVOXplus instrumentation system at its best. Factory-certified technicians and engineers can provide preventive and corrective maintenance, spare parts stocking, troubleshooting, calibration and tuning, or system configuration—whatever's right for you and your system. There's even a fixed-cost service option to help you manage costs better.

Valve Repair You can help keep your process on stream by relying on the Fisher Service Company. With locations across North America, in the United Kingdom, Scandinavia, and Europe, the Fisher Service Company can give you fast

turnaround of emergency and routine valve repairs. You gain the advantages given by factory-authorized repair using genuine Fisher parts, plus each total valve repair receives a one-year warranty. In fact, each Fisher Service Company location has direct access to Fisher Controls' extensive serial number base which tells the exact construction of each Fisher valve manufactured since 1900. That means your repairable Fisher valves can be rebuilt to meet original factory specifications.

Parts Availability An important aspect of keeping your process onstream is the availability of genuine Fisher replacement parts for control valves through the Fisher FAST Service system. When the need is urgent, you can order parts from your Fisher sales office or representative and then receive them the next day, within 24-hours. When your valve parts need is more routine, you can expect to receive your standard parts order within seven days.



Administrative, Sales and Service Locations Worldwide

Administrative Headquarters

Corporate Headquarters - St. Louis, MO. U.S.A.
Final Control Systems Business Unit - Marshalltown, IA
Support Services Business Unit - Marshalltown, IA
Process Instrumentation and Measurement Instrumentation Business Unit - Austin, TX

World Area: Europe, Middle East, and Africa

ADMINISTRATIVE:

Belgium-Brussels
France-Cernay
Germany-Solingen
United Kingdom-Rochester, Leicester

MANUFACTURING:

France-Cernay, Vichy
Germany-Ahaus, Solingen
Italy-Milan
South Africa-Transvaal
Spain-Madrid
United Kingdom-Leicester, Lewisham, Rochester

SALES:

Abu Dhabi
Austria-Vienna
Belgium-Brussels
Cyprus-Nicosia
Denmark
Dubai
Egypt-Cairo
Finland-Helsinki
France-Paris, Pau, Rouen
Germany-Leverkusen, Munich, Offenback/Main, Pinneberg, Solingen
Greece-Athens
Holland-Rijswijk
India-Madras, New Delhi, Pune, Bangalore, Baroda, Hyderabad
Iran-Tehran
Italy-Milan, Rome
Kuwait-Safat
Nigeria-Lagos, Port Harcourt
Norway-Bergen, Oslo Oman-Ruwi
Pakistan-Karachi
Portugal-Lisbon
Qatar-Doha
Saudi Arabia-Al-Khobar
South Africa-Transvaal, Natal
Spain-Barcelona, Madrid
Sweden-Karlstad
Switzerland-Zurich
Syria-Damascus
Turkey-Istanbul
United Kingdom-Aberdeen, Newcastle, Kirkcaldy, Leicester, Lewisham, Rochester
Zambia-Ndola

SERVICE AND REPAIR:

Austria-Vienna
France-Cernay, Vichy
Germany-Solingen
Italy-Milan
Nigeria-Warri
Norway-Bergen
South Africa-Transvaal
Spain-Madrid
Sweden-Hammaro
United Kingdom-Aberdeen, Leicester, Peterlee, Rochester

World Area: Latin America

ADMINISTRATIVE:

Brazil-Sao Paulo
Mexico-Morales

MANUFACTURING:

Argentina-Rio Grande
Brazil-Sao Jose dos Campos, Sao Paulo
Mexico-Toluca

SALES:

Argentina-Buenos Aires
Bolivia-LaPaz, Santa Cruz
Brazil-Sao Paulo
Chile-Santiago
Colombia-Bogota
Costa Rica-San Jose
Ecuador-Quito
Mexico-Coatzacoalcos, Guadalajara, Mexico City, Monterrey, Navojoa, Puebla, Tampico, Queretaro, Villahermosa
Peru-Lima
Venezuela-Caracas, Maracaibo, Puerto La Cruz, Valencia

World Area: Asia Pacific

ADMINISTRATIVE:

Australia-Sydney
Hong Kong
Japan-Tokyo
Republic of Singapore-Singapore

MANUFACTURING:

Australia-Melbourne, Sydney
Japan-Sakura
Republic of Singapore-Singapore

SALES:

Australia-Adelaid, Brisbane, Melbourne, Perth, Sydney
Brunei-Jalan Gadong, Seria
Burma-Rangoon
Hong Kong
Indonesia-Jakarta
Japan-Fukushima, Nagasaki, Nagoya, Osaka, Tokyo
Korea-Seoul
Malaysia-Selangor
New Zealand-Auckland, Wellington
Philippines-Manila
Republic of Singapore-Singapore

SERVICE AND REPAIR:

Republic of Singapore-Singapore

World Area: North America

ADMINISTRATIVE:

Connecticut-North Stonington
Iowa-Marshalltown
Ontario-Cambridge, Woodstock
Texas-Austin, McKinney

MANUFACTURING:

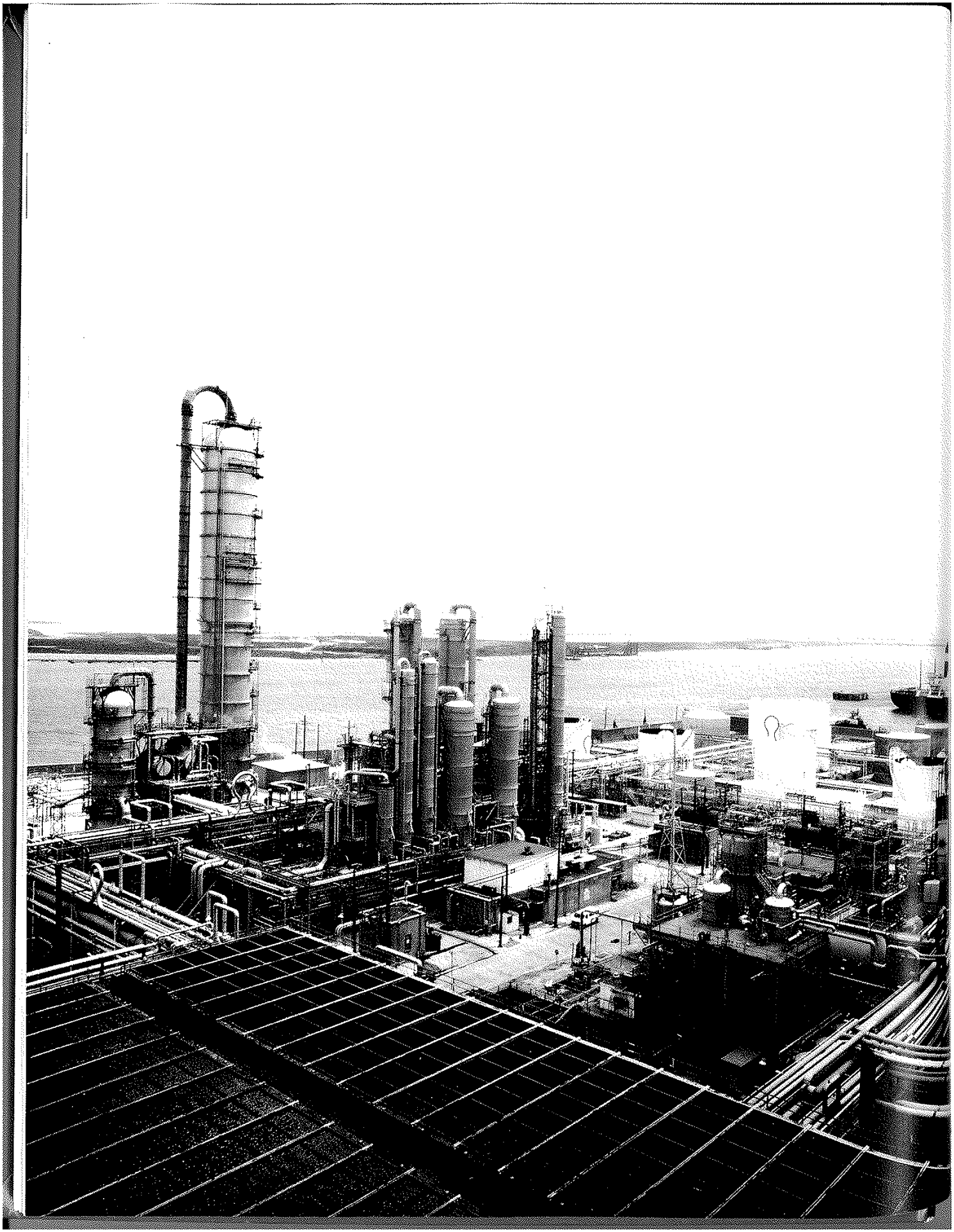
Connecticut-North Stonington
Iowa-Marshalltown
Ontario-Woodstock
Texas-McKinney, Sherman

SALES:

Canada —
Alberta-Calgary, Edmonton
British Columbia-Vancouver
New Brunswick-Saint John
Nova Scotia-Dartmouth
Ontario-London, Sudbury, Thunder Bay, Toronto
Quebec-Montreal, Quebec City
Saskatchewan-Regina
Manitoba-Winnipeg
U.S. —
Alabama-Birmingham, Mobile
Alaska-Anchorage
Arizona-Phoenix, Tucson
California-Bakersfield, Los Angeles, San Diego, San Mateo
Colorado-Denver
Connecticut-Chesire
Florida-Jacksonville, Tampa
Georgia-Atlanta
Hawaii-Honolulu
Illinois-Dekatur, Elk Grove Village, Peoria
Indiana-Indianapolis, Mt. Vernon
Iowa-Davenport, Marshalltown
Kansas-Kansas City, Liberal, Wichita
Kentucky-Louisville
Louisiana-Baton Rouge, Lafayette, Lake Charles, Monroe, New Orleans
Maine-Waterville
Maryland-Baltimore
Massachusetts-Mansfield
Michigan-Farmington Hills, Kalamazoo, Midland
Minnesota-Minneapolis
Missouri-St. Louis
Montana-Billings
Nebraska-Omaha
New Jersey-Tenafly
New York-Albany, Buffalo, Syracuse
North Carolina-Charlotte
Ohio-Cincinnati, Cleveland
Oklahoma-Oklahoma City, Tulsa, Woodward
Oregon-Portland
Pennsylvania-Philadelphia, Pittsburgh, York
Tennessee-Knoxville, Memphis, Nashville
Texas-Amarillo, Beaumont, Corpus Christi, Dallas, Farmington, Freeport, Houston, New Braunfels, Odessa, Webster
Virginia-Midlothian
Wisconsin-Appleton, Milwaukee
Utah-Salt Lake City
Washington-Seattle
Jamaica-Kingston
Puerto Rico-San Juan
Trinidad-San Fernando

SERVICE AND REPAIR:

Alberta-Edmonton
California-Paramount
Illinois-Posen
Louisiana-Gonzales, Monroe
New Jersey-Burlington
Ohio-Mansfield
Ontario-Toronto
South Carolina-Columbia
Texas-LaPorte



Contents

Greater profitability and productivity can be yours—now and in the future—with distributed process control solutions from Fisher Controls.

Technology and PROVOXplus

Ever since Fisher Controls entered the process control business more than a century ago, we have been continually responding to our customers' requirements and to the direction of the marketplace. Providing proven products, service, technology, and applications has established Fisher Controls as a leader in supplying process control solutions.

Building on this foundation of expertise, Fisher Controls has enhanced the power of PROVOX instrumentation systems through a system-wide release of integrated new products and applications software. The result? Greater capabilities for complete process control and total plant integration. PROVOXplus—our response to your process control needs for integrated systems solutions (figure 1).

PROVOXplus provides these advantages:

- Open systems for integration with plant networks and other devices through gateways and standards compatibility
- Economical installation through redundant, remoteable I/O—up to 5,000 feet
- Enhanced operator capability through advanced alarm management
- Improved engineering productivity through global, relational database configuration
- Expandable control-system intelligence through integrated process-supervision and plant-management software
- Process integrity through cost-effective system redundancy.

Fisher Controls incorporates an evolutionary design into PROVOXplus, emphasizing flexibility that evolves and expands with your needs. We are also committed to building business relationships that grow from one year to the next to help you achieve your long-range plans by being a supplier in tune with your needs.

PROVOXplus Architecture

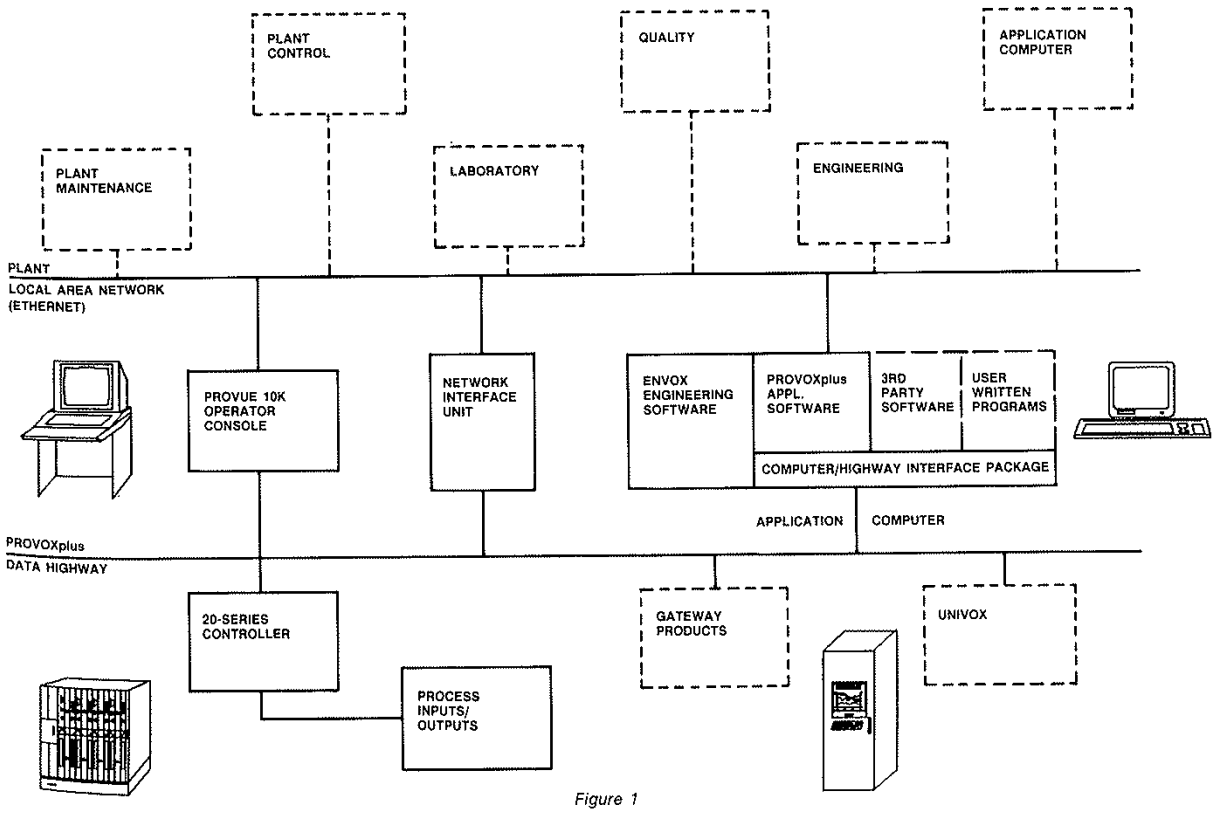


Figure 1

Your integrated manufacturing efforts begin with the leader in designing such strategies: Fisher Controls. You can also team with Fisher Controls for planning and executing a plantwide integrated manufacturing strategy—designing for a more competitive future.

Develop a long-term strategy by benefiting from our knowledge of your industry; our familiarity with computer integrated manufacturing (CIM); our system integration capabilities; our personalized, local support; and our experience in actually implementing plantwide systems.

It's clear that PROVOXplus represents more than just technology—it's also solutions. It's the result of our commitment to fully integrated solutions and total plant automation. Solutions from Fisher Controls means connectivity —integrating plant equipment into your system—and that helps to solve problems. Solutions that are state-of-the-art and reliable as demonstrated by the growing strength of our installed base. The same strategies and planning that go into Fisher Controls solutions are found in our local, comprehensive support network ready to respond when you need them. PROVOXplus represents the next step to total plant automation—and available only from Fisher Controls.

Key Components of PROVOXplus

PROVOXplus Controllers

One of the real technological strengths of PROVOXplus can be found in the controllers (figure 2). The Unit Operations Controller (UOC), Integrated Function Controller (IFC), and Multiplexer (MUX) provide a broad spectrum of both continuous and discrete capabilities. The UOC provides advanced control for batch applications while the IFC is designed for continuous processes such as interlocking and simple sequencing. Both controllers come equipped with advanced 32-bit Motorola 68020 microprocessors for performance that's hard to beat. The multiplexer is designed for monitoring configurable control of discrete processes that include header, simple discrete control, and simple interlocking. With the MUX, you can achieve discrete pump/valve control and analog/discrete inputs.

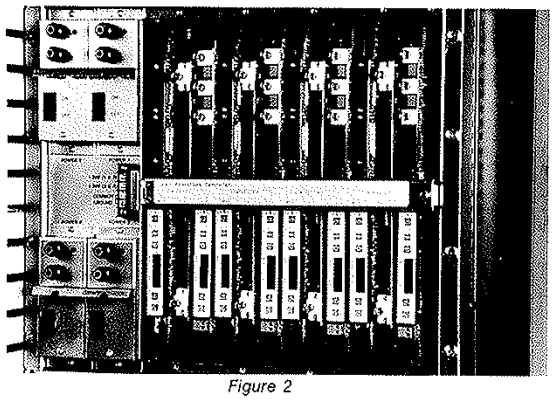


Figure 2

Extended functions of the PROVOXplus controllers include extended alarms, pressure/temperature compensation, and process characterization.

Using the IFC and UOC, you can achieve

- cascaded loops
- direct control of mass flow
- advanced pH control
- non-linear control
- multi-variable control
- split-range control
- modification of PID constants as a function of process variables
- dead-time compensation and more.

Besides sophisticated discrete control capabilities, you can also define multiple failure sequences to provide appropriate control response—from rerouting product flow to complete shutdown.

Recipe Management. Thanks to our multi-product processing capability, recipe-management functions become a snap. Product-specific procedures and simplifying procedure editing to meet changing requirements are easy to set up. Recipe selection is controlled by event, by operator input, or by controller calculation.

Scheduling and Reporting. Process scheduling and resource allocation get help with PROVOXplus controllers. When used in combination with an operator interface, PROVOXplus multi-loop controllers offer batch cycle scheduling and accounting. Batch reporting capabilities supply valuable information for statistical quality control, statistical process control, or government agency validation requirements.

Standard functions available with PROVOXplus controllers include

- configurable proportional, integral, derivative (PID) loops
- adaptive gain
- dead-time compensation
- internal cascade control
- mass flow computation
- ratio outputs
- automatic alarm suppression
- bumpless transfer
- rate-of-change
- set sequencing and interlocking
- user-selectable math and logic functions
- I/O changes through software
- simultaneous, multiple discrete output
- discrete monitor
- pulse count and weigh scale input
- alarm detection and reporting
- totalizing
- selectors and override.

Cost optimization is a concern for project implementation. With a family of controllers ranging from a 320-point multiplexer to a 500-point UOC, matching applications with the appropriate controller is now even easier and more cost effective.

Major features include

- consolidated UOC/IFC/MUX product (single chassis and printed wiring board set with common spares; eight size/functionality options via key module)
- transparent download
- redundancy enhancements (1:N redundancy where N = 1-4; faster redundancy link; decreased data latency; transparent switchover - lock step instruction)
- increased capacity
- real-time clock
- extended pulse count input (EPCI) point
- virtual point enhancements
- upload to PROVOXplus engineering workstation
- Control I/O support for MUX functionality
- improved alarm handling.

Replacement Spares. While cost considerations are important, it is also necessary to weigh the cost of providing spares for the control system. With a common hardware set, one set of spares can serve as a replacement for any of the eight different size/functionality combinations of PROVOXplus controllers.

Transparent Download. Adding or changing loops online is a must in most industries. Being able to do this without "bumping" the process is a significant advantage. The PROVOXplus controller family gives the process engineer the capability to do both. We call it "transparent download." The process engineer can perform partial downloads to the new PROVOXplus controller which will incorporate changes to points, new loops, and other process parameters without the operator knowing it.

Redundancy and Security. Changes not directed to the process should be transparent to the operator and not cost unnecessary scrap expense for off-spec product while the process returns to normal mode. That's why Fisher Controls added several redundancy improvements to the already secure PROVOXplus controllers. With a one megabaud link between redundant controllers, switchover after controller failure is transparent to the process. In addition, with the inclusion of a lock-step instruction, the backup controller can remain constantly in step with the primary unit.

Security doesn't have to be expensive either. One-for-one backup can get costly, but with the new PROVOXplus controllers, one-for-four redundancy slashes the cost of security. As many as four controllers can be backed up by one backup controller. And thanks to high-density packaging, controllers can be mixed and matched in a number of simplex and redundant variations.

Custom Application Capability. Increasing the number of choices available for custom-fitting applications is a powerful advantage. The design of the PROVOXplus controllers includes not only the eight size and functionality options mentioned previously, but also "pick-and-choose" capacity improvements which allow you to design your own configuration to meet the needs of your applications. Not only has the total memory been increased but so have point availability, operation availability, operator action requests, and expressions per operation. Having the capability to select size, functionality, and redundancy scheme makes the PROVOXplus controller family one of the most versatile multi-loop controllers on the market.

Real-Time Clock, EPCI, and Alarm Handling. In addition to the above enhancements, the PROVOXplus controllers contain a real-time clock with system clock access to the master for synchronization of operations and FSTs. EPCI point, virtual point enhancements, and improved alarm handling with PROVUE and ENVOX engineering software are also available. These controllers can now upload to the ENVOX engineering software through its upload/merge utility. Because the multiplexer is now an integral part of this controller, Control I/O, released in 1988, will support the multiplexer.

Control I/O Subsystem

The Control I/O subsystem translates process signals to the language used by the PROVOXplus family of controllers (figure 3). The Control I/O subsystem complements the PROVOXplus controllers and allows I/O files, I/O cards, and termination panels to be located at multiple sites up to 5000 ft from their associated controller. In addition to standard analog and discrete translation, the I/O subsystem supports communication with a variety of devices, such as programmable logic controllers, gas chromatographs, process analyzers, data loggers, turbine and compressor control panels, and remote terminals.

Flexible Hardware Site Location. Geographic remoteability means savings in installation costs. This flexibility allows you to choose a file location that may be more convenient to the process and offer more affordable space. No longer is it necessary to run long lengths of multi-pair cables between the field and control room—one coaxial cable is all you need.

I/O Subsystem Redundancy. Selective levels of redundancy provide a fault-tolerant, fully redundant controller and I/O architecture at the controller electronics, input card, and output card level. What you get with this arrangement is an optimal level of security that is tailored to your needs and budget.

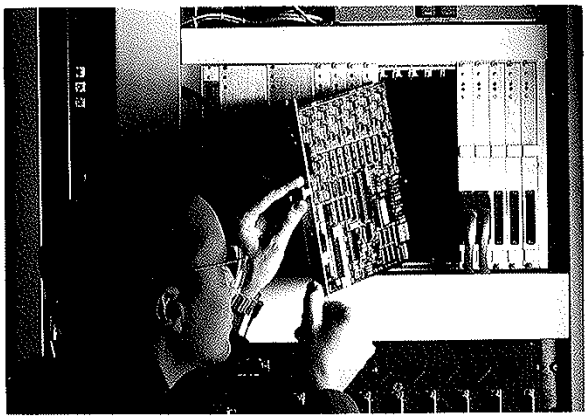


Figure 3

Security/Integrity Levels. The Control I/O subsystem architecture, redundancy options, and self-diagnostic features work together to contain and minimize the effects of possible faults on the process. I/O card redundancy allows one card to back up from one to eight primary cards of the same type to insure process operation integrity regardless of I/O card faults.

Communications Redundancy. The coaxial cable supporting communications between the I/O cards and the controller can serve as communications backup. The analog I/O and discrete I/O cards can be backed up one-for-one, or an interface panel can be used to allow a single card to serve as backup for as many as eight primary cards.

Reduced Part Stocking. Only three I/O cards are needed to accommodate all types of field I/O. This translates to savings for you in replacement part stocking.

No Process Downtime During I/O Card Repair. Communication within the I/O card includes fault detection and reporting. I/O cards can be added to or removed from the file while powered up. Repairs can be made without disrupting the functionality of other I/O cards or files.

Advanced Packaging. Special termination panels require less than five inches of depth and that means big savings in control room floor space.

Simplified Maintenance. The Control I/O subsystem requires little to no maintenance. Fuses and relays are readily accessible and can be changed one at a time without disrupting service on other files.

PROVUE Operator Console

New levels of productivity, efficiency, and decision-making ability are available with the PROVUE operator console that includes many unique advantages (figure 4).

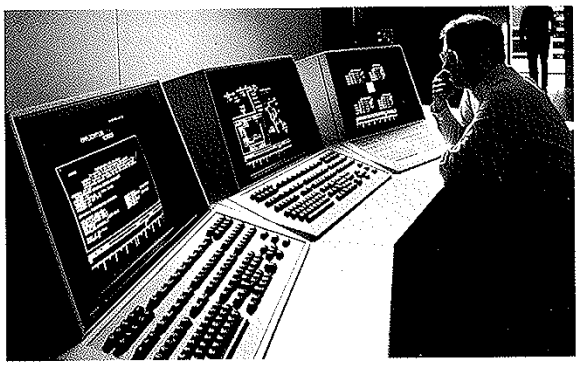


Figure 4

10,000 Tag Database. Operators can now see as many as 10,000 tags of plant information from one operator station. This much information might normally overwhelm many operators but the advanced data and alarm management schemes designed into the software provide a means of grouping information together for quick action.

Advanced Alarm and Data Management. Areas using common equipment can be grouped together for common alarming. In addition, those common areas can be grouped together for reporting to the operator in the format needed. The operator may need to back up another operator's area but not be primarily responsible for control or alarm acknowledgement. This is possible with the PROVUE console.

In addition to the new alarming schemes, an operator attention list has been added to the PROVUE console as a line at the bottom of the display screen that displays the six highest priority alarms in the operator's span of control. These alarms can be either point tags or names of plant process areas that have been grouped together because of similar alarming characteristics. Operator attention requests (OARs) can now be prioritized with the highest priority OAR appearing in the OAR window on the VDU. The number of OARs has also been expanded to 255.

Password Security. Operators now have password access to their specific control or monitor areas. Since the operator's span of control is set up in configuration, there's no danger of one operator controlling another operator's area of the plant. Even operators at different stations of the same PROVUE console only have to be concerned with the alarms in their own area.

Console Redundancy. Redundant consoles provide an added measure of safety and security for users requiring continuous uptime assurance.

Touch-Screen Option. A new touch-screen option provides quicker response to the process by allowing access to DSRs, alarms, and multi-function keys directly from the VDU.

Four Operator Stations (VDUs) per Console. A fourth VDU added to the PROVUE console opens up yet another window to the process.

Black and White Screen Copy. Black and white printouts of the screen image allow on-line documentation of process conditions.

No Wasted Memory. During PROVUE console configuration, any combination of console parameters such as passwords, trend traces, and activities can be defined within the limits of the CPU, memory, and database size. This means no artificial limits exist on individual parameters causing unused configuration space or "wasted" memory.

Easier Directory Access. Operators now have easier access to information through summaries and directories for points, failures, and predefined process and plant management areas.

Graphic Displays. Operator awareness of the process plant world is enhanced even more with dynamic fields on the graphic displays. The process engineer can configure expressions for comparing any number of operating parameters for two points and display different colors or text strings on the VDU based on the result. This configuring allows the operator more hands-off awareness of process conditions. Rather than sifting through process parameters, the operator can now see at a glance the condition of vital areas in the process.

Other PROVUE enhancements include configurable trend set and pen recorder definitions with on-line change capability (via partial download), system clock for synchronization of PROVUE, CHIP, and the trend unit, and the ability to "see," access, and reset the controller EPCI point.

Improved batch control capability through new activity states is also available with PROVUE. An activity can now be "not loaded" thus facilitating removal of a point for partial download, for example. In addition, a "batch end state" is now available.

PROVUE Application Window

Application Window is a powerful capability from Fisher Controls, allowing you to use the PROVUE operator console to view and manipulate Fisher Controls-developed and third-party-developed software packages running in a computer in your plantwide network from the operator console (figure 5). The breakthrough of Application Window opens up worlds of information to the operator and engineer alike. Fisher Controls is supplying CIM tools, such as Application Window, for your process control systems today.

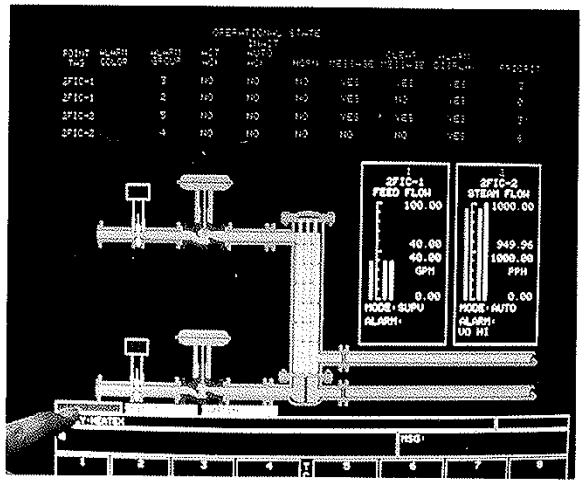


Figure 5

View and Manipulate Plant Databases from Operator Console. Operators can log information directly into plant databases from the PROVUE console since it serves as an input device on the plant data highway. Status of operations, time of operating changes, and batch completions can be sent immediately to plant scheduling networks.

Direct Access to SPC Charts, Diagnostic and Production Information. With Application Window, statistical analysis, production control, and plant scheduling information requiring large dedicated computers can now be displayed directly at the PROVUE console location.

Graphics and Text Emulation Capabilities. The Application Window software places the capability of the DEC VT241 inside the PROVUE console. An overlay attached directly to the PROVUE keyboard provides easy reference to keys. Graphics are available on the PROVUE console via an emulation of the REGIS graphics set.

Multiple VAX Sessions from One Console. As many as eight different sessions can be run simultaneously from one PROVUE console. Each VDU can display a different Application Window session simultaneously without interrupting operator access to the system status.

Plantwide Message Posting via Electronic Mail. Plant message services available to the plant network are accessible by the PROVUE console. Lab data can be sent directly to plant operators without delay, legibility difficulties, or tying up plant phone networks.

New Access Routes to Engineering Workstation Functions. The Application Window software allows the PROVUE console to operate functions included in the ENVOX engineering software and in minicomputers running other PROVOXplus software.

More Available Control Room Space. Application Window software places the functions of a standard DEC workstation into the PROVUE console. No more wasted, expensive control room space. A window into the plant DECNET/ETHERNET highway is available as a standard custom display. Console operation is unaffected by viewing an Application Window, allowing you to immediately switch between PROVUE and ETHERNET highways to respond to high priority messages. Total integrated control at your fingertips—when you want it and where you want it.

ENVOX Engineering Software

Process engineers, contractors, or anyone configuring DCS equipment will experience an increase in productivity and performance with ENVOX engineering software (figure 6). Based on relational database technology, the advantages of this PROVOXplus configuration tool are far reaching. The time required for engineering a system is significantly less than competitive models because of the ease-of-use features built into the software. Inputting, storing, retrieving, and reporting configuration data is both easy and efficient with ENVOX.

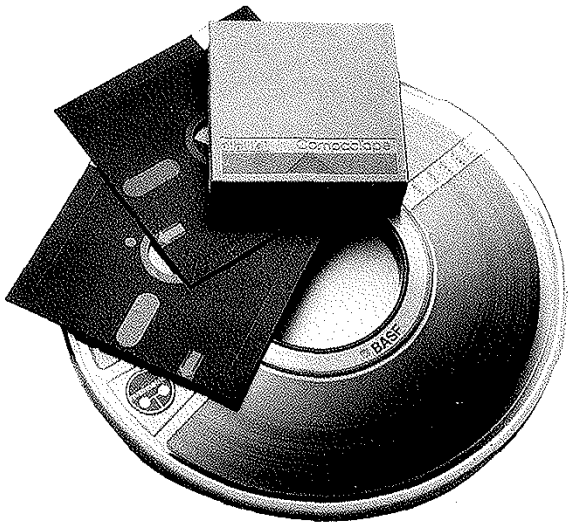


Figure 6

Besides the capabilities increase seen in DCS products and systems, the time required to engineer new complex features has been greatly improved. The need for computer knowledge, internal file and directory structures slow down learning and engineering. ENVOX engineering software accelerates the process by linking key elements in the database for quick access.

Menu System for User Functions. Interactive prompts, help screens, and menus guide the engineer through configuration. Relationships between points, control strategies, and displays are managed by the system. Reports and ad-hoc queries are also provided by the system.

Forms Data Entry for Points and Templates. Forms that check input data reduce guesswork.

Prompt-Oriented, Language-Sensitive Editor for FSTs, Operations, Reports, and Procedures. The text editor is sensitive to the language being entered and can issue prompts for operands, provide on-line help, and do immediate error checking.

Since PROVOXplus was designed from a evolutionary perspective, the many years of experience in software design allowed the strengths of question list displays (QLDs), softkeys, PROFLEX flexibility, and global database to be combined for creating an even more versatile product.

Upload/Merge Facility for Field Devices. Using relational database technology gives users the added capability of integrating plant data into the database. Data such as PID numbers, cabinet layouts, and wiring information that may not be needed by the DCS system can be a part of the entire configuration scheme. This means plant database management is a simpler task.

Partial Verify/Generate. The partial verify/generate capability saves valuable rework time in making changes to configuration data. In addition, the upload/merge facility allows data from field devices to be integrated into the database for recording changes in process parameters. This capability provides a current system update thus eliminating confusion that arises with trying to determine the most recent configuration version.

Database Document Facility. The database document facility has replaced the time-consuming task of searching through volumes of plant configuration data. Documents may resemble data entry forms or may be summaries of point data and compressed information. The database document facility has cross-referencing capabilities that will be especially useful during system checkout and commissioning.

Conversion Utility for Existing PROFLEX Users. A conversion utility will convert existing PROFLEX (VMS) data into the relational database. A user can take full advantage of PROVOXplus technology without sacrificing the investment in the current system.

Improved Security for Configuration Administration. Configuration information security is always a concern, especially as the number of users increases. An "ENVOX Administrator" can be designated to control both the functions and the process areas available to each system user. This approach eliminates the fear users may have of corrupting another database.

Import/Export Facility for Database Formation. The import/export facility allows users to extract portions of the database for movement to another location.

Backup/Restore Facility. The backup/restore facility allows backup of transaction files or the entire database. This significantly reduces downtime after a power failure or reboot.

VAXstation 3100 Hardware Platform. ENVOX runs on any VAX/VMS computer including the VAXstation 3100. The VAXstation 3100 incorporates enhanced graphics and mouse support in a state-of-the-art hardware platform.

Computer/Highway Interface Package (CHIP)

One of the key elements of future CIM integration lies with providing an open systems platform. Fisher Controls has done so with its Computer/Highway Interface Package (CHIP). Fisher Controls has built upon the strength of the CHIP foundation by providing additional capabilities for plant integration, process automation and optimization, and open systems platforms (figure 7).

CHIP is a flexible, cost-effective software package that, with the appropriate highway interface hardware, provides on-line access to the PROVOXplus instrumentation system in addition to vertical integration to higher level business computers. Through CHIP and Fisher-developed, user-written, or third-party software, the computer can access or change operating and tuning parameters residing in PROVOXplus control system devices. In addition, CHIP software supports a real-time, memory-resident database for communicating with process operators at PROVOXplus consoles.

DEC, HP, and IBM Computers and CHIP. These capabilities make CHIP an effective tool for data acquisition, process optimization, supervisory control, and information analysis. The CHIP software package is compatible with most DEC MicroVAX, VAX, and VAXstation computers.

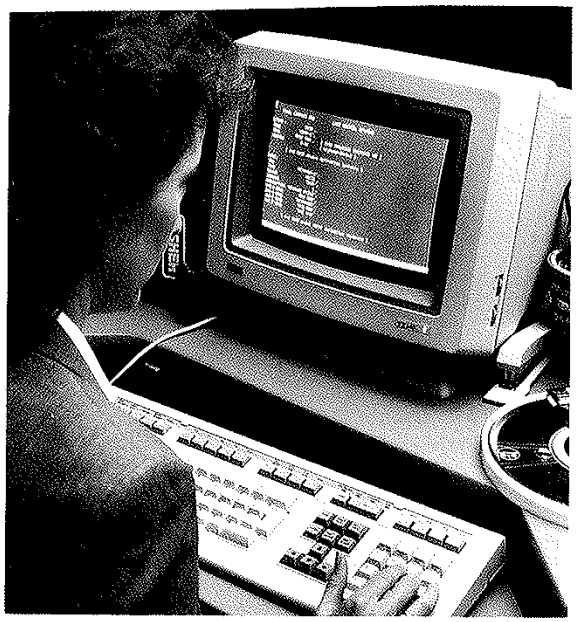


Figure 7

The CHIP software package is also available for HP A-Series computers with the RTE-A operating system and IBM PC, PS/2, and industrial computers with the PC-DOS and OS/2 operating systems. CHIP products for these various supplier computer platforms provide effective CIM solutions with Fisher and other third-party software packages.

CHIP software products provide the user with a choice of supplier platforms and operating environments for matching project and budget requirements of customers.

CHIP and IBM's ARTIC Card. IBM offers A Real-Time Interface Co-processor (ARTIC) card that contains its own CPU, operating system, memory, and communications processor that off-loads all the I/O communication processing and updating of the CHIP real-time database from the IBM PC.

The ARTIC co-processor is in effect a "computer within a computer." The IBM ARTIC/CHIP is well-suited for smaller PROVOX systems. It may well address existing customer needs by simply adding a PC to a PROVOXplus system for data collection, analysis, and optimization for the process engineer or plant operator.

Technology and solutions from Fisher Controls protect customer investments in CHIP and PROVOXplus products by continuing the philosophy of migration planning. Customers with larger VAX BI bus computers can connect to process information through Fisher Controls' gateway, the EIU-Ethernet Interface Unit. This unit consists of a DHI card, an Ethernet card, and an rt-VAX CPU in a PROVUE enclosure. The EIU-Ethernet Interface Unit obtains its "smarts" from a full-function CHIP computer upon download.

PROVOXplus Application Software

PROVOXplus advanced application software solutions form the foundation for an effective plantwide information system. PROVOXplus application software provides you with a set of powerful, unique tools designed to optimize your automation system effectiveness. These programs operate on a process host computer or on the mini-computer based PROVOXplus Application Unit.

Data Historian

Building upon the strength of the CHIP foundation, the Data Historian extends the reach of plantwide integration. CIM becomes more of a reality with Data Historian by providing a historical account of process conditions for analysis, optimization, or integration into user-written and third-party application programs (figure 8).

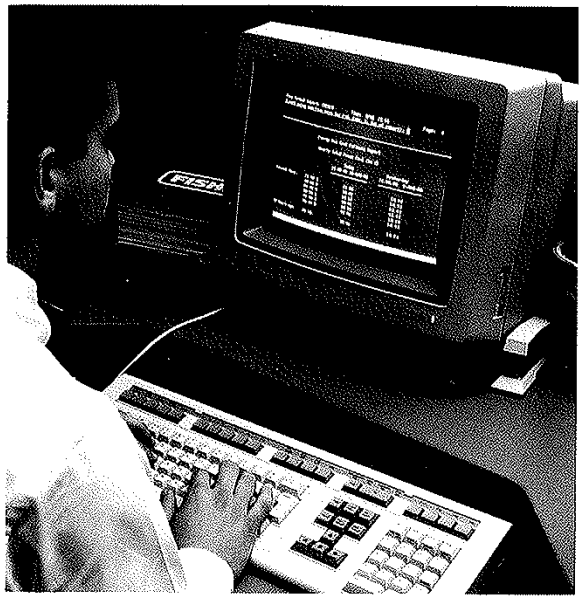


Figure 8

The Data Historian application software package allows you to

- Collect and reduce large amounts of data for process analysis
- Access historical files for optimizing process control
- Export data files and reports for networking to MIS computers
- Generate scheduled custom or on-demand reports of historical or real-time data to support production and maintenance report requirements
- Integrate manually entered data into process data historical files for quality control
- Extend real-time trend of operator console to include process history
- Plot historical and real-time data at the computer terminal for further process analysis.

The Data Historian package is structured in a modular format with a base historian module, referred to as a kernel. The kernel allows you to configure historical data files from which the stored data can then be accessed and used by all optional modules attached to the kernel.

The kernel has an expanded number of historical data files (HDFs) to support statistical quality control (SQC) data storage and can now provide read/write access HDF information. The kernel consists of four modules: data collection, tabular reporting, data archive/retrieval, and user program access. Five optional modules are also available:

- Custom report writer, for presenting historical and/or calculated data in a user-defined format

- Data trend, which transfers data from Data Historian files in the kernel to an LCON or PROVUE console trend display

- Manual data entry, for laboratory and process support information into the historical process database

- Graphics, for graphical plots versus time

- Statistical quality control, for on-line quality alarms and control charts for process operators.

Data Historian automates the entire process of collecting historical data and presenting it for a more visual awareness of process conditions for the operator, production supervisor, maintenance personnel, and management. The flexibility of Data Historian allows for automated record keeping in whatever manner you desire; whether it's environmental reports for government regulation, or management reports for raw material usage. Data Historian lets you create production reports for quality measurements, shift, daily, monthly, and annual production quantities as well as maintenance reports for equipment failures/usage and average downtime.

Batch Data Manager

Similar to Data Historian, Batch Data Manager software builds upon the powerful CHIP database and provides an unequalled integration tool for the batch industry. Batch Data Manager is more than a batch historian; it also manages batch data for a significant increase in operator productivity and awareness of process conditions (figure 9).

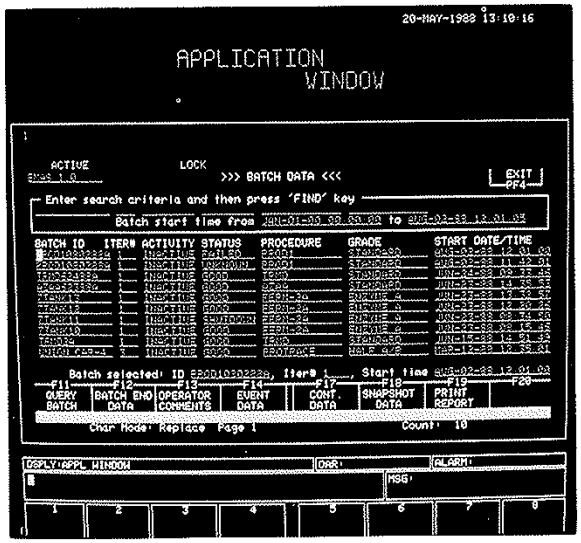


Figure 9

Batch Data Manager is built upon ANSI standard structured query language (SQL) for easy integration between applications. User-friendliness is the key to acceptance Batch Data Manager has received among process operators. On-line query gives operators the ability to interact with the process and comment on current conditions or to access archived databases for a historical account of the batch.

Accurate records are of paramount importance for validation and government regulations. Batch Data Manager provides full forward and reverse genealogy tracking along with standard and customized reports for complete knowledge of the process. Having the ability to backtrack from a product to its raw materials, or from a raw material to every product created by it, provides the engineer and operator with process information that will lead to improved productivity, reduced scrap and prevented waste, and process optimization.

Management can receive reports of raw materials use, average process up-time, daily production, and critical quality measurements. Spreadsheet integration capabilities bring CIM into the process, providing new levels of control and optimization. Batch Data Manager is truly the data manager for batch processes.

Batch Data Manager software has five data collection types.

- Continuous data collection, for viewing continuous, chronological data retrieved on a time-scanned basis

- Snapshot data collection, for viewing batch data gathered at a particular time during the process

- Batch end data collection, for viewing a complete history of a specific batch process

- Batch materials genealogy, for tracing histories of feedstocks, intermediates, and end products

- Event tracking data collection, for tracking certain significant events that occur during the batch process.

The Batch Data Manager utilities include

- Configuration
- Custom reporting
- Flexible operator interface
- Data archiving.

Batch Data Manager software offers several optional features that are available by special request.

- Spreadsheet package, for enhanced data manipulation

- Statistical analysis package, for SQC applications

- Remote database access, to allow data access from several different computers

- User-program access, to allow user-written application software to extract database information using higher level programming languages, such as "C," FORTRAN, or PASCAL.

Console Trend Display

The Console Trend Display software package records and displays trended data such as process variables, setpoints, value outputs, discrete signals and application programs (figure 10).

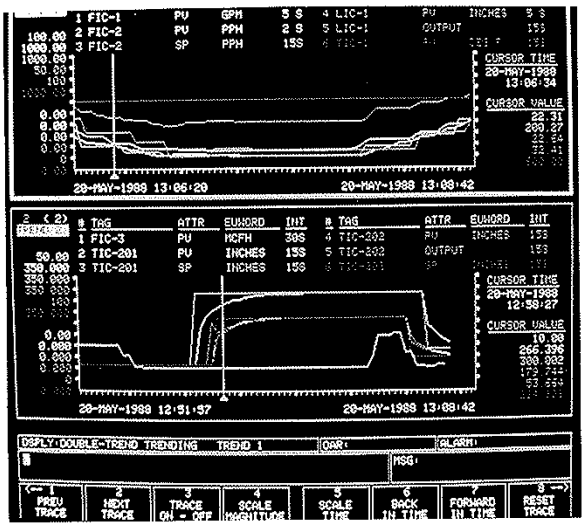


Figure 10

Console Trend Display points receive continual updates with information from the CHIP database. The Console Trend Display software package features

- Real-time or historical data trending
- Archiving and retrieval of historical data
- Access to trended data from all highway devices
- User program access to trend data.

Console Trend Display extends the real-time trend of the operator console to include process history and develops user programs for data analysis, reporting, and networking information to higher level computer systems. As many as 1,000 attributes can be recorded and up to 96 console trend traces can be supported by Console Trend Display.

PROVOXplus/Gensym G2 Interface

The PROVOXplus/Gensym G2 Interface offers the capability to use expert system analysis, prediction of process conditions, and recommendation of action to take if the process becomes upset. Having the PROVOXplus/Gensym G2 Interface provides an added element of security in your plant.

SIMVOX

SIMVOX provides you with a valuable cost-saving tool that reduces startup time. Process simulation and interaction with process variables offline are powerful capabilities offered by SIMVOX. Locating process "bugs" before wasting valuable raw materials is a significant advantage for you. Besides reducing startup time, SIMVOX can provide early training for operators and engineers alike—before startup. Operators will already be familiar with the new control system, graphic displays, and console control before it is operational. Engineers can have answers to process questions without having to actually affect the process.

Other benefits include early shipment of the I/O system to begin field wiring. Simulating the process through a computer eliminates hardwiring of switches and signal generators for tieback operations.

SIMVOX has compatibility with PROVOXplus controllers for VAX/VMS versions and is available with a version for the IBM PC.

UNIVOX Automation System

The UNIVOX automation system, introduced in 1987, provides advanced control for smaller process applications. This versatile system is ideal for small plants or single units in a large plant—especially off-line and retrofit projects. In effect, the UNIVOX automation system is a unit-oriented, full-function process control and management instrumentation system. It offers significant advantages over other similar control systems, such as

- Full functionality that is easy to use, yet powerful and flexible
- A design that promotes affordable system migration towards computer integrated manufacturing
- An integrated, self-contained, stand-alone automation system that can be installed right on the plant floor
- Support for two operator/engineer interfaces
- Redundant controllers for those critical applications that cannot afford any downtime
- Flexible packaging options providing cost-effective custom installations
- Desktop operator/engineer interface with full-stroke keyboard

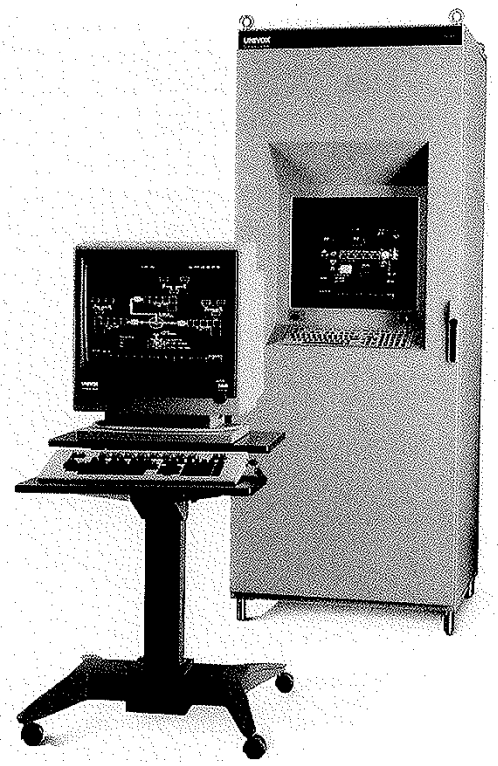


Figure 11

- Operator interface enhancements with custom graphics, trending, and log capabilities.

UNIVOX automation systems provide continuous or batch process control for many types of small applications (typically of 50 to 200 PROVOX points). Each UNIVOX system provides the full power of an advanced PROVOXplus controller coupled with an integrated operator/engineer interface. The custom color graphics and powerful operator interface features simplify critical loop monitoring.

Discrete, continuous, and logic control functions are easily addressed by UNIVOX systems. These control functions are coupled with powerful, built-in sequencing and batch control capabilities that provide all levels of control from simple data acquisition to sophisticated, fully automated batch processing complete with recipe handling and activity logs.

UNIVOX Features

Support for Two Stations. Each UNIVOX automation system can support an additional operator/engineer interface to be used as a maintenance interface, as a configuration workstation, or as a remote operation station. Both stations are capable of handling full operator interface and configuration, although to maintain control strategy integrity not all configuration functions can be performed simultaneously.

The second operator/engineer interface can be remotely located up to 200 ft (59 m) by fiber optic communication. A desktop version allows process interaction in a more desirable location, such as an office or control room.

Custom Graphics Display. As many as 33 graphic displays can be user-defined for a customized interactive "window" into the process. Animated schematics allow for a detailed representation of changing process conditions in the plant. In addition, dynamic color expressions let you use color to quickly alert the operator to changing conditions, such as alarms or flow direction.

Custom Logs. As many as 16 custom logs can be created for display or printout after each batch, shift, day, or other reporting period. The logs, which include both data and text fields, can be customized for special reports requested by management. Custom logs may be generated based on batch sequencing, on demand, or time of day.

Real-Time Trending. Dynamic trend displays allow operators to monitor event- or time-control-critical process parameters. As many as 32 trend groups with three parameters each allow for a maximum of 96 variables that can be trended at any one time. Operators need only to select the parameter to be trended, the upper and lower scale values, and the sample interval. For additional accuracy, a movable time cursor provides an exact, real-time value/status readout of each trend group.

Personal Computer Interface. The UNIVOX data port allows process data to be passed between the UNIVOX and a personal computer. A PC can be connected to the data port for archiving configuration data and operating third-party software, such as ONSPEC from Heuristics. In addition, the data port can communicate to a PC through Fisher Controls' CHIP and IBM's ARTIC card.

With the ARTIC/CHIP communications platform, UNIVOX can interface with PC networks and host computers for both simple and sophisticated computer integrated manufacturing strategies. This interface allows third-party software, such as THE FIX from Intellution, to access process data for performing higher-level supervisory functions.

UNIVOX Multi-Loop Controller Redundancy. The combination of single-loop integrity and redundancy can provide you with just the right amount of process security for any application. UNIVOX controller redundancy makes your entire process secure—right on up to your most process-critical loop. UNIVOX multi-loop controller redundancy responds with reliability, providing the insurance that critical processes demand.

UNIVOX Redundant Control. Redundant control provides an extra level of security by backing up both automatic PID and manual functions. Failure of a controller that is backed up with redundant control causes no change in the loop. In the event of failure, the loop continues to operate with the same automatic PID and manual capabilities as required.

The UNIVOX switching module adds redundancy to an existing UNIVOX automation system and secondary controller by automatically connecting the I/O files and operator interface to the active controller. When two operator interface units are connected to redundant UNIVOX controllers, a second switching module is needed to switch the second operator interface. This allows both operator interface units to maintain full functionality.

Flexible Packaging Options. Not every application requires use of the UNIVOX environmentally enclosed cabinet. The UNIVOX operator interface can be placed in a desktop or in its own environmentally sealed enclosure. Similarly, the controller electronics are available in rack-mountable format as well as mounted in the UNIVOX cabinet. The new flexible assembly architecture allows versatile installation options for whatever components (controller and/or operator interface) are necessary for building a custom system. The system also allows for easy ordering of additional operator interfaces for use as second operator stations.

The environmentally enclosed, upright version of UNIVOX contains both an integral controller unit and built-in operator interface. The sealed cabinet, membrane keyboard, and break-resistant window make this model suitable for installation on the plant floor—even in harsh environments (figure 12).

The rack-mountable operator interface can be ordered for those applications requiring special or custom mounting in customer-supplied enclosures (figure 13).

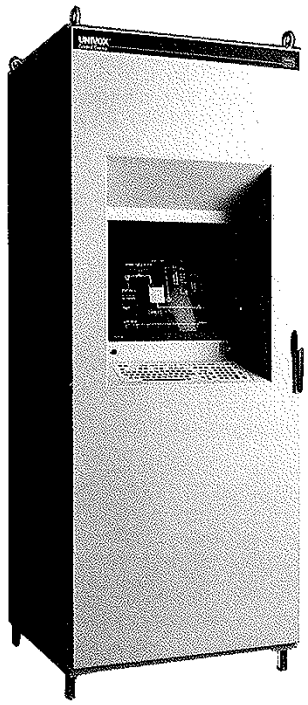


Figure 12

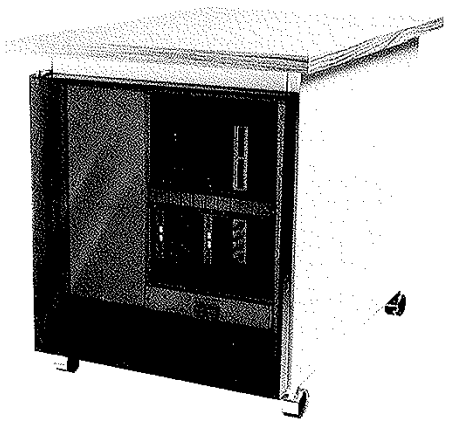


Figure 13

The desktop operator interface comes with a full-stroke keyboard and CRT monitor with a tilt-and-swivel base (figure 14).

The cabinet-mounted operator interface is equipped with a membrane keyboard and an environmentally sealed cabinet for use in harsh plant-floor conditions.

The UNIVOX controller units can be ordered with an operator interface for a complete UNIVOX automation system. UNIVOX flexible packaging also includes the capability to use one controller with two operator interfaces.

The rack-mountable controller unit is for use in a custom enclosure while the cabinet-mounted model comes equipped with the controller unit mounted inside an environmentally enclosed cabinet (figure 15).

Figure 14

DPR900 Series Family of Control Products

DPR900 Controller

The DPR900 is a single-loop, user-configured digital PID controller where all controller functions reside in the controller. Configuration consists of selecting the appropriate functions and setting the tuning parameters using the front display panel. A configuration may be entered or changed while the controller is in operation. The DPR900 controller scans and updates all input and output signals five times per second. Connection to and communication with external equipment is through four analog and four digital inputs, two analog and six digital outputs, and a serial data port (RS-232) (figure 16).

Figure 15

DPR900 Operation. The user enters all function changes and control settings via push buttons on the front display panel. The front panel also shows the analog values of process value, setpoint, and output signal on three vertical bar displays. A five-character LED display shows the process value in appropriate units. Alternatively, this display can show the setpoint value, alarms, configuration values, appropriate fault codes or a selected analog signal value.

DPR900 Features

- Configuration via easy-to-read-and-operate front display panel
- Autotuner function automatically tunes the controller to present operating functions
- Gain scheduling selects PID parameters automatically by tracking a selected analog reference signal
- Feedforward function amplifies a selected analog sensor signal and adds it to the output signal
- RTD transducer and thermocouple sensor (millivolt) inputs connect directly to the controller
- External communications and control available via RS-485 serial interface or two digital inputs
- Configuration reference card conveniently stored under hinged display panel cover
- Front installation without special tools means easy change-out
- Power supply options of 110/120V AC or 220/240V DC
- Front panel environmental classification meets or exceeds NEMA 12 (IP 64 according to IEC 529).

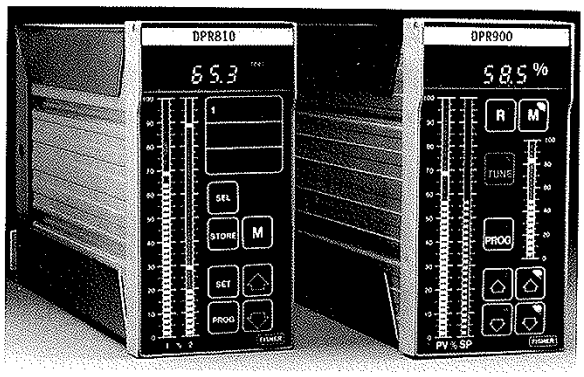


Figure 16

DPR900 Functions. The on-board controller functions let you configure controller operation to suit most process control requirements. Standard controller functions include:

- Process value alarms
- Deviation alarms
- Process monitoring
- Linearization
- Setpoint and output limiting
- Setpoint ramping
- Signal filtering
- Computer control and data logging
- External or remote switching and control via digital outputs.

DPR810 Multi-Station

The DPR810 Multi-Station is a single-output, digital control station and user-configurable for any of these control functions:

- Dual indicator station
- Manual loader station with auto-tracking
- Ratio station with bias
- Bias station with gain
- Terminal station (for use with RS-485 communications).

The multi-station serves as either a stand-alone control station or as part of a larger control system in conjunction with other DPR Series control products. When configured as a manual loader station, the multi-station can be a temporary direct replacement for a DPR900 controller without any change to existing controller wiring (figure 16).

Configuration of the multi-station is easy and straightforward. The user selects appropriate configuration functions and associated tuning parameters via the front display panel. No separate configuration device is required.

DPR810 Multi-Station features include the following:

- Five selectable control functions
- Direct temperature input availability
- External communication via a standard RS-485 serial interface
- Standard AC or DC current power supply
- Easy-to-read analog and digital displays
- High reliability digital circuitry with important data stored in EEPROM
- Front panel environmental sealing classification meets IP64 in accordance with IEC 529
- Front panel configuration; no external configuration devices required
- Quick reference configuration guide conveniently located under the front cover
- Easy-to-install front-mounting cassette assembly.

General Functions of the DPR810 Multi-Station Controller. The general functions of the DPR810 Multi-Station controller include

- Temperature input, with the appropriate temperature input modules, can range from − 50 degrees C to + 1500 degrees C (− 58 degrees F to + 2372 degrees F)
- Computer control, to allow the computer to read internal values and exercise control over the manual functions; user can always override computer control of a process by using the buttons on the front display panel
- Alarm indications, with four configurable alarm relay outputs selected by the user (HIGH, LOW, HIGH/HIGH, LOW/LOW) and associates selected alarm with an input signal; activated alarm shown on digital display
- Fault indications, through continuous self-checking programs; should an internal fault be detected, a fault code appears in the digital display and the multi-station automatically takes configured corrective actions
- Signal levels, set by the user during configuration; configuration also involves logic level selections for the active state of these signals.

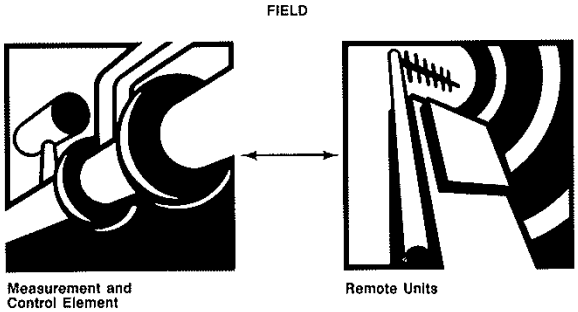
Additional Information

The preceding descriptions have presented only the highlights of PROVOXplus instrumentation systems. For additional information, contact your local Fisher sales office or Representative.

Fisher Field Automation Systems are designed to provide the oil and gas industries with the capability to remotely monitor and control field operations from a central location. Data collected by the system can be processed at the central location and made available to computers at the corporate level.

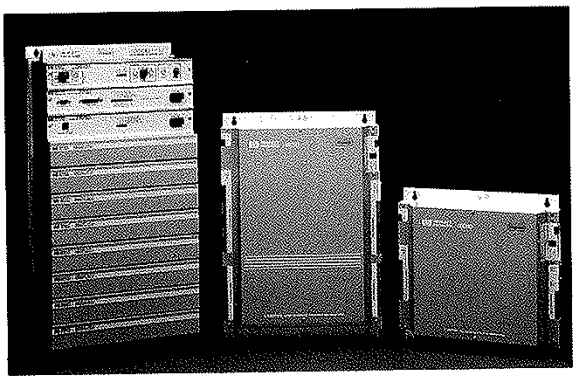
With Field Automation Systems, Fisher has put into place a true turnkey solution to field automation with the expertise to handle all phases of a project from conceptualization and planning to installation and start-up. Expert service and long-term support are provided by representative and factory personnel.

The four major product families which make up Field Automation Systems are: Remote Units; Master Computers; Measurement and Control Elements; and Communications. A full range of support services rounds out the offering.



Basic components of a Fisher Field Automation System.

Remote units are available in free-standing, weatherized enclosures for easy, low-cost installation.



Remote units offer a wide range of functionality and point count options.

Remote Units

Remote units provide the data acquisition, totalizing, alarming, and control functions required for field automation. They are designed for installation at a field site and connect directly to measurement and control elements.

Remote units have the memory capacity to stand alone in the field when used with portable and hand-held operator interfaces. These interfaces provide the capability to perform configuration, calibration, tuning, and data retrieval.

Remote units are ideally suited to applications requiring the real-time gathering and reporting of information critical to efficient and accurate operation. They can modulate control valves or regulators, start and stop compressors and pumps, and perform emergency shutdowns. Some standard applications include:

- Monitoring flows, pressures, temperatures, and levels
- Managing tank storage
- Starting/stopping pumps and compressors
- Logic/sequence control
- Opening/closing control valves
- Implementing PID loop control
- Emergency safety shutdown
- Flow calculations
- Monitoring cathodic systems

Microprocessor-based electronics performs I/O scanning, communications interfacing, flow calculations, sequential control, closed loop control, and data storage functions. Modularity makes the electronics easy to size to the requirements of the application and easy to repair.

Remote units are powered by either utility line power or solar power. Utility line power can be backed up with batteries or an uninterruptable power supply. Solar power is converted to electricity by solar panels using batteries as storage devices. Solar panel requirements are determined by geographic region and electrical load demands.

Remote units support a variety of telephone line, fiber optic, and radio communication hardware.

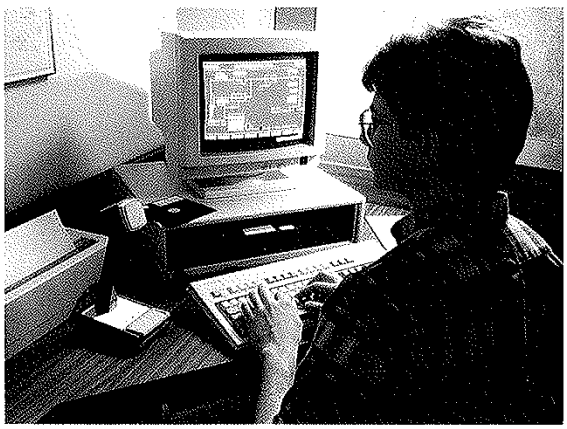
Master Computers

Master computers serve as the central data collection point for a field automation system. Their function is to request data from each remote unit in the system on a periodic basis, store the information, and present it to the operator through video displays and printouts.

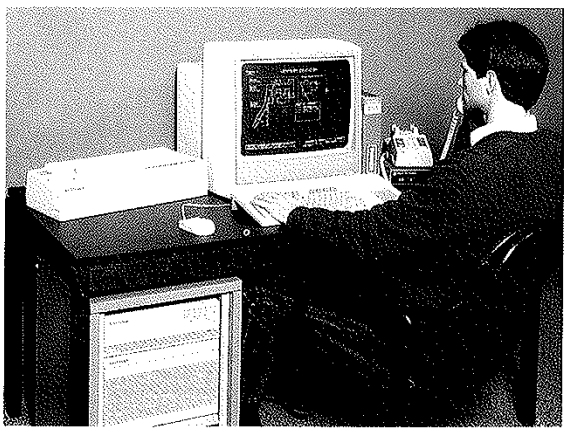
Master computers are either personal computer (IBM PC/386 compatible) or minicomputer-based, feature color monitors, and are available in desk-top or cabinet versions. The minicomputer-based master computer provides multi-tasking and multi-user capabilities in addition to a redundant CPU option that provides extra reliability in critical applications.

Configuration

Master computer configuration for each remote unit and its I/O points is accomplished by filling in blanks on screen templates.



The PC-based master computer is powerful, yet easy to use.



The mini-based master computer is available in a small, desk-size version.

The mini-based master computer provides the power needed for large, console-based systems.

All parameters can later be edited on-line. The complete database can be documented on the system printer.

Communications

Master computers communicate to remote units through a special communications protocol. Each remote unit is polled on a scheduled basis to retrieve information. The time and frequency of polling is determined by the user during configuration. Users can also poll any remote unit on demand.

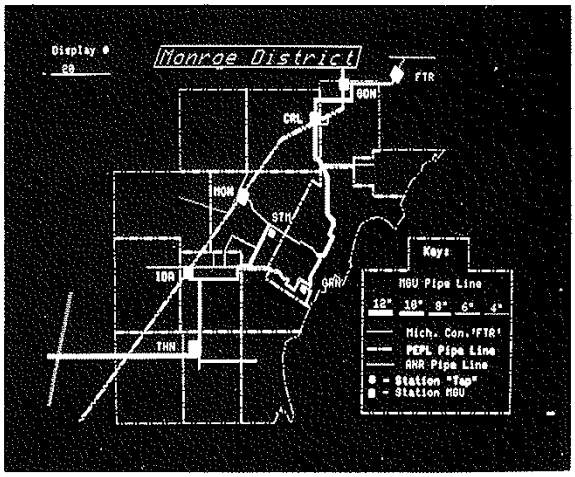
Master computers can support communication links to other computers such as auxiliary stations and engineering and corporate computers.

Alarms

A summary of alarms for each remote unit is retrieved periodically and stored to disk. The alarms can be used in reports, displayed, or exported to spreadsheet or database programs.

Displays

The software provides user-defined graphic displays in a combination of foreground and background colors. Displayed



Building full-color graphic displays is easy with the user-friendly software.

data can come directly from the system database, historical database, or from calculated values.

Displays are created on-line by the user in a two-step process. First, template information is defined which consists of text, graphic symbols, and color information. Second, real-time data, calculations, and alarms are defined as dynamic fields. Once a display has been built, changes to the display can be made on-line.

Displays can be accessed by menu, direct entry, or scrolling.

Reports

Reports are provided for output to the printer at scheduled times or on demand. Reports are generated in the same way as displays but can be wider and several pages longer.

Historical Data Collection

Historical data collection records information for archival purposes. Points within the database can be archived, and measured or calculated points in the historical database can be graphically displayed or printed. Data stored in the remote unit can be retrieved, processed, and archived to disk, tape, or transferred to another system.

Calculations

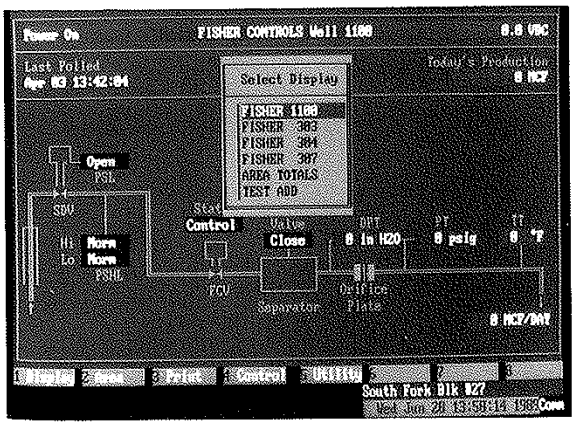
Real-time calculations can be performed using database values, historical values, calculated values, and constants combined in an arithmetic expression.

Operator Interface

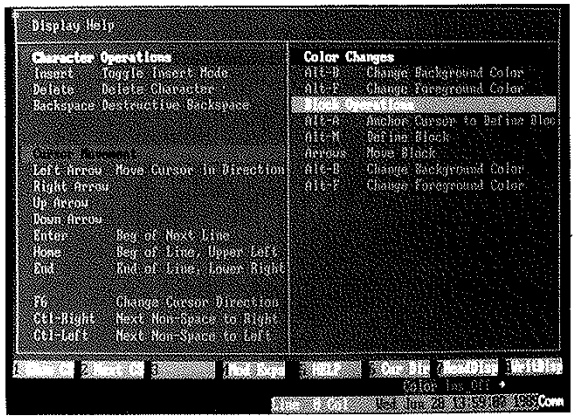
The operator interface is responsive and easy to use. It capably presents the large amount of real-time, historical, and graphical information contained in computer memory, and also makes it possible for the user to accurately implement his control decisions. Operator interface consists primarily of a monitor, a keyboard, and a printer. The monitor and keyboard may be placed on a desk or table, or they may be mounted in a human-engineered, control-room console.

Monitors are available in different sizes and varying display capabilities, but in general they provide high-resolution, color displays of visual information that can be comprehended quickly. The keyboard allows user interaction with the system, especially by means of softkeys (defined on-screen) and cursor position control. The printer provides permanent records of screen displays, alarm and event logs, and user-designed reports.

The user is aided by screen prompts, help displays, and the ability to select other displays or options directly from the



Menus make display and report selection easy.



Help displays guide users through database and display building.

screen, based on cursor position. The speed of cursor movement can be increased by adding a mouse. Alarms are displayed on a dedicated area of the screen, as well as indicated audibly and logged on a printer. Two kinds of supervisory control are provided: on/off control for changing the status of a discrete output, and setpoint control for regulating an analog output.

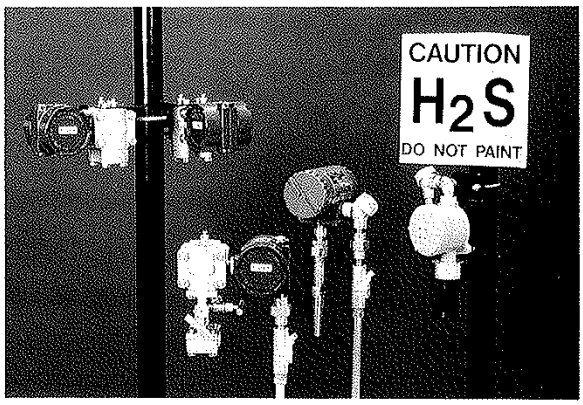
Security

Multiple levels of security are provided by the use of passwords to prevent unauthorized access to system functions.

Measurement and Control Elements

Fisher can provide and install the wide range of measurement and control elements necessary for field automation. These include:

- Temperature, pressure, differential pressure, flow, level, current, and voltage transmitters.
- Temperature, pressure, and level switches.
- Regulators, and on/off and throttling control valves.
- Bypass and 3-way valves.
- HS and dewpoint sensors.
- Turbine, PD, and orifice flowmeters.
- Cathodic system monitor.



Fisher offers a full line of measurement and control elements suited to field automation needs.

In addition, Fisher has engineered special hardware/software packages for many industry applications. These packages use the measurement and control elements previously described along with mounting hardware and electrical and pressure fittings as necessary. Some packages include software for use by the remote units or master computer.

Communications

Communications provides a data link between a remote unit and a master computer. The type of communications system used depends upon many factors including economics, geography, frequency, and channel availability, and can include:

- Telephone line
- Fiber optic cable
- VHF/UHF two-way radio
- 928/952 MHz radio
- Microwave
- Satellite

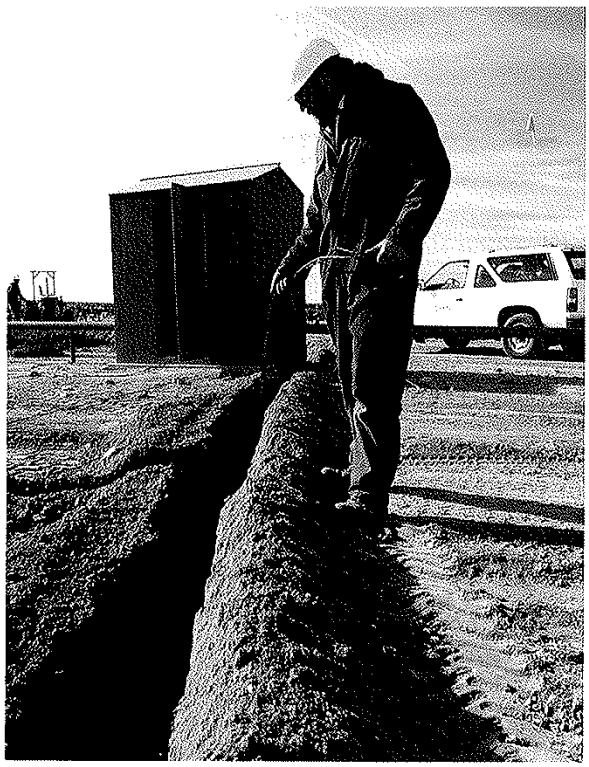
A communication system must be carefully engineered and implemented to deliver reliable data. Fisher can provide a complete turnkey communications system to fit almost any application.

Services

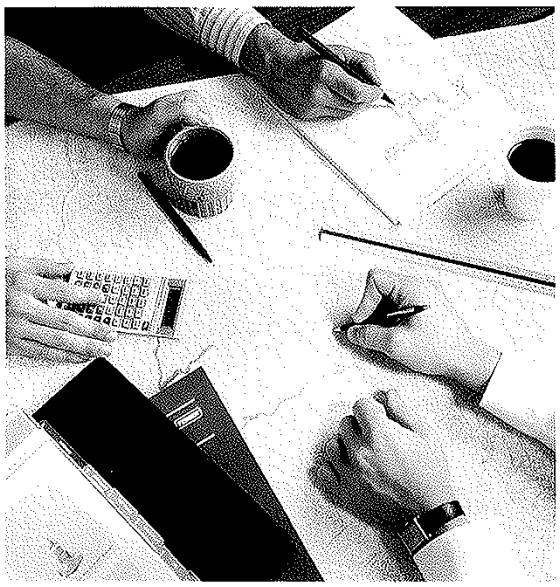
Fisher Field Automation Systems support services are designed to ensure that all facets of a customer project are carried out smoothly and according to plan. They consist of:

- Project Management
- Site Surveys
- Hardware and Software Engineering
- Installation
- Start-up
- System Documentation
- Training
- Maintenance

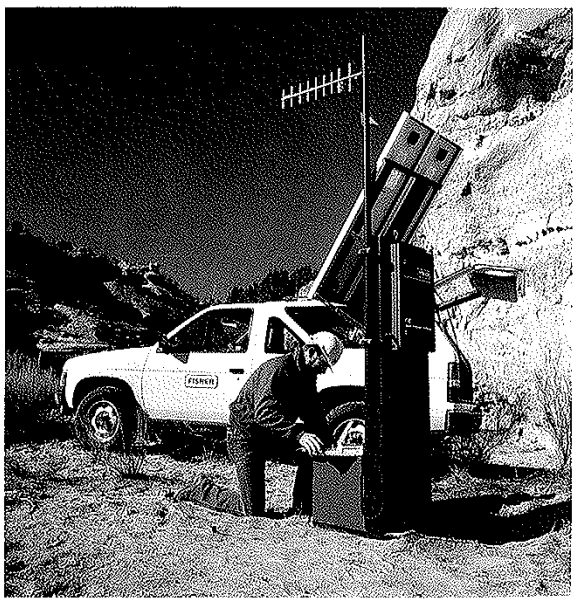
These services are performed by a combination of Fisher factory personnel, Fisher representatives, and outside sources under the guidance of Field Automation Systems personnel.



Installation is one of a full-range of project services available from Fisher.



Good results start with good planning. Fisher works with you to achieve the best solution to your needs.



On-site maintenance service is provided locally by your Fisher Representative.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Contents

Introduction

Field-mounted instrumentation measures a variable such as flow, level, pressure, or temperature and converts the measured variable into an electronic signal that is used by electronic controllers, indicators, and recorders located in a control room.

The electronic portion of the total control loop is terminated with field-mounted transducers and positioners. They receive the electronic signals generated within the control instrumentation and convert the signals into pneumatic and hydraulic pressures that operate actuators and control valves. The control valves regulate the measured variables that were sensed by the field instruments described in the previous paragraph.

Mass Flowmeters

Description

Mass flowmeters measure mass flow rate directly by monitoring Coriolis forces which occur when a rotating mass is accelerated. The EXAC Mass Flowmeter consists of a transmitter and sensor. The Series EX sensor features twin loops that enable flowing material to rotate while a drive coil vibrates the twin loops to accelerate the material and create the Coriolis (gyroscopic-like) forces. Electro-magnetic detectors sense the movement and produce flow signals. The sensor design is non-intrusive with no moving parts and allows any substance that flows to be measured accurately, including liquids, emulsions, and slurries. The mass flowmeter measures mass flow rate and total volumetric flow rate and total density, temperature, percent solids/concentration and dry solids mass flow rate and total dry solids. Additionally, EXAC produces a net oil meter which utilizes the mass flowmeter to measure percent cut and oil and water flow.

The 8300 transmitter features advanced electronics for more precise sensor signal processing, as well as unique direct digital communications.

Selection (Application)

The following applications are addressed by the Model 8300EX Mass Flowmeter:

- Variable density
- Full-to-empty
- Empty-to-full
- Slug flow
- Abrasive fluids
- High viscosity
- Slurries
- Custody transfer
- Pulsed flow
- High solids content

Application industries include chemical processing, pulp and paper manufacturing, oil production/net oil, food and beverage manufacturing, pharmaceuticals, petroleum/refining, petrochemical, mining, automotive, textiles, printing, paint and coatings, pipeline and others.

Flow Transmitters

Description

Flow transmitters sense the flow rate of a liquid, gas, or vapor and produce analog (4 to 20 or 10 to 50 milliampere dc) or digital communication signals. Fisher flow transmitters use an orifice plate and a differential pressure sensor to sense the flow rate. Their output is either linear with the flow rate or linear with the differential pressure, depending on the transmitter chosen. This choice provides the system engineer with additional design variations to meet your flow measurement and control applications.

Selection

Familiarize yourself with the following application considerations as they apply to your flow measurement requirements.

- Upper and lower limits of the flow rate
- Transmitter output range
- Explosion proof or intrinsic safety requirements
- Ambient Temperature
- Mounting method

The following selection table will guide you to product descriptions that describe the transmitters which are best suited to your flow measurement needs. To help you make your final selection, contact your Fisher sales office or sales representative.

Flow Transmitters

INPUT RANGE				INPUT/OUTPUT RELATIONSHIP	TYPE NUMBER	PAGE
Minimum	Maximum	Minimum	Maximum			
5 inch H_2O	750 inch H_2O	1.24 kPa	186.45 kPa	Linear with flow rate	1151DP Flow Transmitter	3-10
5 inch H_2O	750 inch H_2O	1.24 kPa	186.45 kPa	Linear with differential pressure	1151DP Differential Pressure Transmitter	3-10

Level Transmitters

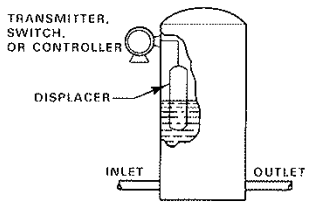
Description

Level Transmitters sense the level of liquids and liquid-to-liquid interfaces. The transmitters produce analog (4 to 20 or 10 to 50 milliampere dc) or digital communication signals that are proportional to level.

Liquids

Ball floats, displacers, and differential pressure and gauge pressure sensors are elements used to sense liquid level. Typically, ball float sensors are low-cost and are used in applications where accuracy is not a significant factor. Displacers and differential pressure sensors are used where higher accuracy is required; the displacers are normally used with clean liquids, and differential pressure sensors are normally used with harder-to-handle liquids such as slurries or viscous solutions.

A ball float senses level by floating on the surface of the liquid. However, a displacer remains relatively stationary as level changes; therefore, the displacer becomes more or less submerged as level changes and creates a buoyancy force that is proportional to level. The buoyancy force is then converted into analog signals by the level transmitters.



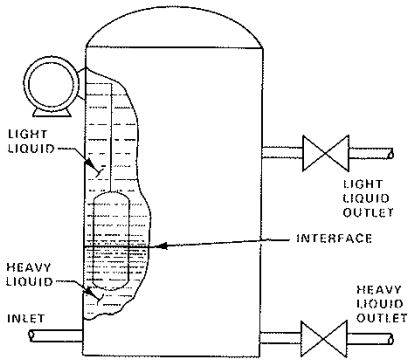
Displacer Sensor

Another method of sensing liquid level is to sense the pressure differential between a constant reference pressure and the pressure created by the height of the measured liquid column. Typically, one input of a differential pressure sensor is vented to atmosphere, and the other input is connected to the bottom of the vessel containing the measured liquid. Or, a gauge pressure transmitter is connected to the vessel. A change in liquid level causes a proportional change in the difference between atmospheric pressure and the liquid column pressure.

Liquid-to-Liquid Interface

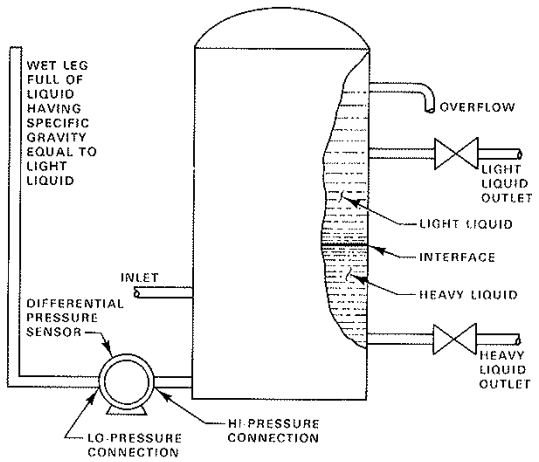
Displacers and differential pressure sensors are normally used in liquid-to-liquid interface applications. Because of their simplicity, displacers are most often used in interface applications involving clean liquids. If the liquids are viscous, however, a differential pressure sensor may be a better choice.

When using a displacer, it must be completely submerged at all times as shown in the following figure. The buoyancy force changes only when the liquid density changes as a result of an increasing or decreasing interface level on the displacer.



Liquid-to-Liquid Interface

As shown in the following figure, a differential pressure sensor can sense interface level by comparing a constant reference pressure created by the wet leg with the pressure created by the liquid column in the vessel. The total column height in the vessel is maintained at a constant level by the overflow; therefore, the only variable sensed is the height of the interface.



Differential Pressure Sensor

Selection

Familiarize yourself with the following application considerations as they apply to your level measurement requirements.

- Composition, specific gravity, and temperature of the process
- Upper and lower range values of the level being sensed
- Type of output required (contact closure or analog)
- Output range if analog signal is required
- Requirements for field-mounted gauges or meters
- Ambient temperature
- Explosion proof or intrinsic safety requirement
- Mounting method

The following selection table will guide you to product descriptions that describe one or two products which are best suited to your level measurement needs. To help you make your final selection, contact your Fisher sales office or sales representative.

Level Transmitters

MEASURED VARIABLE	INPUT SPAN				SENSING ELEMENT	TYPE NUMBER	SEE PAGE
	Minimum	Maximum	Minimum	Maximum			
Liquid level	1.4 inch H_2O	120 inch H_2O	0.35 kPa	22.9 kPa	Displacer	2390-249	3-9
	25 inch H_2O	2770 inch H_2O	635 mm H_2O	19050 mm H_2O	Differential pressure sensor; flange mounted to vessel	1151LT	3-8
	5 inch H_2O	750 inch H_2O	1.24 kPa	184.45 kPa	Differential pressure sensor; remotely mounted from vessel	1151DP	3-10
Liquid-to-liquid interface	1.4 inch H_2O	120 inch H_2O	0.35 kPa	22.9 kPa	Displacer	2390-249	3-9
	25 inch H_2O	2770 inch H_2O	635 mm H_2O	19050 mm H_2O	Differential pressure sensor; flange mounted to vessel	1151 LT	3-8
	5 inch H_2O	750 inch H_2O	1.24 kPa	184.45 kPa	Differential pressure sensor; remotely mounted from vessel	1151 DP	3-10

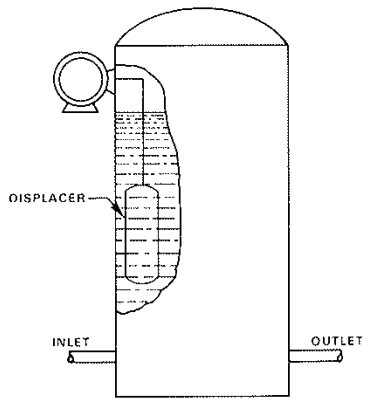
Density Transmitters

Description

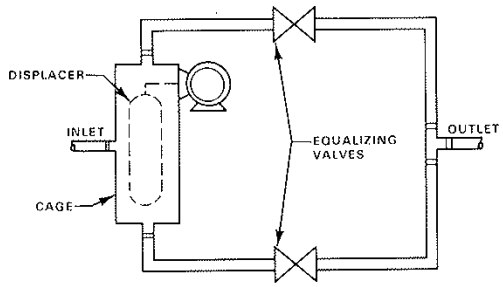
These transmitters sense the density (specific gravity) of liquids and produce analog (4 to 20 or 10 to 50 milliampere dc) or digital communication signals proportional to density.

Displacers, differential pressure sensors, and mass flowmeters are used to sense liquid density. Displacers are sensitive to small density changes and are used when small input spans are required. Also, displacers can be easily compensated for temperature variations. However, a differential pressure sensor may be a better choice if the process consists of viscous liquids.

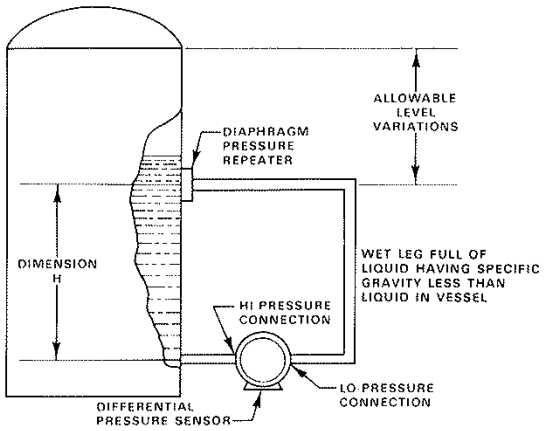
When using a displacer, it must be completely submerged at all times as shown below. The buoyancy force changes only when the liquid density changes; it does not change when liquid level changes.



Density of a liquid flowing through a pipe can be measured in a displacer as shown in the following figure. The displacer is placed inside a cage that has an inlet near its center section. The liquid leaves the cage through the top and bottom connections and flows through the two equalizing valves that have a twofold purpose. They keep the displacer totally immersed in the liquid, and they equalize the flow out of the top and bottom connections of the cage, thereby canceling the effects of liquid velocity on the displacer.



A differential pressure sensor can sense density as shown below. The sensor compares a reference pressure created by the wet leg with the pressure created by the liquid column in the vessel. The wet leg is connected to the vessel through a diaphragm pressure repeater that isolates the liquid in the wet leg from the liquid in the vessel; however, the repeater applies to the wet leg a pressure caused by level variations in the vessel.



3/4

Because level variations are applied to both sides of the differential pressure sensor, changes in liquid level do not affect the sensor output. The only variable sensed is the density of the liquid in the vessel.

Exac Mass Flowmeters also measure density based on monitoring the natural frequency of the sensor tubes with respect to mass flow. The natural frequency of the sensor tubes changes as density changes. With sophisticated digital electronics, the mass flowmeter measures the change and produces 4 to 20 milliampere dc analog and digital communications signals. Both density and mass flow rate can be measured simultaneously.

Selection

Familiarize yourself with the following application considerations as they apply to your density measurement requirements.

- Composition, specific gravity, and temperature of the process
- Upper and lower range values of the density being sensed
- Output signal range
- Requirements for field-mounted gauges or meters
- Ambient temperature
- Explosion proof or intrinsic safety requirement
- Mounting methods

The following selection table will guide you to product descriptions that describe one or two products which are best suited to your density measurement needs. To help you make your final selection, contact your Fisher sales office or sales representative.

Density Transmitters

Minimum Input Span		Sensing Element	Type Number	See Page
$\Delta SG = \frac{10}{V}$ where, ΔSG = Minimum density span in specific gravity V = Displacer volume in cubic inches	$\Delta SG = \frac{164}{V}$ where, ΔSG = Minimum density span in specific gravity V = Displacer volume in cubic centimeters	Displacer	2390-249A	3-9
Example: Transmitter with 48 inch long by 3 inch diameter (1219 mm long by 76 mm diameter) displacer, which has a volume of 339 inch^3 (5560 cm^3), produces 100% output change when the input spans 0.03 specific gravity				
$\Delta SG = \frac{20}{H}$ where, ΔSG = Minimum density span in specific gravity H = Dimension H in inches shown in differential pressure sensor figure above	$\Delta SG = \frac{508}{H}$ where, ΔSG = Minimum density span in specific gravity H = Dimension H in millimeters shown in differential pressure figure above	Differential pressure sensor; flange mounted to vessel	1151LT	3-8
		Differential pressure sensor; remotely mounted from vessel	1151DP	3-8
Example: Transmitter connected to 48 inch (1219 mm) tall vessel produces 100% output change when the input spans 0.42 specific gravity				
Measurement Range	0.3 gm/cc to 3.0 gm/cc	Mass Flowmeters	8300EX EXAC	3-7

Pressure Transmitters

Description

Pressure transmitters sense the pressure of gases, liquids, or steam. The transmitters produce analog (4 to 20 or 10 to 50 milliampere dc) or digital communication signals that are proportional to pressure.

Pressures sensed by the transmitters and switches fall into three categories. Following is a brief description of each category.

Gauge Pressure—Pressure measured with respect to atmospheric pressure. Gauge pressure is a positive pressure; i.e., it is greater than atmospheric pressure. However, with zero elevation capability, the transmitter can be used in some vacuum services.

Absolute Pressure—Pressure measured with respect to absolute zero (a perfect vacuum).

Differential Pressure—The result of the difference between two pressures.

Selection

Familiarize yourself with the following application considerations as they apply to your pressure measurement requirements.

- Composition and temperature of the measured material
- Upper and lower limits of the measured pressure
- Transmitter output range
- Explosion proof or intrinsic safety requirements
- Ambient temperature
- Field mounted gauge or meter requirements
- Mounting method

The following table will guide you to product descriptions that describe one or two products which are best suited to your pressure measurement needs. To help you make your final selection, contact your Fisher sales office or sales representative.

Pressure Transmitters

CATEGORY	INPUT SPAN				TYPE NUMBER	SEE PAGE
	Minimum	Maximum	Minimum	Maximum		
Absolute	30 psia	6000 psia	0.21 MPa	41.34 MPa	1144	3-9
	2 inch H_g	1000 psia	6.77 kPa	6.89 MPa	1151AP	3-10
Draft	0.5 inch H_2O	6 inch H_2O	0.12 kPa	1.49 kPa	1151DR	3-11
Gauge	30 psi	6000 psi	0.21 MPa	41.34 MPa	1144	3-9
	5 inch H_2O	6000 psi	6.77 kPa	41.37 MPa	1151GP	3-12
Differential	5 inch H_2O	1000 psi	1.24 kPa	6.89 MPa	1151DP	3-10
	25 inch H_2O	300 psi	6.22 kPa	2.07 MPa	1151HP	3-11

Temperature Transmitters

Description

These field-mounted transmitters sense temperature with thermocouples or resistance elements and produce a 4 to 20 milliampere dc signal. Resistance elements are normally used for greater accuracy. However, when physical ruggedness is important and wider input spans are allowable, thermocouples are normally preferred.

Selection

Familiarize yourself with the following application considerations as they apply to your temperature measurement requirements.

- Temperature range and composition of material to be measured
- Ambient temperature

See product descriptions on pages 3-12 and 3-13. To help you make your final selection, contact your Fisher sales office or sales representative.

Valve Position Switches

Description

This device normally mounts on a valve actuator and produces contact closures at desired points of valve travel.

Selection

Familiarize yourself with the following application considerations as they apply to your position sensing needs

- Sensed motion, linear or rotary
- Amount of sensed motion
- Switching output

See product description on page 6-41. To help you make your final selection, contact your Fisher sales office or sales representative.

Transducers & Positioners

Description

Transducers and positioners convert electronic instrumentation signals into pneumatic or hydraulic pressures that control actuators and valves. A positioner is normally used when it is necessary to position a valve stem accurately with respect to the value of the instrumentation signal. When less accurate positioning is allowable, a transducer can be used to provide a more economical installation.

High-pressure applications sometimes require the use of electro-hydraulic positioners. Fisher Controls offers these positioners as an integral part of a valve actuator. When high-pressure applications are encountered, refer to the electro-hydraulic valve actuators in the selection guide starting on page 6-8 in addition to the following table.

Selection

Familiarize yourself with the following application considerations as they apply to your control needs.

- Range of electronic input signal
- Valve stem travel
- Direct or reverse action
- Explosion proof or intrinsic safety requirements

The following selection table will guide you to product descriptions that describe the products which are best suited to your control needs. To help you make your final selection, contact your Fisher sales office or sales representative.

Transducers & Positioners

Product	Input Signal	Output Signal	Type Number	See Page
Transducer	1 to 5 mA, or 4 to 20 mA, or 10 to 50 mA, or 1 to 9 Vdc	3 to 15 6 to 30,or 3 to 27 psig (20 to 100, 40 to 200, or 20 to 190 kPa) proportional to input signal	546	3-13
	4 to 20 mA dc	3 to 15 psig (20 to 100 kPa) proportional to input signal	646	3-14
Positioner	4 to 20 mA, or 10 to 50 mA; and valve stem movement ranging from 0 to 7/16 up to 0 to 4-1/8 inch (0 to 11 up to 0 to 105 mm)	Pneumatic pressure up to 50 psig (340 kPa) as required to accurately move a valve stem proportional to an electronic input signal	3582i	3-14
	4 to 20 mA; or split range 4 to 12 mA and 12 to 20 mA two-way, or 4 to 9.3 mA, 9.3 mA to 14.7 mA, and 14.7 mA to 20 mA three-way	Pneumatic pressure as required by the actuator up to 150 psig (1020 kPa)	3620 Series	3-15
		Pneumatic pressure as required by the actuator up to 90 psig (620 kPa)	3661	3-15

Solenoid Valves

These 3 and 4-way valves are used to switch pneumatic pressures from one line to another. The solenoid valves are actuated with 117 Vac. For additional information about the solenoid valves, contact your Fisher sales office or sales representative and request bulletin 62.3:015.

EXAC Model 8300EX Mass Flowmeters

The EXAC Coriolis Mass Flowmeter measures mass flow rate and total flow, standard volumetric flow rate and total, real volumetric flow rate and total, density, temperature, and percent solids/solids flow rate and total.

The Model 8300EX Mass Flowmeter is comprised of the Model 8300 transmitter and the Series EX Sensor.

FLOWMETER CHARACTERISTICS

Measurement Accuracies: *Mass flow rate and total accuracy*— ± 0.15% of rate ± Zero Offset (see table in Series EX Sensor section)

Standard Volumetric Flow Rate and Total: *Accuracy*—Dependent on mass flow accuracy plus the accuracy of the user-entered standard density factor (gm/cc) of fluid.

Real Volumetric Flow Rate and Total: *Accuracy*—Dependent on mass flow accuracy as described herein plus the accuracy of the measured density of the fluid.

Density: *Accuracy*— ± 0.003 gm/cc. *Repeatability*— ± 0.001 gm/cc. *Range*—0.3 to 3.0 gm/cc.

Temperature: *Accuracy*— ± 2 degrees C sensor tube temperature. *Resolution*—0.2 degree C

Percent Solids/Solids Flow Rate and Total: *Accuracy*—Dependent on measure density plus the accuracy of the user-entered density vs. percent solids function.

Operation in Hazardous Areas: Intrinsically safe operation allows locating Series 8300 Transmitter in a Class I, Division 2 or safe area and Sensor in Class I, Division 1, Group C & D areas.

Non-incendive operation allows Series 8300 Transmitter and EX Sensor installation in Class I, Division 2, Group A, B, C, D areas.

The EXAC Model 8300EX has earned approvals from the following agencies: Factory Mutual, Baseefa (CENELEC), CSA.

SERIES 8300 TRANSMITTER

Ambient Temperature: − 15 degrees C to + 50 degrees C (5 degrees F to 122 degrees F)

Enclosure: NEMA 4x low-copper aluminum alloy, polyurethane coating

Humidity: 95% non-condensing

Power: 115/230 VAC ± 20%; 50/60 Hz. 25Wtyp., 40W max, 24 Vdc ± 20%

Cable Requirement: Transmitter to sensor, 4 individually shielded twisted pairs, 18AWG, 500 ft. maximum distance between sensor and transmitter.

Display: LCD plus keyboard panel

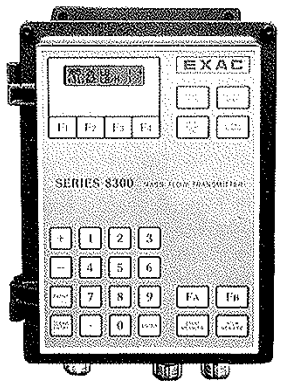
Inputs: *Configurable Contact Inputs Selected functions*—Clear alarms, Totalizer reset for mass and volumetric flow, Zero flow calibrate, Totalizer inhibit, Inhibit flow rate.

Current Loop Outputs: *Up to 2 current loop outputs available*—2-30 mA or 0-20 mA (selectable), 750 ohm load maximum; *Selectable variables*—Mass, volume, solids, flow rates, density, percent solids, temperature.

Current Loop and Pulse Outputs: Outputs are optically isolated from power source (2 outputs maximum); *Frequency output*—One frequency output available, 0-10 kHz, 0-12 volt, 0-24 volt or open collector, 5k ohm minimum load; *Selectable variables*—Mass flow rate, volumetric flow rate, dry solids mass flow rate.

Configurable Discrete Outputs: Open collector transistor, 30 Vdc maximum; 100mA maximum current; Non-isolated; *Selectable functions*—High and/or low limit alarms on any measure variable, Batch control, Flow direction, Malfunction alarm, Analog output overrange.

Digital Communications: *RS485/422 Port (standard)*—RS485/422 standard, ASCII format, 300-9600 selectable baud rate and parity, 4000 ft. maximum. *ST/DC TDC 3000*—Optional. *Networking*—Up to 25 flowmeters on one computer port.



Series 8300 Transmitter

SERIES EX SENSOR

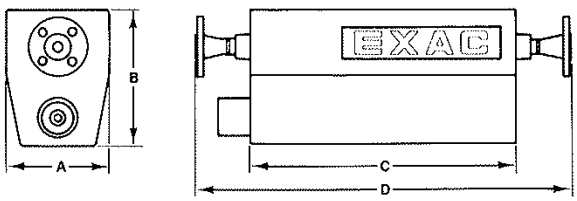
Operating Temperature: − 75 degrees C to + 232 degrees C (− 100 degrees F to + 450 degrees F).

Wetted Surfaces: 316L stainless steel

Enclosure: 304 stainless steel

Humidity: 0-100% non-submersible

Purge Fittings: Purge fittings are standard on all sensors.



Series EX Sensor

Series EX Sensor

Series EX Sensor	DIMENSIONS (INCH)				Weight (lbs)	Zero Offset (lbs/min)	FLOW RANGE	
	A	B	C	D			(lb/min)	(gpm water)
EX12	6	6	12	18-23	8	.003	.12 - 18	.0144 - 2.15
EX120	6	8	16	20-28	17	.03	1.2 - 180	.144 - 21.5
EX1200	9	12	24	31-41	65	.3	24 - 1800	2.88 - 215
EX9000	17	19	60	66-70	475	3.0	540 - 13,500	65.0 - 1620

Calibration traceable to United States National Bureau of Standards. Response time (Damping): Keyboard adjustable from 0.1 to 50 seconds.

1151DP Flow Transmitter

The Type 1151DP Flow Transmitter is a 2-wire transmitter that senses differential pressure across an orifice, performs a square root extraction, and produces 4 to 20 milliampere dc or HART™ digital communications signals that are directly proportional to flow. Input span can be as small as 5 in. H_2O (1.24 kPa) or as large as 750 in. H_2O (186.45 kPa).

Input: *Type*—Differential pressure produced by flow. *Service*—Liquid, gas, or vapor. *Span*—Continuously adjustable from 5 to 30, 25 to 150, or 125 to 750 in. H_2O (1.24 to 7.465 kPa, 6.22 to 37.29 kPa, or 31.08 to 186.45 kPa). *Zero*— ± 10% of calibrated span.

Output: *4 to 20 mA dc*—linear relationship with flow. Up to 600 ohm load impedance with 24 Vdc power, or up to 1650 ohm load impedance with 45 Vdc power. Transmitter also available with HART digital communications.

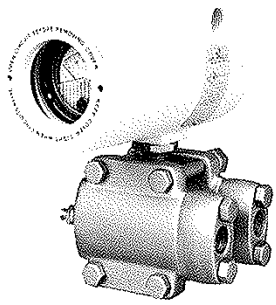
Accuracy Rating: ± 0.25% of calibrated span for a range of 20 to 100% of flow (4 to 100% of input pressure.) Includes combined effects of hysteresis, repeatability and conformity of the square root function. Output linear with input pressure for the range of 0 to 20% of flow (0 to 4% of input pressure.)

Electrical Classification: CSA or FM listed as explosion proof (Intrinsically safe versions also available)

Temperature Limits: − 20 to + 150°F (− 29 to + 66°C) Amplifier operating. − 40 to 220°F (− 40 to 104°C) Sensing element operating with silicone fill. 32 to 160°F (0 to 71°C) Sensing element operating with inert fill. − 60 to 180°F (− 51 to 82°C) Storage

Mounting: Mounts on a 2 in. (nominal) pipestand or on a panel

Bulletin Reference: 11.1:1151DP



1151LT Liquid Level Transmitter

Because it is designed to flange-mount on the side of a vessel, this 2-wire transmitter is easily installed to sense liquid level or density of a liquid in both open and closed tanks. The output signal of the Type 1151LT transmitter produces 4 to 20 or 10 to 50 milliampere dc or HART™ digital communication signals when the input span is as small as 25 in. H_2O (635 mm H_2O) or as large as 2770 in. H_2O (70.36 mH_2O).

Input: *Type*—Differential Pressure. *Service*—Liquid level or density. *Span*—Continuously adjustable from 0-25/150 in. H_2O (0-635/3810 mm H_2O), 0-125/750 in. H_2O (0-3175/19050 mm H_2O), or 0-471/2770 in. H_2O (0-11.96/70.36 m H_2O.) *Zero*—Continuously adjustable elevation or suppression.

Zero Elevation and Suppression: Regardless of output specified, zero elevation and suppression must be such that neither the span nor the upper or lower range value exceed 100% of the upper range limit. 4-20 mA dc maximum zero elevation: 600% of calibrated span. Maximum zero suppression: 500% of calibrated span. 10-50 mA dc maximum zero elevation or suppression: 150% of calibrated span (50% of span for range code 6)

Output: 40 to 20 mA dc (up to 600 ohm load impedance with 24 Vdc power, or up to 1650 ohm load impedance with 45 Vdc power), or 10 to 50 mA dc (up to 300 ohm load impedance with 45 Vdc power.) Transmitter also available with HART digital communications.

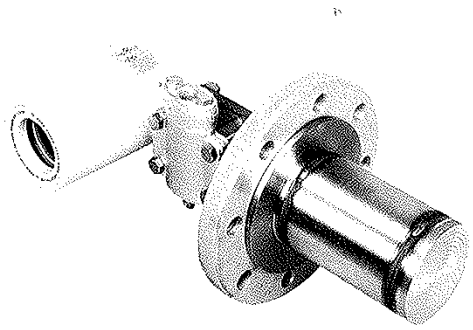
Accuracy Rating: Output signal represents the sensed pressure ± 0.25% of calibrated span

Electrical Classification: CSA or FM listed as explosion proof (Intrinsically safe versions also available)

High Side Temperature Limits (at atmospheric pressure and above): − 20 to 200°F (− 29 to 93°C) amplifier operating; − 40 to 300°F (− 40 to 149°C) with silicone oil fill; 0 to 400°F (− 17.1 to 204°C) with Syltherm 800™ fill (100°F or 37.8°C ambient); 0 to 200°F (− 17.7 to 93°C) with glycerine and water; 0 to 400°F (− 17.7 to 204°C) with Neobee™ M-20

Mounting: Flange mount

Bulletin Reference: 11.2:1151LT

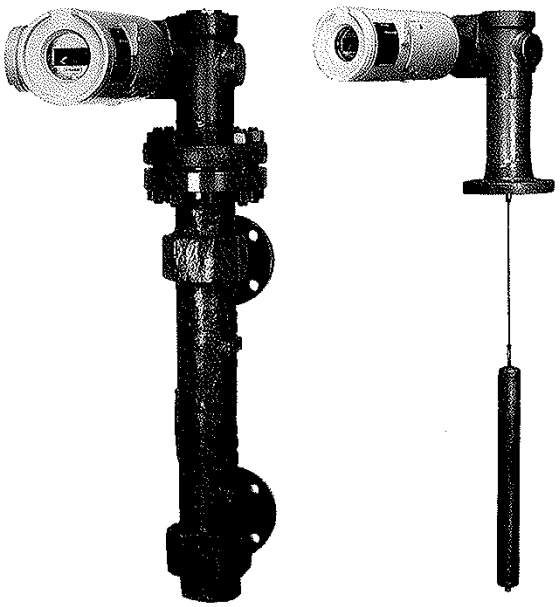


2390-249 Series Level Transmitters and Displacer Sensors

The 2390-249 Series consists of a Type 2390 Liquid Level Transmitter and a 249 Series Level-Trol® Displacer Sensor. It measures changes in liquid level, specific gravity, or interface level and transmits a current output signal proportional to the changes.

The transmitter has external, non-interacting zero and span adjustments. In addition, a dry span calibration adjustment allows field recalibration without removing the transmitter field wiring cover or the signal conditioner cover. Span adjustment does not require the process fluid to be raised or lowered.

Cage and cageless sensors are available with 249 Series displacer sensors. Cageless sensors perform well in applications where the vessel has no internal obstructions and where fluid turbulence is not severe. Cageless sensors also offer many displacer stem lengths so the displacer can be lowered to the optimum depth in the vessel.



Type 2390 Liquid Level Transmitter and 249 Series Displacer Sensor

Available Configurations: *Type 2390 Liquid Level Transmitter and 249 Series Displacer Sensor*—Side-mounted cage sensors or top-mounted cageless sensors

Input: Liquid level, interface level, or density changes

Minimum Differential Specific Gravity: 0.1 with a standard construction

Output Signal: 4 to 20 mA dc

Power Supply Requirements: 11 to 45 volts dc

Accuracy: *Linearity*— ± 0.5% full scale; *Hysteresis*— ± 0.1% full scale; *Repeatability*— ± 0.1% full scale

Sensor Working Pressures: Consistent with ANSI Class 125 through 600 pressure/temperature ratings, depending upon construction

Environmental Protection: Transmitter is waterproof per NEMA 4 (IEC 529 IP66)

Material of Wetted Parts: *Displacer Cage*—Cast iron, steel, or stainless steel. *Displacer Assembly*—316 Stainless steel. *Torque Tube*—Nickel alloy

Mounting: With a free-hanging displacer, the transmitter flange mounts to the top or side of the process vessel; with a cage displacer, the transmitter flange mounts to the cage.

Bulletin Reference: 11.2:2390-249

1144 Pressure Transmitter

The Type 1144 is an economical 2-wire absolute pressure or gauge pressure transmitter that produces a proportional 4 to 20 milliampere dc signal. Input span can be as small as 30 psi (2.0 bar) or as large as 6000 psi (414 bar). Zero adjustment allows zero-based or suppressed zero ranges, and the wide adjustability enables the transmitter to be used in absolute or gauge pressure applications.

Input: *Type*—Absolute or gauge pressure. *Service*—Liquid, gas or vapor. *Span*—Continuously adjustable from 30 to 120, 50 to 200, 150 to 600, 300 to 1200, 500 to 2000 or 1500 to 6000 psi (0.21 to 0.83, 0.34 to 1.38, 1.03 to 4.14, 2.07 to 8.27, 3.45 to 13.78, or 10.34 to 41.34 MPa). *Zero*—Continuously adjustable. Zero may be suppressed up to 100% of calibrated span, but upper range value cannot exceed maximum span value for each choice above. Zero may be elevated to include full vacuum for transmitter calibrated for gauge pressure

Output: 4 to 20 mA dc (up to 550 ohm load impedance with 24 Vdc power)

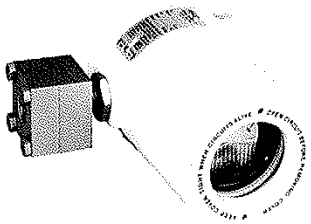
Accuracy Rating: Output signal represents the sensed pressure ± 0.5% of calibrated span

Electrical Classification: CSA or FM listed as explosion proof (Intrinsically safe versions also available)

Temperature Limits: − 20 to + 200°F (− 29 to + 93°C) amplifier operating; − 40 to 220°F (− 40 to 104°C) sensing element operating with silicone fill; 32 to 160°F (0 to 71°C) sensing element operating with inert fill; − 60° to 250°F (− 51 to 121°C) storage

Mounting: Mounts on a 2 in. (nominal) pipestand or on a panel

Bulletin Reference: 11.3:1144



1151AP Absolute Pressure Transmitter

The Type 1151AP is a 2-wire transmitter that senses pressure referenced to an absolute zero cell and produces a proportional 4 to 20 or 10 to 50 milliampere dc or HART™ digital communications signals. Minimum input span is 2 in. HgA (6.77 kPa) and maximum input span is 1000 psi (6.89 MPa). Allowable overpressure to 2000 psia (13.79 MPa) simplifies potentially complex systems by minimizing special precautions for transmitter protection.

Input: *Type*—Absolute Pressure. *Service*—Liquid, gas, or vapor. *Span*—Continuously adjustable from 2 to 11 or 10 to 55 HgA; 17 to 100, 50 to 300, or 170 to 1000 psia (6.77 to 37.25, 33.86 to 186.25,or 117.21 to 689.48 kPa; or 0.34 to 2.07 or 1.17 to 6.89 MPa). *Zero*—Continuously adjustable elevation. For 4 to 20 mA output, the magnitude of the upper range value is equal to the maximum span value for each span choice above. For 10 to 50 mA output, the limits are reduced—see bulletin listed in Bulletin Reference for details

Output: 4 to 20 mA dc (up to 600 ohm load impedance with 24 Vdc power, or up to 1650 ohm load impedance with 45 Vdc power), or 10 to 50 mA dc (up to 300 ohm load impedance with 45 Vdc power.) Transmitter also available with HART™ digital communications.

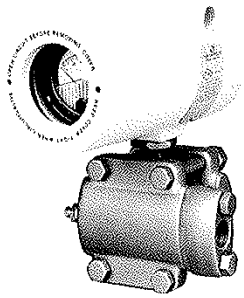
Accuracy Rating: Output signal represents the sensed pressure ± 0.25% of calibrated span

Electrical Classification: CSA or FM listed as explosion proof (Intrinsically safe versions also available)

Temperature Limits: − 20 to + 200°F (− 29 to + 93°C) amplifier operating; − 40 to 220°F (− 40 to 104°C) sensing element operating with silicone fill; 32 to 160°F (0 to 71°C) sensing element operating with inert fill; − 60° to 250°F (− 51 to 121°C) storage

Mounting: Mounts on a 2 in. (nominal) pipestand or on a panel

Bulletin Reference: 11.3:1151AP



1151DP Differential Pressure Transmitter

The Type 1151DP Differential Pressure Transmitter is a 2-wire transmitter that senses differential pressure and produces standard 4 to 20 or 10 to 50 milliampere dc or HART™ digital communications signals that are proportional to differential pressure. Input span can be as small as 5 in. H_2O (12 mbar) or as large as 1000 psid (69.0 bar). Zero-based, suppressed, elevated, or reversed ranges can be used.

Input: *Type*—Differential pressure. *Service*—Liquid, gas, or vapor. *Span*—Continuously adjustable from 5 to 30, 25 to 150, or 125 to 750 in. H_2O, or from 17 to 100, 50 to 300, or 170 to 1000 psi. (1.24 to 7.46, 6.22 to 37.29, 31.48 to 186.45 or 117.2 to 689.5 kPa; or 0.34 to 2.07 or 1.17 to 6.89 MPa.) *Zero*—Continuously adjustable elevation or suppression. For 4 to 20 mA output, the magnitude of the upper range limit and lower range limit is equal to the maximum span value for each span choice above. For 10 to 50 mA output the limits are reduced—see bulletin listed in Bulletin Reference for details

Zero Elevation and Suppression: Regardless of output specified, zero elevation and suppression must be such that neither the span nor the upper or lower range value exceed 100% of the upper range limit. Maximum zero elevation: 600% of calibrated span. Maximum zero suppression: 500% of calibrated span.

Output: 4 to 20 mA dc (up to 600 ohm load impedance with 24 Vdc power, or up to 1650 ohm load impedance with 45 Vdc power), or 10 to 50 mA dc (up to 300 ohm load impedance with 45 Vdc power.) Transmitter also available with HART digital communications.

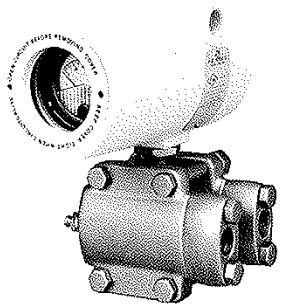
Accuracy Rating: Output signal represents the sensed pressure ± 0.2% of calibrated span for spans from 5 to 750 in. H_2O (0.01 to 1.9 bar) and ± 0.25% of calibrated span for spans from 17 to 1000 psi (1.2 to 69.0 bar)

Electrical Classification: CSA or FM listed as explosion proof (intrinsically safe versions also available)

Temperature Limits: − 20 to + 200°F (− 29 to + 93°C) amplifier operating; − 40 to 220°F (− 40 to 104°C) sensing element operating with silicone fill; 32 to 160°F (0 to 71°C) sensing element operating with inert fill; − 60° to 250°F (− 51 to 121°C) storage

Mounting: Mounts on a 2 in. (nominal) pipestand or on a panel

Bulletin Reference: 11.4.1151DP

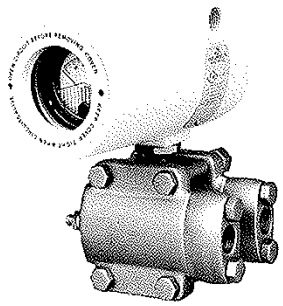


1151DR Differential Pressure Transmitter for Draft Ranges

The 1151DR differential pressure transmitter measures extremely low pressure differentials in fractions of an inch with both positive and/or negative static pressures and produces standard 4 to 20 mA dc signal that is proportional to the differential pressure. It is designed for monitoring of furnace pressure, gas flow to low pressure burners, total, primary, and secondary air flow, and draft loss.

Input: *Type*—Differential pressure. *Service*—Liquid, gas or vapor *Span*—Continuously adjustable from 0 to 0.5 or 0 to 6 in. H_2O (0 to 0.12 or 0 to 1.49 kPa). *Zero*—Continuously adjustable

Zero Elevation and Suppression: Must be such that neither the span nor the upper or lower range value exceed 100% of the upper range limit. Maximum zero elevation—600% of calibrated span. Maximum zero suppression—500% of calibrated span.
Output: 4 to 20 mA dc (up to 600 ohm load impedance with 24 Vdc power, or up to 1650 ohm load impedance with 45 Vdc power.) Also available with HART digital communications.
Accuracy Rating: ± 0.5% of calibrated span. Includes combined effects of linearity, hysteresis and repeatability.
Electrical Classification: CSA or FM listed as explosion proof (Intrinsically safe versions also available)
Temperature Limits: − 20 to 200°F (− 29 to 93°C) operating. − 60 to 250°F (− 51 to 121°C) storage.
Mounting: Mounts on a 2 in. (nominal) pipestand or on a panel.



1151HP Differential Pressure Transmitter for High Line Pressure

The Type 1151HP, a 2-wire, transmitter for high line pressure applications, senses differential pressure and produces proportional 4 to 20 or 10 to 50 milliampere dc or HART™ digital communication signals that are proportional to differential pressure. The transmitter can be operated at a static pressure up to 4500 psig (31.0 MPa.)Differential input spans of 25 in. H_2O to 300 psid (6.22 kPa to 2.07 MPa) can be used. Zero-based, suppressed, elevated, or reversed ranges can be used.

Input: *Type*—Differential pressure for high static pressure. *Service*—Liquid, gas, or vapor. *Span*—Continuously adjustable from 25 to 150 or 125 to 750 in. H_2O, or from 17 to 100 or 50 to 300 psid (6.22 to 37.29, 31.08 to 186.45 or 117.2 to 689.5 kPa; or 0.34 to 2.07 MPa.) *Zero*—Continuously adjustable elevation or suppression.

Zero Elevation and Suppression: Regardless of output specified, zero elevation and suppression must be such that neither the span nor the upper or lower range value exceed 100% of the upper range limit. Maximum zero elevation: 600% of calibrated span. Maximum zero suppression: 500% of calibrated span.

Output: 4 to 20 mA dc (up to 600 ohm load impedance with 24 Vdc power, or up to 1650 ohm load impedance with 45 Vdc power), or 10 to 50 mA dc (up to 300 ohm load impedance with 45 Vdc power.) Transmitter also available with HART digital communications.

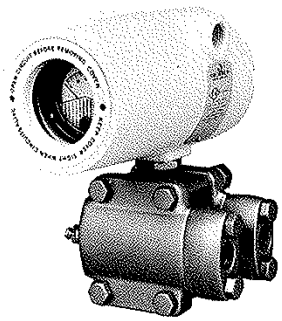
Accuracy Rating: Output signal represents the sensed pressure ± 0.25% of calibrated span

Electrical Classification: CSA or FM listed as explosion proof (Intrinsically safe versions also available)

Temperature Limits: − 20 to + 200°F (− 29 to + 93°C) amplifier operating; − 40 to 220°F (− 40 to 104°C) sensing element operating with silicone fill; 32 to 160°F (0 to 71°C) sensing element operating with inert fill; − 60° to 250°F (− 51 to 121°C) storage

Mounting: Mounts on a 2 in. (nominal) pipestand or on a panel.

Bulletin Reference: 11.4:1151HP



1151GP Gauge Pressure Transmitter

The Type 1151GP is a 2-wire transmitter that senses pressure referenced to atmosphere (gauge) and produces proportional 4 to 20 or 10 to 50 milliampere dc or HART™ digital communication signals. Input span can be as small as 5 in. H_2O to as large as 6000 psi (1.24 kPa to 41.37 MPa.). Zero-based, suppressed, and elevated ranges can be used. Up-scale vacuum indication can be accomplished by specifying the proper range and reversing the sensor flanges in the field.

Zero Elevation and Suppression: Regardless of output specified, zero elevation and suppression must be such that neither the span nor the upper or lower range value exceed 100% of the upper range limit. Maximum zero elevation: 600% of calibrated span. Maximum zero suppression: 500% of calibrated span.

Input: *Type*—Gauge pressure. *Service*—Liquid, gas, or vapor. *Span*—Continuously adjustable from 5 to 30, 25 to 125, or 125 to 750 in. H_2O, or from 17 to 100, 50 to 300, 170 to 1000, 500 to 3000, or 1000 to 6000 psi (1.24 to 7.46, 6.22 to 37.29, 31.08 to 186.45 or 117.2 to 689.5 kPa; or 0.34 to 2.07, 1.17 to 6.89, 3.45 to 20.68 or 6.89 to 41.37 MPa.) *Zero*—Continuously adjustable elevation or suppression.

Output: 4 to 20 mA dc (up to 600 ohm load impedance with 24 Vdc power, or up to 1650 ohm load impedance with 45 Vdc power), or 10 to 50 mA dc (up to 300 ohm load impedance with 45 Vdc power.) Transmitter also available with HART digital communications.

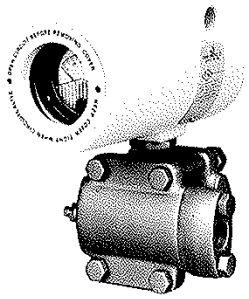
Accuracy Rating: Output signal represents the sensed pressure ± 0.25% of calibrated span

Electrical Classification: CSA or FM listed as explosion proof (Intrinsically safe versions also available)

Temperature Limits: − 20 to 200°F (− 29 to 93°C) amplifier operating; − 40 to 220°F (− 40 to 104°C) sensing element operating with silicone fill; 32 to 160°F (0 to 71°C) sensing element operating with inert fill; − 60 to 250°F (− 51 to 121°C) storage.

Mounting: Mounts on a 2 in. (nominal) pipestand or on a panel

Bulletin Reference: 11.5:1151GP



Type TE1220 Thermocouple Temperature Transmitter

The TE1220 thermocouple temperature transmitter accurately converts millivolt input signals from thermocouples to a 4 to 20 millampere signal. The two-wire Type TE1220 transmitter features modular printed wiring board assembly to handle temperature ranges associated with type J, K, T, E, N, R and S thermocouples.

Available Configuration: Dual compartment, NEMA 4 housing in which zero/span adjustments have been isolated from the electronics

Reference Accuracy: ± 0.1 percent of calibrated span. Includes combined effects of terminal-based conformity, hysteresis, and repeatability

Long Term Stability: ± 0.2 percent of calibrated span for six months

Input Signal: Type J, K, T, E, N, R or S thermocouples

Output Signal Range: 4 to 20 milliamperes dc, two-wire system, reverse polarity protected

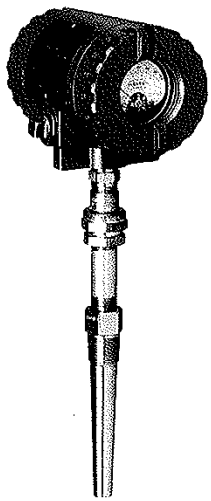
Under/Over Range: 3.8 to 22 milliamperes

Maximum Current Limit: 30 milliamperes at maximum supply voltage

Ripple: 10 millivolt rms (maximum) across a 250-ohm load

Mounting: Direct mounted with thermocouple element and thermowell assembly, or remote mounted on a 2 in. (51 mm) pipestand

Bulletin Reference: 11.6:TE1220



Type TE1220 Thermocouple Transmitter, Direct-mounted

Type TE1240 Resistance Temperature Transmitter

The field-mounted Type 1240 resistance temperature transmitter uses the linearity, sensitivity, and repeatability characteristics of platinum resistance temperature detectors (RTDs) to measure process temperatures and provide analog signal outputs.

The Type 1240 transmitter design includes a bridge circuit to measure the resistance of the RTD element. The transmitter amplifies and converts the resistance signal to a 4 to 20 milliampere analog output which is linear with temperature or resistance (user selectable).

Available Configuration: Dual compartment, NEMA 4 housing in which zero/span adjustments have been isolated from the electronics

Reference Accuracy: ± *0.1 percent of calibrated span*—Linear with respect to resistance. ± *0.2 percent of calibrated span*—Linear with respect to temperature when used with RTDs conforming to DIN 43760 standards. Includes combined effects of terminal-based linearity, hysteresis, and repeatability

Long Term Stability: ± 0.2 percent of calibrated span for six months

Input Signal: Three-wire 100 ohm (standard) or 200 ohm (optional) at 32°F (0°C) platinum resistance elements. (Reference DIN 43760., Alpha = 0.00385 ohm/ohm/°C)

Output Signal Range: 4 to 20 milliamperes dc, two-wire system, reverse polarity protected

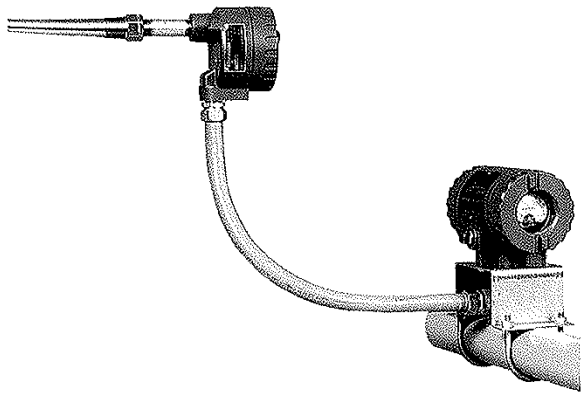
Under/Over Range: 3.8 to 22 milliamperes

Maximum Current Limit: 30 milliamperes at maximum supply voltage

Ripple: 10 millivolt rms (maximum) across a 250-ohm load

Mounting: Direct mounted with thermocouple element and thermowell assembly, or remote mounted on a 2 in. (51 mm) pipestand

Bulletin Reference: 11.6:TE1240



Type TE1240 Resistance Temperature Transmitter, Remote-mounted

546 Electro-Pneumatic Transducer

The Type 546 field-mounted transducer converts standard electronic instrumentation signals into proportional pneumatic signals that are typically used to operate an actuator and valve. Its high-capacity output allows it to operate actuators directly without additional relays or boosters.

Input: 1 to 5 mA dc, 4 to 20 mA dc, 10 to 50 mA dc, or 1 to 9 Vdc

Output: 3 to 15, 6 to 30, or 3 to 27 psig (0.2 to 1.0, 0.4 to 2.1, or 0.2 to 1.9 bar) proportional to input signal

Supply Pressure: 20 psig for 3 to 15 psig output range, or 35 psig for 6 to 30 or 3 to 27 psig output range (1.4 bar for 0.2 to 1.0 bar output range, or 2.4 bar for 0.4 to 2.1 or 0.2 to 1.9 bar output range)

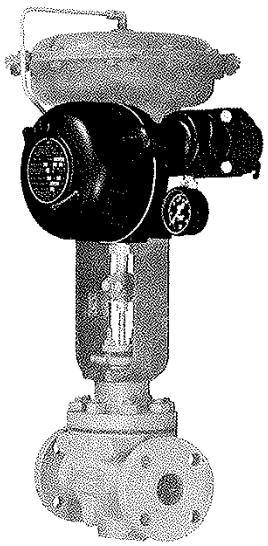
Air Consumption: 0.35 scfm at 20 psig supply pressure; 0.50 scfm at 35 psig supply pressure (0.0094 normal m^3/min at 0°C and 1.01325 bar, absolute, with 1.4 bar supply pressure; 0.013 normal m^3/min at 0°C and 1.01325 bar, absolute, with 2.4 bar supply pressure)

Normal Operating Temperature: − 40 to + 150°F (− 40 to + 66°C) ambient

Classifications: CSA listed as explosion proof for Class I, Group D, Divisions 1 and 2 (Intrinsically safe versions are also available)

Mounting: Mounts on actuator yoke or 2 in. (nominal) pipestand

Bulletin Reference: 13.1:546 or 62.1:546



Type 546 Mounted on Actuator

646 Electro-Pneumatic Transducer

The Type 646 field-mounted transducer uses a patented converter module to change a 4 to 20 milliampere input signal to a proportional 3 to 15 psig (0.2 to 1.0 bar) pneumatic output signal. The converter module uses small parts of minimum mass which are balanced symmetrically around a pivot point at the center of the mass. This balanced arrangement reduces sensitivity to vibration, resulting in a high performance instrument which can be actuator-mounted.

Input: 4 to 20 mA dc

Output: 3 to 15 psig (0.2 to 1.0 bar) direct acting only

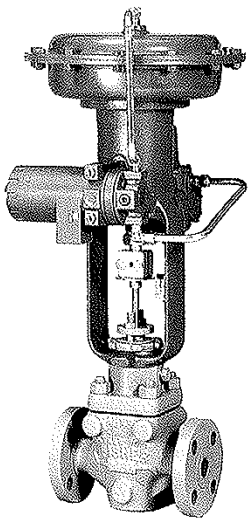
Supply Pressure: *Recommended and Minimum*—20 psig (1.4 bar) *Maximum*—50 psig (3.5 bar)

Air Consumption: Less than 0.05 scfm (0.08 normal m^3/hr) at 20 psig (1.4 bar) supply pressure

Normal Operating Temperature: − 40 to + 160°F (− 40 to 71°C)

Classification: CSA Class I, Division 1, Group D; Class II, Division 1, Groups E,F,G; Class I, Division 2, Groups A,B,C,D; Class II, Division 2, Groups E,F,G

Bulletin Reference: 62.1:646



Type 646 I/P Transducer Mounted to Actuator Yoke

3582i Electro-Pneumatic Positioner

The Type 3582i accurately positions a pneumatically-actuated control valve with respect to a standard electronic instrument signal. The positioner compares the electronic signal with feedback (via a mechanical link) about the valve stem position; it then produces the pneumatic pressure necessary to move the valve stem until the the stem position feedback corresponds with the electronic signal value.

Inputs: *Electrical*—4 to 20 mA dc. *Mechanical*—Stem travel with span adjustable between 7/16 and 4-1/8 in. (4 and 105 mm)

Output: Pneumatic pressure as required by actuator up to 95 percent of supply with either direct or reverse action

Supply Pressure: *Recommended*—5 psi (0.3 bar) above actuator requirement. *Maximum*—50 psig (3.4 bar) or pressure rating of actuator, whichever is lower.

Air Consumption: Maximum of 12 scfh with 20 psig supply; 15.6 scfh with 30 psig supply; and 17 scfh with 35 psig supply (0.32 normal m^3/hr at 0°C and 1.01325 bar absolute with 1.4 bar supply; 0.42 normal m^3/hr at 0°C and 1.01325 bar absolute with 2.1 bar supply; 0.46 normal m^3/hr at 0°C and 1.01325 bar absolute with 2.4 bar supply)

Accuracy: *Independent Linearity*— ± 1% of output signal span. *Hysteresis*—0.5% of span. *Open Loop Gain*—100

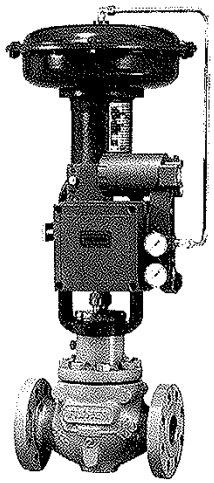
Normal Operating Temperature: − 40 to 160°F (− 40 to 71°C) with standard materials

Typical Construction Materials: *Case and Cover*—Aluminum. *Bellows*—Phosphor bronze. *Flapper and Nozzle*—Stainless steel. *O-rings*—Nitrile

Valve Stem Travel: Maximum of 4-1/8 in. (105 mm) Adjustable to obtain full output with lesser travels

Mounting: Fastens to actuator yoke with mounting plate

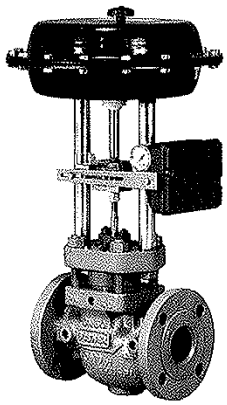
Bulletin Reference: 62.1:3582



Type 3582i Mounted to Actuator Yoke

3661 Electro-Pneumatic Valve Positioner

The Type 3661 accurately positions a pneumatically-actuated control valve with respect to a standard electronic instrument signal. It is used in throttling control applications.



Type 3661 Positioner with Type 1250 Actuator and Design GL Valve Body

Input: 4 to 20 mA dc or split range

Output: Pneumatic pressure as required by the actuator up to full supply pressure

Supply Pressure: *Maximum*—90 psig (6.2 bar); *Recommended*—10% above actuator requirement

Performance: *Independent Linearity*— ± 1% of output span; *Hysteresis*—0.5% of output span; *Deadband*—0.1% of input span; *Repeatability*—0.1%

Adjustments: *Span*—from 0.8 to 2 in. (20 to 50 mm); *Zero*—0 to 100%; *Gain*—0 to 6% PB; *Output volume damping*—Loop dynamic response adjustment

Operating Temperature Limits: − 40 to 176°F (− 40 to 80°C)

Typical Construction Materials: *Case and Cover*—Aluminum with epoxy paint; *Feedback assembly*—Stainless steel; *Flapper and nozzle*—Aluminum; *Input module*—ECO; *Relay metal parts*—Aluminum and stainless steel

Valve Travel Range: 0.8 to 2 in. (20 to 50 mm)

Mounting: Fastens to post style actuator yoke with adjustable clamp

Classification: CSA Class I, Division 2, Groups A,B,C,D

Bulletin Reference: 62.1:3660

3620 Series Electro-Pneumatic Valve Positioners

The 3620 Series current-to-pneumatic valve positioners are utilized with Fisher rotary and globe style control valves to provide a valve position that is proportional to a dc current input signal. They mount directly to the housing of the Type 1052 (rotary output) diaphragm actuator and the Type 1062 (rotary output) and Type 585 (linear output) piston actuators. Actuator-to-positioner feedback linkages are fully protected by the actuator housing against mechanical damage. Positioner bleed air continually purges the positioner housing to protect internal parts against corrosive atmospheres.

Available Configurations: *Type 3620J*—single acting pneumatic valve positioner for Type 1051 and 1052 diaphragm actuators. *Type 3620JP*—double acting pneumatic valve positioner for Type 1061 piston actuator. *Type 3621JP*—double acting pneumatic valve positioner for Type 585 piston actuator.

Input: *Standard*—3 to 15 psig (0.2 to 1.0 bar), 6 to 30 psig (0.4 to 2.0 bar), or split range. *Adjustable*—Zero is continuously adjustable between 3 and 22 psig (0.2 and 1.5 bar)

Output: Pneumatic pressure as required by the actuator (up to full supply pressure)

Supply Pressure: *Recommended*—10% above actuator requirement. *Maximum*—150 psig (10.3 bar)

Air Consumption: *Type 3620J*—10 scfh (0.27 normal m^3/hr) *Types 3620JP and 3621JP*—20 scfh (0.54 normal m^3/hr)

Accuracy: *Independent Linearity*— ± 1% of output span. *Hysteresis*—0.5% of output span. *Deadband*—0.1% of output span.

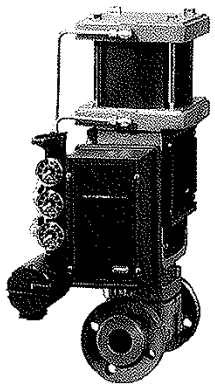
Normal Operating Temperature: − 40 to 180°F (− 40 to 80°C)

Typical Construction Materials: *Case*—Aluminum with electro-deposited epoxy paint. *Cover*—Polyester plastic. *Feedback lever and relay valve plugs and seats*—stainless steel.

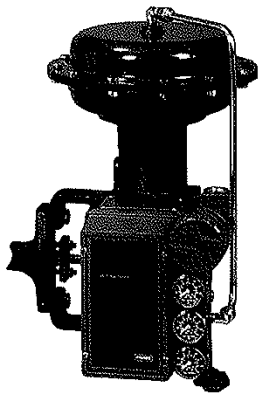
Valve Rotation: 60 and 90 degrees

Mounting: Bolts directly to actuator housing
Classification: CSA Class I, Division 1, Group D; Class II, Division 1, Groups E,F,G; Class I, Division 2, Groups A,B,C,D; Class II, Division 2, Groups E,F,G

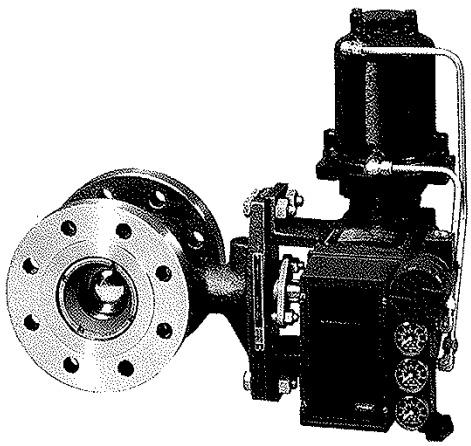
Bulletin Reference: *Types 3620J and 3620JP*—62.1:3620; *Type 3621JP*—61.2:585



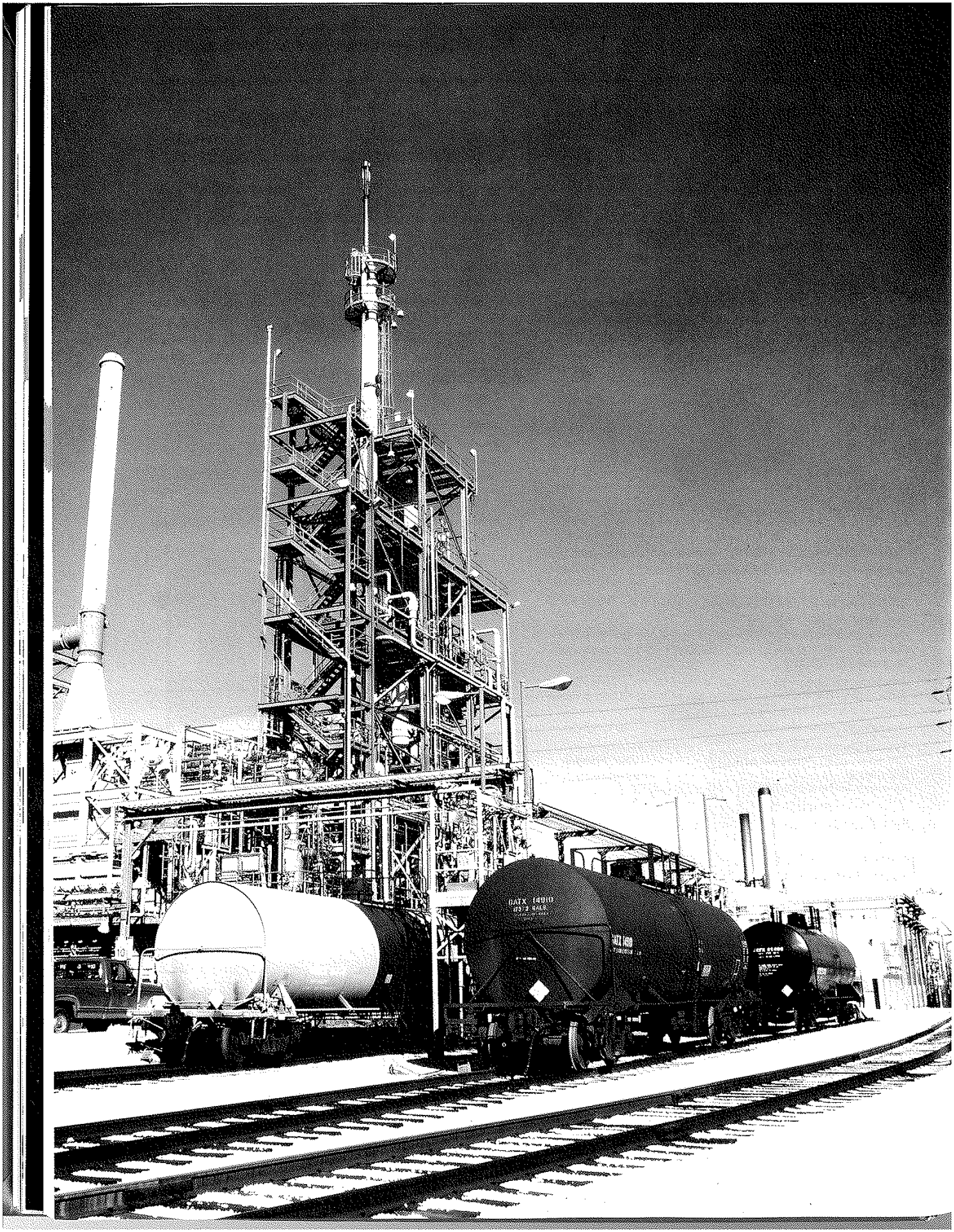
Type 3621JP Current-to-Pressure Positioner Assembly



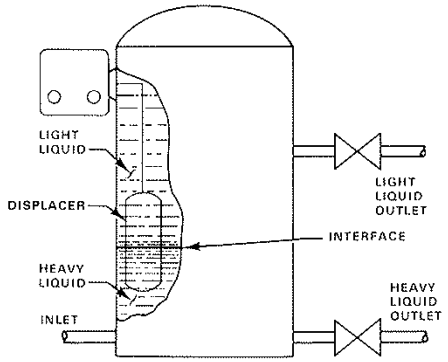
Type 3620J Positioner with Type 1051 Actuator



Type 3620JP Positioner with Type 1061 Actuator and Design V500 Valve


DATX 14010

Contents



Introduction

Fisher Controls manufactures a line of pneumatic field instruments which includes transmitters, controllers, positioners, and switches. The transmitters sense measured variables such as pressure, liquid level, or density and produce a pneumatic output signal that represents the quantity of the measured variable. This pneumatic signal can be sent to indicators and recorders to give direct readings of the measured variable, or the signal can be sent to a controller, which will provide automatic control of the variable.

The controllers receive a transmitter signal that represents a measured variable, or they can directly sense the measure variable. The controllers compare the measured variable with an operator-adjusted set point; they then produce an output signal that strokes a control valve to maintain the measured variable at a value around set point. On-off, one-mode, two-mode, or three-mode controllers are available for control action requirements ranging from simple on-off action to proportional-plus-reset-plus-rate (proportional-plus-integral-plus-derivative) action.

A positioner works with an actuator to position a valve stem with more accuracy than is possible with just an actuator. By receiving a pneumatic input plus a mechanical feedback from the valve stem, the positioner moves the valve stem until the mechanical feedback corresponds with the pneumatic input. In effect, the positioner overcomes actuator and valve friction and decreases the deadband.

Pneumatic instruments are ideal for local control; that is, the transmitters, controllers, and positioners can mount directly on a valve and actuator to comprise a single, field-mounted package that controls a variable more accurately than a regulator.

Level Transmitters & Switches

Description

Level transmitters and switches sense the level of liquids or the level of a liquid-to-liquid interface. The transmitters produce 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) signals that are proportional to level, and the switches turn on and off a pneumatic signal at selected levels.

Liquids

Switches sense level with ball floats or displacers, and the transmitters sense level with displacers. The displacer senses liquid level by remaining relatively stationary. As the level changes, the displacer becomes more or less submerged and creates a buoyancy force that is proportional to level. The transmitter converts this buoyancy force into a proportional pneumatic signal.

Liquid-to-Liquid Interface

Transmitters with displacers can be used in liquid-to-liquid interface applications. When using a displacer, it must be completely submerged at all times as shown in the following figure. With it completely submerged, the displacer senses *interface* level only—it does not sense *liquid* level.

Selection

Familiarize yourself with the following considerations as they apply to your level measurement requirements.

- Composition, specific gravity, static pressure, and temperature of process fluid
- Upper and lower range values of the level
- Output range of transmitter, or switch points of switch
- Ambient temperature
- Mounting method

The following two selection tables will guide you to descriptions of the one or two products which are best suited to your level measurement application. For assistance in making your final selection, contact your Fisher sales office or sales representative.

Liquid Level Switches

INPUT RANGE(1)		TYPE NUMBER	SEE PAGE
Inch	mm		
0.7	18	2100	4-15

1. Values of input range are applicable when measured liquid has specific gravity equal to one. Consult your Fisher sales office or sales representative for available ranges when specific gravity is other than one.

Level Transmitters

MEASURED VARIABLE	INPUT RANGE		INPUT SPAN				SENSING ELEMENT	TYPE NUMBER	SEE PAGE
			Inch		mm				
	Inch	mm	Minimum	Maximum	Minimum	Maximum			
Liquid Level	0 to 14	0 to 356	1.4	14	36	356	Displacer	2500T-249	4-13
	0 to 32	0 to 813	3.2	32	81	813			
	0 to 48	0 to 1219	4.8	48	122	1219			
	0 to 60	0 to 1524	6.0	60	152	1524			
	0 to 72	0 to 1829	7.2	72	183	1829			
	0 to 84	0 to 2133	8.4	84	213	2133			
	0 to 96	0 to 2438	9.6	96	244	2438			
	0 to 108	0 to 2743	10.8	108	274	2743			
	0 to 120	0 to 3048	12.0	120	305	3048			
Liquid-to-Liquid Interface Level	0 to 120	0 to 3048	1.4	120	36	3048	Displacer	2500T-249	4-13

Level Controllers

Description

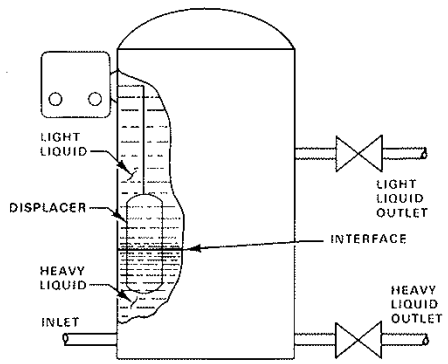
The pneumatic level controllers sense the level of a liquid or a liquid-to-liquid interface, compare the level with a desired value (set point) and produce a pneumatic signal that can operate an actuator and control valve. By operating an actuator and valve, the controller maintains level at a value around set point.

Liquids

Level is sensed by a ball float or a displacer. A ball float senses level by floating on the surface of the liquid. However, a displacer senses level by remaining relatively stationary as level changes; therefore, the displacer becomes more or less submerged as the level changes and creates a buoyancy force that is proportional to level.

Liquid-to-Liquid Interface

Controllers with displacers can be used in liquid-to-liquid interface applications. When using a displacer, it must be completely submerged at all times as shown in the following figure. With it completely submerged, the displacer senses interface level only—it does not sense liquid level.



Controller Action

Depending upon the specific type selected, the controller produces a pneumatic output signal resulting from one of several available control actions. Refer to the following descriptions that define the control actions available in our level controllers; then, select a controller from the following two tables.

On-Off—An on-off controller has two discrete output values; either fully on or fully off. One discrete output value is obtained when the input exceeds the upper switching point. This discrete output value remains constant until the input decreases below the lower switching point, at which time the controller switches to its other discrete value. The output does not change again until the input passes through the upper switching point. The area between the two switching points is called the differential gap and is expressed in percent of input range. Intermittent bleed indicates that the controller consumes supply air only during the transition from fully on to fully off or vice versa. Continuous bleed indicates that the controller continually consumes supply air.

Proportional-Only—A proportional-only controller has a continuously variable output that can be used to throttle a control valve and actuator. Proportional-only action in a level controller will maintain process level within an adjustable band. The width of this band is expressed in percent of input range.

Proportional-Plus-Reset—Reset action in a level controller attempts to eliminate the offset between desired and actual process level. This offset is unavoidable when using a proportional-only controller. Because reset action reduces offset, a proportional-plus-reset controller maintains the process level about a point rather than within a band.

Selection

Familiarize yourself with the following considerations as they apply to your level control needs.

- Composition, specific gravity, static pressure, and temperature of the process fluid
- Upper and lower range values of the level being controlled
- Controller output range
- Ambient temperature
- Controller mounting method

The following two selection tables will guide you to descriptions of the one or two products which are best suited to your level control application. For assistance in making your final selection, contact your Fisher sales office or sales representative.

Level Controllers for Liquid Level

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND		TYPE NUMBER	REFER TO
Inch	mm		Minimum	Maximum		
0 to 2[1]	0 to 51[1]	On-off, continuous bleed	12.5	100	2900-244	2900-244V to 2901-279VBU, Page 4-20
		On-off, intermittent bleed	12.5	100	2901-244	
0 to 4[1]	0 to 102[1]	On-off, continuous bleed	17.5	17.5	2100	Page 4-15
0 to 14 or 0 to 32 or 0 to 48 or 0 to 60 or 0 to 72 or 0 to 84 or 0 to 96 or 0 to 108 or 0 to 120	0 to 356 or 0 to 813 or 0 to 1219 or 0 to 1524 or 0 to 1829 or 0 to 2134 or 0 to 2438 or 0 to 2743 or 0 to 3048	On-off, intermittent bleed	25	40	2503-249	2500-249 to 2503-249, Page 4-18
		Proportional-only	10	100	2500-249	Page 4-18
		Proportional-plus-Reset	20	200	2502-249	2500-249 to 2503-249 Page 4-18
0 to 60[1] or 0 to 138[1] or 0 to 277[1] or 0 to 415[1] or 0 to 554[1] or 0 to 831[1]	0 to 1524[1] or 0 to 3505[1] or 0 to 7036[1] or 0 to 10,541[1] or 0 to 14,072[1] or 0 to 21,107[1]	Proportional-only	6	100	4152K	4150K & 4160K Series, Page 4-22
		Proportional-plus-Reset	6	100	4162K	4150K & 4160K Series, Page 4-22
As defined by a pneumatic level transmitter that produces a 3 to 15 or 6 to 30 psig output signal	As defined by a pneumatic level transmitter that produces a 0.2 to 1.0 or 0.4 to 2.0 bar output signal	Proportional-only	10	200	2506	2506 & 2516, Page 4-19
		Proportional-plus-Reset	10	200	2516	

1. Values of input range are applicable when measured liquid has specific gravity equal to one. Consult your Fisher sales office or sales representative for available ranges when specific gravity is other than one.

Level Controllers for Liquid-to-Liquid Interface

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND		TYPE NUMBER	REFER TO
Inch	mm		Minimum	Maximum		
0 to 2	0 to 51	On-off, continuous bleed	12.5	100	2900-244	2900-244V to 2901A-279VBU, Page 4-20
		On-off, intermittent bleed	12.5	100	2901-244	
0 to 14 or 0 to 32 or 0 to 48 or 0 to 60 or 0 to 72 or 0 to 84 or 0 to 96 or 0 to 108 or 0 to 120	0 to 356 or 0 to 813 or 0 to 1219 or 0 to 1524 or 0 to 1829 or 0 to 2134 or 0 to 2438 or 0 to 2743 or 0 to 3048	On-off, continuous bleed	20	100	2500S-249	2500-249 to 2503-249, Page 4-18
		On-off, intermittent bleed	25	43	2503-249	
		Proportional-only	10	100	2500-249	Page 4-18
		Proportional-plus-Reset	20	200	2502-249	2500-249 to 2503-249, Page 4-18
As defined by a pneumatic level transmitter that produces a 3 to 15 or 6 to 30 psig output signal	As defined by a pneumatic level transmitter that produces a 0.2 to 1.0 or 0.4 to 2.0 bar output signal	Proportional-only	10	200	2506	2506 & 2516, Page 4-19
		Proportional-plus-Reset	10	200	2516	

Pressure Transmitters

Description

Pressure transmitters sense the pressure of a process fluid (gas, liquid, steam, etc.) and produce a pneumatic signal that represents the quantity of the sensed pressure. Bourdon tubes, bellows, and diaphragms are used in the transmitters to sense the various pressure ranges. Typically, bellows are used to sense low-range pressures of up to 30 psig (2.0 bar), Bourdon tubes are used to sense high-range pressure of up to 20,000 psig (1379 bar), and two opposed bellows are used to sense differential pressures.

Pressures sensed by the transmitters fall into four categories. Following is a brief description of each.

Gauge Pressure—Pressure measured with respect to atmospheric pressure. Gauge pressure is a positive pressure; i.e., it is greater than atmospheric pressure.

Vacuum—Pressure measured with respect to atmospheric pressure. Vacuum is a negative pressure; i.e., it is less than atmospheric pressure.

Compound Pressure—Pressure measured with respect to atmospheric pressure. Compound pressure can be either positive or negative; i.e., it can be greater than atmospheric pressure, pass through zero, and be less than atmospheric pressure.

Differential Pressure—The result of the difference between two pressures.

Selection

Familiarize yourself with the following application considerations as they apply to your pressure measurement application:

- Composition and temperature of the process fluid
- Upper and lower range values of the sensed pressure
- Transmitter output range
- Ambient temperature
- Transmitter mounting method

The following selection table will guide you to product descriptions that describe pressure transmitters which are best suited to your needs. To help you make your final selection, contact your Fisher sales office or sales representative.

Pressure Transmitters

PRESSURE MEASUREMENT							TYPE NUMBER	SEE PAGE
Category	Input Range		Input Span					
			Minimum	Maximum	Minimum	Maximum		
Gauge	0 to 30 psig	0 to 2.0 bar	3.6 inch wc	30 psig	0.009 bar	2.0 bar	4158K	4-14
	0 to 20,000 psig	0 to 1379 bar	1.8 psig	20,000 psig	0.1 bar	1379 bar	4157K	4-14
Vacuum	30 inch Hg vac. to 0 psig	1.0 bar vac. to 0 bar	3.6 inch wc	30 inch Hg	0.009 bar	1.0 bar	4158K	4-14
Compound	30 inch Hg vac. to +15 psig	1.0 bar vac. to +1.0 bar	3.6 inch wc	60 inch Hg	0.009 bar	2.0 bar	4158K	4-14
Differential	0 to 30 psi	0 to 2.0 bar	4.8 inch wc	30 psi	0.01 bar	2.0 bar	4155K	4-14

Pressure Controllers

Description

Pressure controllers sense the pressure of liquids or gases, compare the pressure with a desired value (set point), and produce a pneumatic signal that can operate an actuator and control valve. By operating an actuator and valve, the controller maintains pressure at a value around set point.

To sense pressure, the controllers contain Bourdon tubes, bellows, or diaphragms. Typically, bellows are used to sense low-range pressures of up to 30 psig (2.0 bar). Bourdon tubes are used to sense high-range pressure of up to 20,000 psig (1379 bar), and diaphragms are used to sense differential pressures.

Pressures sensed by the controllers fall into four categories. Following is a brief description of each.

Gauge Pressure—Pressure measured with respect to atmospheric pressure. Gauge pressure is a positive pressure; i.e., it is greater than atmospheric pressure.

Vacuum—Pressure measured with respect to atmospheric pressure. Vacuum is a negative pressure; i.e., it is less than atmospheric pressure.

Compound Pressure—Pressure measured with respect to atmospheric pressure. Compound pressure can be either positive or negative; i.e., it can be greater than atmospheric pressure, pass through zero, and be less than atmospheric pressure.

Differential Pressure—The result of the difference between two pressures.

Depending on the specific type selected, the controller produces a pneumatic output signal resulting from one of several available control actions. Refer to the following descriptions that define the control actions available in our pressure controllers; then, select a controller from the following tables.

On-Off—An on-off controller has two discrete output values; either fully on or fully off. One discrete output value is obtained when the input exceeds the upper switching point. This discrete output value remains constant until the input decreases below the lower switching point, at which time the controller output switches to its other discrete output value. The output does not change again until the input passes through the upper switching point. The area between the two switching points is called the differential gap and is expressed in percent of input range. Intermittent bleed indicates that the controller consumes supply air only during the transition from fully on to fully off or vice versa. Continuous bleed indicates that the controller continually consumes supply air.

Proportional-Only—A proportional-only controller has a continuously variable output that can be used to throttle a control valve and actuator. Proportional-only action in a pressure controller will maintain process pressure within an adjustable band. The width of this band is expressed in percent of input range.

Proportional-Plus-Reset—Reset action in a pressure controller attempts to eliminate the offset between desired and actual process pressure. This offset is unavoidable when using a proportional-only controller. Because reset action reduces offset, a proportional-plus-reset controller maintains the process pressure about a point rather than within a band.

Proportional-Plus-Reset-Plus-Rate—The addition of rate action allows the controller to react rapidly to sudden changes in the actual process pressure. This minimizes the time required for the controller to return the process pressure to the set point.

In addition, Fisher controllers are available in either non-indicating or indicating styles. The indicating style controller features a large, easily read display with red process and set point indicators being highly visible against a white-on-black scale.

Selection

Familiarize yourself with the following considerations as they apply to your pressure controller needs.

- Composition and temperature of the process fluid
- Upper and lower range values of the sensed pressure
- Control action
- Controller output range
- Ambient temperature
- Controller mounting method

The following selection tables will guide you to descriptions of the one or two products which are best suited to your pressure control application. For assistance in making your final selection, contact your Fisher sales office or sales representative.

Gauge Pressure Controllers — Non-Indicating

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
0 to 60 inch wc	0 to 149 mbar	On-off, continuous bleed	15	100	4152KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4152K	
		Proportional-plus-Reset	6	100	4162K	
0 to 5 psig	0 to 0.3 bar	On-off, continuous bleed	5	25	4103Z	4100Z Series, Page 4-21
		Proportional-only	3	65	4106Z	
0 to 10 psig	0 to 0.7 bar	On-off, continuous bleed	15	100	4152KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4152K	
		Proportional-plus-Reset	6	100	4162K	
0 to 13 psig	0 to 0.9 bar	On-off, continuous bleed	5	25	4103Z	4100Z Series, Page 4-21
		Proportional-only	2	65	4106Z	
0 to 15 psig	0 to 1.0 bar	On-off, continuous bleed	5	25	4103Z	
			15	100	4152KS	4150K & 4160K Series, Page 4-22
		Proportional-only	2	65	4106Z	4100Z Series, Page 4-21
			6	100	4152K	4150K & 4160K Series, Page 4-22
		Proportional-plus-Reset	6	100	4162K	
3 to 15 psig	0.2 to 1.0 bar	Proportional-only	10	200	2506	2506 & 2516, Page 4-19
		Proportional-plus-Reset	10	200	2516	
0 to 20 psig	0 to 1.4 bar	On-off, continuous bleed	15	100	4152KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4152K	
		Proportional-plus-Reset	6	100	4162K	
0 to 25 psig	0 to 1.7 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
			5	25	4103Z	
		Proportional-only	2	50	4100Z	
			2.8	65	4106Z	

- Continued -

Gauge Pressure Controllers — Non-Indicating (Continued)

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
0 to 30 psig	0 to 2.0 bar	On-off, continuous bleed	15	100	4150KS	4150K & 4160K Series, Page 4-22
					4152KS	
		Proportional-only	6	100	4150K	
					4152K	
		Proportional-plus-Reset	6	100	4160K	
					4162K	
6 to 30 psig	0.4 to 2.0 bar	Proportional-only	10	200	2506	2506 & 2516, Page 4-19
		Proportional-plus-Reset	10	200	2516	
0 to 50 psig	0 to 3.4 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
		Proportional-only	2	50	4100Z	
0 to 60 psig	0 to 4.1 bar	On-off, continuous bleed	15	100	4150KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	
0 to 100 psig	0 to 6.9 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
			15	100	4150KS	4150K Series, Page 4-22
		Proportional-only	2	50	4100Z	4100Z Series, Page 4- 21
			6	100	4150K	4150K & 4160K Series, Page 4-22
		Proportional-plus-Reset	6	100	4160K	
0 to 200 psig	0 to 13.8 bar	On-off, continuous bleed	15	100	4150KS	
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	
0 to 250 psig	0 to 17.2 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
		Proportional-only	2	50	4100Z	
0 to 300 psig	0 to 20.7 bar	On-off, continuous bleed	15	100	4152KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	
0 to 500 psig	0 to 34.5 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
		Proportional-only	2	50	4100Z	
0 to 600 psig	0 to 41.4 bar	On-off, continuous bleed	15	100	4150KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	
0 to 1000 psig	0 to 68.9 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
			15	100	4150KS	4150K Series, Page 4-22
		Proportional-only	2	50	4100Z	4100Z Series, Page 4-21
			6	100	4150K	4150K & 4160K Series, Page 4-22
		Proportional-plus-Reset	6	100	4160K	
0 to 1500 psig	0 to 103 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
			15	100	4150KS	4150K Series, Page 4-22
		Proportional-only	2	50	4100Z	4100Z Series, Page 4-21
			6	100	4150K	4150K & 4160K Series, Page 4-22
		Proportional-plus-Reset	6	100	4160K	

- Continued -

Gauge Pressure Controllers — Non-Indicating (Continued)

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
0 to 2500 psig	0 to 172 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
		Proportional-only	2	50	4100Z	
0 to 3000 psig	0 to 207 bar	On-off, continuous bleed	15	100	4150KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	
0 to 5000 psig	0 to 345 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
			15	100	4150KS	4150K Series, Page 4-22
		Proportional-only	2	50	4100Z	4100Z Series, Page 4-21
			6	100	4150K	4150K & 4160K Series, Page 4-22
		Proportional-plus-Reset	6	100	4160K	
0 to 7500 psig	0 to 517 bar	On-off, intermittent bleed	5	85	4102Z	4100Z Series, Page 4-21
			10	25	4104Z	
		On-off, continuous bleed	10	25	4101Z	
		Proportional-only	2	50	4100Z	
0 to 8000 psig	0 to 552 bar	On-off, continuous bleed	15	100	4150KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	
0 to 10,000 psig	0 to 689 bar	On-off, continuous bleed	15	100	4150KS	
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	
0 to 15,000 psig	0 to 1034 bar	On-off, continuous bleed	15	100	4150KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	
0 to 20,000 psig	0 to 1379 bar	On-off, continuous bleed	15	100	4150KS	
		Proportional-only	6	100	4150K	
		Proportional-plus-Reset	6	100	4160K	

Gauge Pressure Controllers — Indicating

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
0 to 30 psig in seven ranges	0 to 2 bar in seven ranges	On-off, continuous bleed	5	100	4195S	4195 Series, Page 4-23
		Proportional-only	5	500	4195A	
		Proportional-plus-Reset			4195B	
		Proportional-plus-Reset-plus-Rate			4195C	

Vacuum Controllers — Non-Indicating

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
60 inch wc vac. to 0 psig	149 mbar vac. to 0 mbar	On-off, continuous bleed	15	100	4152KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4152K	
		Proportional with remote set	6	100	4153K	
		Proportional-plus-Reset	6	100	4162K	
10 inch Hg vac. to 0 psig	339 mbar vac. to 0 mbar	On-off, continuous bleed	15	100	4152KS	
		Proportional-only	6	100	4152K	
		Proportional with remote set	6	100	4153K	
		Proportional-plus-Reset	6	100	4162K	
30 inch Hg vac. to 0 psig	1.0 bar vac. to 0 bar	On-off, continuous bleed	15	100	4152KS	
		Proportional-only	6	100	4152K	
		Proportional with remote set	6	100	4153K	
		Proportional-plus-Reset	6	100	4162K	

Vacuum Controllers — Indicating

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
− 30 to 0 inch Hg in four ranges	− 400 to 0 mbar in five ranges	On-off, continuous bleed	5	100	4195S	4195 Series, Page 4-23
		Proportional-only	5	500	4195A	
		Proportional-plus-Reset			4195B	
		Proportional-plus-Reset-plus-Rate			4195C	

Compound Pressure Controllers — Non-Indicating

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
30 inch wc vac. to + 30 inch wc	75 mbar vac. to + 75 mbar	On-off, continuous bleed	15	100	4152KS	4150K & 4160K Series, Page 4-22
		Proportional-only	6	100	4152K	
		Proportional with remote set	6	100	4153K	
		Proportional-plus-Reset	6	100	4162K	
15 inch Hg vac. to + 7.5 psig	0.5 bar vac. to + 0.5 bar	On-off, continuous bleed	15	100	4152KS	
		Proportional-only	6	100	4152K	
		Proportional with remote set	6	100	4153K	
		Proportional-plus-Reset	6	100	4162K	
30 inch Hg vac. to + 15 psig	1.0 bar vac. to + 1.0 bar	On-off, continuous bleed	15	100	4152KS	
		Proportional-only	6	100	4152K	
		Proportional with remote set	6	100	4153K	
		Proportional-plus-Reset	6	100	4162K	

Compound Pressure Controllers — Indicating

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
− 30 inch Hg to 10 psig in six ranges	− 175 mbar to 1 bar in eight ranges	On-off, continuous bleed	5	100	4195S	4195 Series, Page 4-23
		Proportional-only	5	500	4195A	
		Proportional-plus-Reset			4195B	
		Proportional-plus-Reset-plus-Rate			4195C	

Differential Pressure Controllers — Non-Indicating

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
0 to 80 inch wc	0 to 199 mbar	Proportional-only	6	100	4154K	Page 4-24
		Proportional with remote set	6	100	4159K	Page 4-24
		Proportional-plus-Reset	6	100	4164K	Page 4-24
0 to 10 psi	0 to 0.7 bar	Proportional-only	6	100	4154K	Page 4-24
		Proportional with remote set	6	100	4159K	Page 4-24
		Proportional-plus-Reset	6	100	4164K	Page 4-24
0 to 20 psi	0 to 1.4 bar	Proportional-only	6	100	4154K	Page 4-24
		Proportional with remote set	6	100	4159K	Page 4-24
		Proportional-plus-Reset	6	100	4164K	Page 4-24
0 to 30 psi	0 to 2.0 bar	Proportional-only	6	100	4154K	Page 4-24
		Proportional with remote set	6	100	4159K	Page 4-24
		Proportional-plus-Reset	6	100	4164K	Page 4-24

Differential Pressure Controllers — Indicating

INPUT RANGE		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
			Minimum	Maximum		
0 to 100 inch wc in five ranges; 0 to 75 psi in three ranges	0 to 250 mbar in five ranges; 0 to 5.2 bar in three ranges	On-off, continuous bleed	1	100	4194HS	4194H Series, Page 4-25
		Proportional-only	5	500	4194HA	
		Proportional-plus-Reset			4194HB	
		Proportional-plus-Reset-plus-Rate			4194HC	
0 to 30 psid in four ranges	0 to 2 bar in four ranges	On-off, continuous bleed	1	100	4194S	4194 Series, Page 4-25
		Proportional-only	5	500	4194A	
		Proportional-plus-Reset			4194B	
		Proportional-plus-Reset-plus-Rate			4194C	

Temperature Controllers

Description

A temperature controller senses the temperature of liquids or gases, compares the temperature with a desired value (set point), and produces a pneumatic signal that can operate an actuator and control valve. By operating an actuator and valve, the controller maintains temperature at a value around set point.

To sense temperature, the controllers use a gas-filled temperature bulb immersed in the process fluid. The temperature bulb is connected by a capillary tube to a Bourdon tube in the controller.

Depending on the specific type selected, the controller produces a pneumatic output signal resulting from one of several available control actions. Refer to the following descriptions that define the control actions available in our temperature controllers; then, select a controller from the following tables.

On-Off—An on-off controller has two discrete output values; either fully on or fully off. One discrete output value is obtained when the input exceeds the upper switching point. This discrete output value remains constant until the input decreases below the lower switching point, at which time the controller output switches at its other discrete output value. The output does not change again until the input passes through the upper switching point. The area between the two switching points is called the differential gap and is expressed in percent of input range. Continuous bleed indicates that the controller continually consumes supply air.

Proportional-Only—A proportional-only controller has a continuously variable output that can be used to throttle a control valve and actuator. Proportional-only action in a controller will maintain process temperature within an adjustable band. The width of this band is expressed in percent of input range.

Proportional-Plus-Reset—Reset action in a temperature controller attempts to eliminate the offset between desired and actual process temperature. This offset is unavoidable when using a proportional-only controller. Because reset action reduces offset, a proportional-plus-reset controller maintains the process temperature about a point rather than within a band.

Selection

Familiarize yourself with the following application considerations as they apply to your temperature controlling requirements.

- Composition and pressure of the process fluid
- Upper and lower range values of the sensed temperature
- Control action
- Controller output range
- Ambient temperature
- Controller mounting method

Refer to the product descriptions provided in the table below. For assistance in making your final selection, contact your Fisher sales office or sales representative.

Temperature Controllers — Non-Indicating and Indicating

INPUT RANGE(1)		CONTROL ACTION	PERCENT PROPORTIONAL BAND OR DIFFERENTIAL GAP		TYPE NUMBER	REFER TO
°F	°C		Minimum	Maximum		
Temperature Controllers — Non-Indicating						
0 to 1000°F in 13 ranges	−18 to 538°C in 13 ranges	On-off, continuous bleed	15	100	4156KS	4156K and 4166K Series, Page 4-26
		Proportional-only	3	100	4156K	
		Proportional-plus-Reset	6	200	4166K	
		Proportional-plus-Reset with Anti-Reset Windup	6	200	4166KF	
Temperature Controllers — Indicating						
−100 to 600°F in 14 ranges	−75 to 300°C in 12 ranges	On-off, continuous bleed	5	100	4196S	4196 Series, Page 4-27
		Proportional-only	5	500	4196A	
		Proportional-plus-Reset			4196B	
		Proportional-plus-Reset-plus-Rate			4196C	
−100 to 1000°F in 16 ranges	0 to 500°C in 9 ranges	Proportional-plus-Reset	4	400	5190	5190 Series, Page 4-28
					5190S	
		Proportional-plus-Reset-plus-Rate	4	400	5190	
					5190S	

1. Sensing element ranges are in °F. Equivalents of those ranges in °C are shown for convenience only.

Density Transmitters & Controllers

Description

These transmitters and controllers sense the density (specific gravity) of liquids. The transmitters produce a 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) signal that is proportional to density, and the controller produces a pneumatic signal that typically throttles a valve to regulate density.

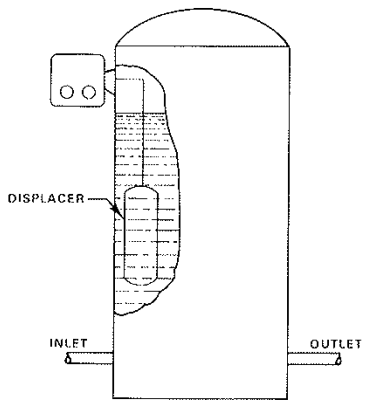
The transmitters and controllers sense density with displacers. Displacers are sensitive to small density changes and are used when small input spans are required. Also, displacers can be easily compensated for temperature variations.

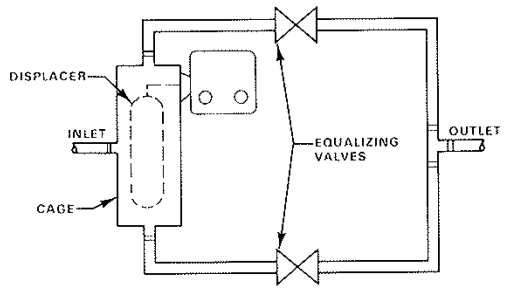
When using a displacer, it must be completely submerged at all times as shown below. The buoyancy force changes only when the liquid density changes; it does not change when liquid level varies.

Density of a liquid through a pipe can be measured as shown in the following figure. A displacer is placed inside a cage that has an inlet near its center section. The liquid leaves the cage through the top and bottom connections and flows through the two equalizing valves that have a two-fold purpose. They keep the displacer totally immersed in the liquid, and they equalize the flow out of the top and bottom connections of the cage, thereby canceling the effects of liquid velocity on the displacer.

As previously mentioned, a density transmitter produces a signal that represents density. Its output can be used as an input signal to devices such as indicators and recorders. A density controller, however, produces a signal that throttles a valve to control density. The accuracy that the controller can provide depends on the type of control action selected. Refer to the following descriptions that define the control actions available in our density controllers; then, select a controller from the appropriate table below.

On-Off—An on-off controller has two discrete output values; either fully on or fully off. One discrete output value is obtained





when the input exceeds the upper switching point. This discrete output value remains constant until the input decreases below the lower switching point, at which time the controller output switches at its other discrete output value. The output does not change again until the input passes through the upper switching point. The area between the two switching points is called the differential gap and is expressed in percent of input range. Continuous bleed indicates that the controller continually consumes supply air.

Proportional-Only—A proportional-only controller has a continuously variable output that can be used to throttle a control valve and actuator. Proportional-only action in a controller will maintain process density within an adjustable band. The width of this band is expressed in percent of input range.

Proportional-Plus-Reset—Reset action in a density controller attempts to eliminate the offset between desired and actual process density. This offset is unavoidable when using a proportional-only controller. Because reset action reduces offset, a proportional-plus-reset controller maintains the process density about a point rather than within a band.

Selection

Familiarize yourself with the following applications considerations as they apply to your density measurement requirements.

- Composition, specific gravity, static pressure, and temperature of the process
- Upper and lower range values of the density being sensed
- Output signal range
- Direct or reverse acting
- Ambient temperature
- Mounting methods

Refer to the product descriptions provided in the table below. For assistance in making your final selection, contact your Fisher sales office or sales representative.

Density Transmitter

Minimum Input Span	Sensing Element	Minimum Span Setting	Type Number	See Page
$\Delta SG = \frac{0.5 \times SPAN}{V}$ where, ΔSG = Minimum density span in specific gravity V = Displacer volume in cubic inches Span = Minimum span as defined in the third column of this table $\Delta SG = \frac{8.19 \times SPAN}{V}$ where, ΔSG = Minimum density span in specific gravity V = Displacer volume in cubic centimeters Span = Minimum span as defined in in third column of this table Example: Transmitter with 48 inch long by 3 inch diameter (1219 mm long by 76 mm diameter) displacer, which has a volume of 339 inch^3 (5560 cm^3), produces 100% output change when the input spans 0.03 specific gravity.	Displacer	20	2500T-249	4-13

Density Controllers

Minimum Input	Sensing Element	Control Action	Minimum Proportional Band Setting	Type Number	Refer To
$\Delta SG = \frac{0.5 \times PB}{V}$ where, ΔSG = Minimum density span in specific gravity V = Displacer volume in cubic inches PB = Minimum proportional band setting as defined in fourth column of table $\Delta SG = \frac{8.19 \times PB}{V}$ where, ΔSG = Minimum density span in specific gravity V = Displacer volume in cubic centimeters PB = Minimum proportional band setting as defined in fourth column of table Example: Controller with 48 inch long by 3 inch diameter (1219 mm long by 76 mm diameter) displacer, which has a volume of 339 inch^3 (5560 cm^3), produces 100% output change when the input spans 0.03 specific gravity	Displacer	On-off, intermittent bleed	20	2503-249	Page 4-18
		Proportional-only	20	2500-249	Page 4-18
		Proportional-plus-Reset	20	2502-249	2500-249 to 2503-249, Page 4-18

Valve Stem Position Transmitters

This device normally mounts on a valve and actuator to sense valve stem travel. The transmitter converts stem travel into standard pneumatic signals that can be sent to instruments such as indicators or controllers. For additional information, refer to 3583 Series Motion Transmitter on page 6-43.

Valve Stem Positioners

A positioner mounts on a valve and actuator to accurately position the valve stem according to a pneumatic signal typically received from a controller. For additional information, refer to 3582 Series Valve Positioner on page 4-16, 3610 Series Valve Positioner on page 4-16, and 3660 Series Valve Positioner on page 4-17.

Instrument Air Products

The following table lists products typically associated with the air supply system for pneumatic instrumentation.

Instrument Air Products

Product	Description	Type Number	See Page
Regulators	Reduces an uncontrolled pressure to a constantly-controlled pressure to operate pneumatic instrumentation	64 Series	7-23
		67 Series	7-24
Filters for removing particles and moisture from operating medium for pneumatic instruments	Aluminum oxide element in a housing with a maximum rating of 175 psig at 150°F (12.1 bar at 66°C)	361	10-3
	Fine grain felt element in a housing with a maximum rating of 250 psig at 150°F (17.2 bar at 66°C)	254	10-2
	Bonded felt element in a housing with a maximum rating of 3600 psig at 150°F (248 bar at 66°C)	254E or 254F	10-2

Accessories for Transmitters & Controllers

The following table lists accessories typically utilized with pneumatic transmitters and controllers.

Accessories for Transmitters and Controllers

Product	Description	Type Number	Refer To
Bourdon tube protectors	Isolates corrosive or clogging process fluids from Bourdon tubes in our pneumatic transmitters and controllers	SB or SG	Page 4-29
Pressure gauges	2-1/2 inch (64 mm) diameter gauges used to indicate pressure in ranges up to 2000 psig	J500 Series	Page 7-53
Glass sight gauges	Attaches to the side of any level controller or transmitter using a 249 Series caged displacer; the sight gauge provides a visual indication of level within the displacer cage	Jerguson Gauges	Page 4-29

2500T-249 & 2500TC-249 Level-Trol® Transmitters

These transmitters sense the level of a liquid in a vessel and produce a standard 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) pneumatic output signal when the input span is as small as 2.8 inches or as large as 120 inches (71 or 3048 mm). Because a displacer is used as the primary sensing element, these transmitters may also be used to measure the level of a liquid-to-liquid interface or the density of a liquid. The transmitters each have the displacer located in an external cage that mounts to the outside of a vessel, or the transmitters mount directly to the outside of a vessel (without cage), and the displacer operates inside a vessel. The two transmitter types are identical except the Type 2500T-249 has a mechanical level indicator.

Input: *For Liquid Level or Liquid-to-Liquid Interface Level Measurements*—Ranges are determined by displacer length; nine standard displacers are available for ranges from 0 to 14 in. up to 0 to 120 in. (to 356 mm up to 0 to 3048 mm). When using a standard volume displacer, the span is adjustable between 20 and 100% of displacer length. Zero is adjustable to position the input span anywhere on the displacer. *For Density Measurements*—Displacer volume determines upper range limit of the change in density. Span is adjustable between 20 and 100% of the upper range limit, and zero is adjustable between 0 and 80% of the upper range limit.

Output: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Supply Pressure Requirements: 20 psig for 3 to 15 psig output. 35 psig for 6 to 30 psig output. (1.4 bar for 0.2 to 1.0 bar output. 2.4 bar for 0.4 to 2.0 bar output)

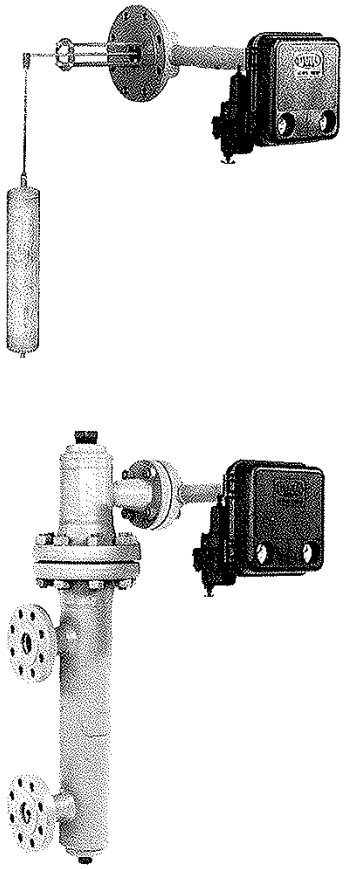
Air Consumption: Maximum of 27 scfh with 20 psig supply and 42 scfh with 35 psig supply (0.72 normal m³/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

Normal Operating Temperature: *Ambient*— − 40 to + 160°F (− 40 to 71°C.) *Process*—Up to 1100°F (593°C.) Temperatures listed are with standard materials; depending upon the process and ambient temperatures, a heat insulator may be required.

Typical Materials of Process Wetted Parts: *Cage, where used, and Cage Head*—Cast iron, steel or alloy steel, depending on rating. *Displacer*—304 stainless steel. *Torque Tube*—K-Monel*. *Other Wetted Parts*—316 stainless steel

Mounting: *Transmitter with Cage*—1-1/2 and 2 in. screwed or 1-1/2 and 2 in. Classes 125 through 2500 flanged connections. The cage mounts to side of vessel with two connections that may be on the top and bottom, on the side, or in any combination of top, bottom or side of the cage. *Transmitter without Cage*—3 through 8 in. Classes 125 through 2500 flanged connections. Flange mounts to top or side of vessel with displacer inside vessel

Bulletin Reference: 34.2:2500



Typical 2500T-249 Series

*Trademark of International Nickel Co.

4155K Wizard® II Differential Pressure Transmitter

This transmitter senses differential pressure utilizing a bellows and produces a standard 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) pneumatic output signal when the input span is as small as 4.8 inches water column (11.9 mbar) or as large as 30 psi (2.0 bar.) This transmitter may be used in gas, steam, and liquid applications.

Input: *Type*—Differential pressure. *Ranges*—Equal to standard bellows ranges as follows: 0 to 80 in. wc and 0 to 10, to 20 and to 30 psi (0 to 0.2, and 0 to 0.7, to 1.4, and to 2.0 bar.) *Span*—Adjustable between 6 and 100% of bellows range. *Zero*—Continuously adjustable to position span of less than 100% anywhere within the bellows range.

Output: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Supply Pressure Requirements: 20 psig for 3 to 15 psig output. 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output. 2.4 bar for 0.4 to 2.0 bar output)

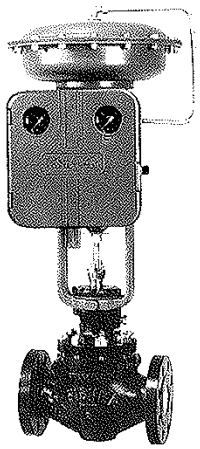
Air Consumption: Maximum of 27 scfh with 20 psig supply and 42 scfh with 35 psig supply (0.7 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply; and 1.1 normal m^3/hr at 0°C and 1.013215 bar, absolute, with 2.4 bar supply)

Normal Operating Temperature: − 40 to 160°F (− 40 to 71°C) with standard materials

Typical Materials of Process Wetted Parts: *Bellows*—Brass or stainless steel, depending on the range. *Bourdon Tube*—Brass, steel, or stainless steel, depending on the range. *Tubing*—Copper or stainless steel

Mounting: Actuator yoke, panel, wall, or pipestand

Bulletin Reference: 34.3:4150K



4157K & 4158K Wizard® II Gauge Pressure Transmitters

These transmitters sense gauge pressure with either a bellows or a Bourdon tube and produce a standard 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) pneumatic output signal. Gauge pressure can mean a positive pressure, a vacuum, or a compound pressure (pressure that ranges from a vacuum to a positive pressure). Depending on the transmitter type and its sensing element range, the input span may be as small as 3.6 inches water column (9.0 mbar) or as large as 20,000 psig (1379 bar.) These transmitters may be used in gas, steam, and liquid applications. The table below lists the transmitters and the sensing element ranges and styles.

TYPE NUMBER	SENSING ELEMENT			
	Measurement	Range		Style
4157K	Positive Pressure	0 to 20,000 psig in 15 ranges	0 to 1380 bar in 15 ranges	Bourdon Tube
4158K	Vacuum	0 to 30 inch Hg in 3 ranges	0 to 1.0 bar in 3 ranges	Bellows
	Compound Pressure	30 inch wc vac. to 30 inch wc	75 mbar vac. to + 75 mbar	
		15 inch Hg vac. to 7.5 psig	0.5 bar vac. to + 0.5 bar	
		30 inch Hg vac. to 15 psig	1.0 bar vac. to + 1.0 bar	
	Positive Pressure	0 to 30 psig in 8 ranges	0 to 2.0 bar in 8 ranges	

Input: *Type*—Gauge pressure. *Ranges*—See table above. *Span*—Adjustable between 6 and 100% of the sensing element range. *Zero*—Adjustable to position the input span of anywhere within the sensing elementrange.

Output: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Supply Pressure Requirements: 20 psig for 3 to 15 psig output. 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output. 2.4 bar for 0.4 to 2.0 bar output)

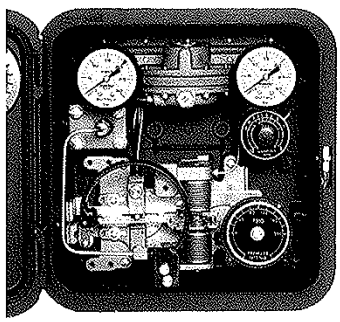
Air Consumption: Maximum of 27 scfh with 20 psig supply and 42 scfh with 35 psig supply (0.7 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply; and 1.1 normal m^3/hr at 0°C and 1.013215 bar, absolute, with 2.4 bar supply)

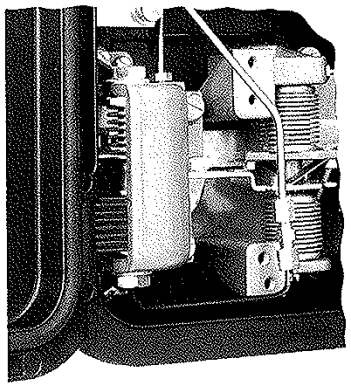
Normal Operating Temperature: − 40 to 160°F (− 40 to 71°C) with standard materials

Typical Materials of Process Wetted Parts: *Bellows*—Brass or stainless steel, depending on the range. *Bourdon Tube*—Brass, steel, or stainless steel, depending on the range. *Tubing*—Copper or stainless steel

Mounting: Actuator yoke, panel, wall, or pipestand

Bulletin Reference: 34.3:4150K





2100 Pneumatic Liquid Level Switch

The on-off Type 2100 pneumatic switch senses high or low liquid levels. Typically, this on-off switch pneumatically operates safety shutdown systems for field processing equipment on oil and gas production applications. A displacer is used as the sensor of the Type 2100 switch, and this sensor is located in an external cage that mounts to the outside of a vessel.

Input: *Type*—Liquid Level

Output: Output signal is equal to supply pressure when switch is in normal position (flapper against nozzle) and is reduced to approximately atmospheric pressure (depending on the size of the fixed restriction and piping configuration) when the switch is activated. Switch action may be reversed from a high-level to a low-level switching application or vice versa

Supply Pressure Requirements: 30 to 150 psig (2.0 to 10.3 bar)

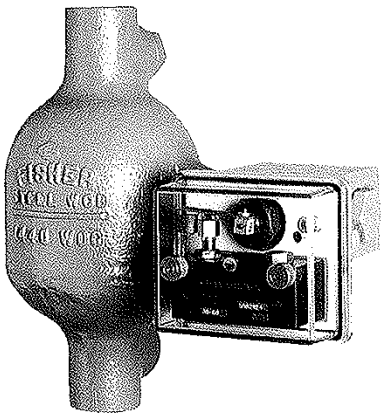
Air Consumption: Less than 1 scfh (0.0268 normal m^3/hr at 0°C and 1.01325 bar, absolute) when switch is in normal position (flapper against nozzle)

Normal Operating Temperature: *Ambient*— − 20 to 150°F (− 29 to 66°C.) *Process*— − 20 to 400°F (− 29 to 204°C)

Typical Materials of Process Wetted Parts: *Cage*—Steel. *Displacer Assembly*—Stainless steel

Mounting: 1 in. NPT female connections in cage

Bulletin Reference: 32.2:2100



4660 High-Low Pressure Pilot

The Type 4660 pneumatic high-low pressure pilot activates safety shutdown systems for flow lines, production vessels, and compressors. It is available with either single or dual set point capability to maintain full output pressure when the process pressure is within the set point range. If the process pressure is outside this range, the pilot switches from full output pressure to zero output pressure.

Available Configurations: *Nozzle/Flapper Construction*—High-low set point capability only. *Block-and-Bleed Relay Construction with Supply Test*—High-low, low-only, or high-only set point capability

Input Signal: 5 to 95, 13 to 237, 25 to 475, 50 to 950, 75 to 1425, 125 to 2375, 250 to 4750, or 375 to 7125 psig

Output Signal: Zero pressure or full supply pressure

Supply Pressure: *Nozzle/Flapper Construction*—20 to 50 psig normal. *Block-and-Bleed Relay Construction*—20 to 50 psig normal

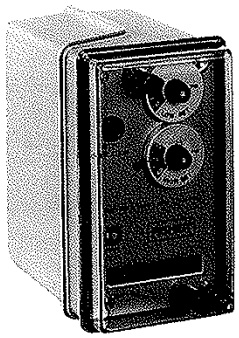
Pilot Supply Flow Requirement: Minimum of 150 scfh (4.3 m^3/hr)

Set Point Adjustments: Continuously adjustable between 5 and 95% of Bourdon tube rating

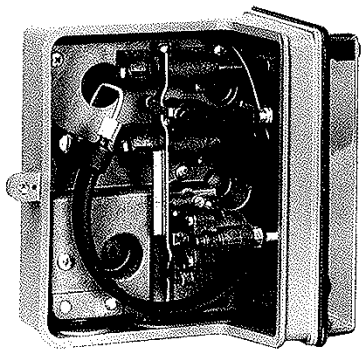
Typical Construction Materials: *Case and cover*—Polyester. *Base*—Hard anodized nickel sealed aluminum alloy. *Bourdon Tube*—4130 steel; 316 stainless steel; or K-Monel. *Relay housings*—Glass-filled Ryton[1]. *O-Rings*—Nitrile and nitrile impregnated with molybdenum disulphide.

Mounting: Panel, rack, pipestand, or actuator.

Bulletin Reference: 34.5:4660



Front View



Left Side with Case Cover Off

1. Trademark of Phillips Petroleum Co.

3582 Series Valve Positioners

These positioners are used with diaphragm-actuated control valve assemblies to provide an accurate valve plug position that is proportional to the pneumatic input signal received from a controller.

The following table lists the type numbers within this series. The Type SS-52 clip-on air chuck with pressure gauge is available to monitor the instrument pressure, the output pressure, or the supply pressure on positioners equipped with automotive tire valves.

Input: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar.) Split ranges using a portion of one of the standard ranges is also available

Output: 3 to 15, 5 to 25, or 6 to 30 psig (0.2 to 1.0, 0.3 to 1.7, or 0.4 to 2.0 bar) with either direct or reverse action

Supply Pressure Requirements: 20 psig for 3 to 15 psig output; 30 psig for 5 to 25 psig output; and 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output; 2.0 bar for 0.3 to 1.7 bar output; and 2.4 bar for 0.4 to 2.0 bar output)

Air Consumption: Maximum of 12 scfh with 20 psig supply, 15.6 scfh with 30 psig supply, and 17 scfh with 35 psig supply (0.32 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply, 0.42 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.1 bar supply, and 0.46 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

Accuracy: *Independent Linearity*— ± 1% of output signal span. *Hysteresis*—0.5% of span. *Open Loop Gain*—100

Normal Operating Temperature: − 40 to 160°F (− 40 to 71°C) with standard materials

Typical Construction Materials: *Case and Cover*—Aluminum. *Bellows*—Phosphor bronze. *Flapper and Nozzle*—Stainless steel. *O-Rings*—Nitrile

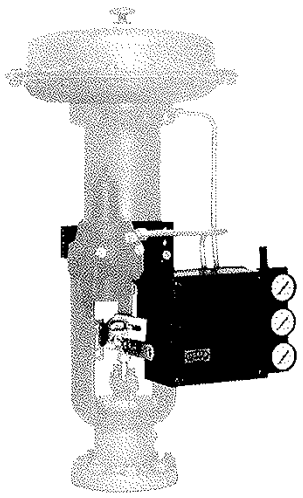
Valve Stem Travel: Maximum of 4-1/8 in. (105 mm.) Adjustable to obtain full output with lesser travels

Mounting: Fastens to actuator yoke with mounting plate

Bulletin Reference: 33:3582

Type Number	Bypass(1)	Pressure Gauge	Automotive Tire Valves
3582	Yes	Yes	No
3582A	No	No	No
3582C	No	No	Yes
3582D	Yes	No	Yes
3582G	No	Yes	No

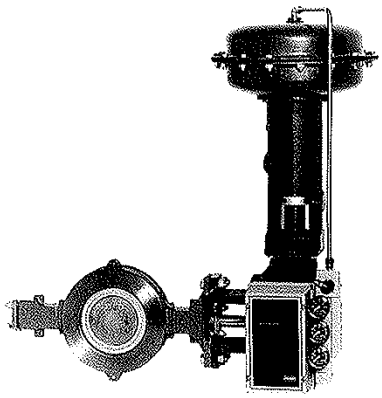
1. Positioners with bypass may be mechanically checked and serviced without breaking any pressure connections or disturbing the control action of the main valve.



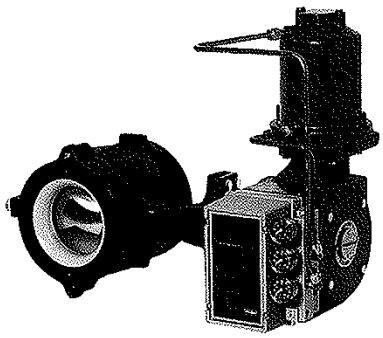
Typical 3582 Series Positioner Mounted to Actuator Yoke

3610 Series Valve Positioners

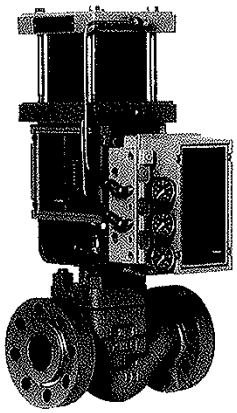
The 3610 Series pneumatic valve positioners are utilized with Fisher rotary and globe style control valves to provide a valve position that is proportional to a pneumatic input signal received from a controller. They mount directly to the housing of the Type 1052 (rotary output) diaphragm actuator and the Type 1062 (rotary output) and Type 585 (linear output) piston actuators. Actuator-to-positioner linkages being protected by the housing. Positioner bleed air continually purges the positioner housing to protect internal parts against corrosive atmospheres.



Type 3610J Positioner with Type 1052 Actuator and ēdisc® Valve Body



Type 3610JP Positioner with Type 1061 Actuator and Design V100 Valve Body



Type 3611JP Positioner with Type 585 Actuator and Design CE Valve Body

Available Configurations: *Type 3610J*—Single acting pneumatic valve positioner for Type 1051 and 1052 diaphragm actuators. *Type 3610JP*—Double acting pneumatic valve positioner for Type 1061 piston actuator. *Type 3611JP*—Double acting pneumatic valve positioner for Type 585 piston actuator

Input: *Standard*—3 to 15 psig or 6 to 30 psig (0.2 to 1.0 bar or 0.4 to 2.0 bar), or split range. *Adjustable*—Zero is continuously adjustable between 3 and 22 psig (0.2 and 1.5 bar)

Output: Pneumatic pressure as required by the actuator (up to full supply pressure)

Supply Pressure: *Recommended*—10% above actuator requirement. *Maximum*—150 psig (10.3 bar)

Air Consumption: *Type 3610J*—10 scfh (0.27 normal m^3/hr.) *Types 3610JP and 3611JP*—20 scfh (0.54 normal m^3/hr)

Accuracy: *Independent Linearity*— ± 1% of output span. *Hysteresis*—0.5% of output span. *Deadband*—0.1% of output span

Normal Operating Temperature: — 40 to 180°F (— 40 to 80°C)

Typical Construction Materials: *Case*—Aluminum with electro-deposited epoxy paint. *Cover*—Polyester plastic. *Feedback lever and relay valve plugs and seats*—Stainless steel. *Tubing*—Copper or stainless steel.

Valve Rotation: 60 and 90 degrees

Mounting: Bolts directly to actuator housing

Bulletin Reference: *3610J and 3610JP*—62.1:3610. *3611JP*—61.2:585

3660 Pneumatic Valve Positioner

The Type 3660 pneumatic valve positioner is intended for throttling control applications; it provides an accurate valve stem position that is proportional to the pneumatic input signal received from a controller.

Input: 3 to 15 psig or 6 to 30 psig (0.2 to 1.0 bar or 0.4 to 2.0 bar); or split range

Output: Pneumatic pressure as required by the actuator up to full supply pressure

Supply Pressure: *Maximum*—90 psig (6.2 bar). *Recommended:* 10% above actuator requirement

Performance: *Independent Linearity*— ± 1% of output span. *Hysteresis*—0.5% of output span. *Deadband*—0.1% of input span. *Repeatability*—0.1%

Adjustments: *Span*—From 0.8 to 2 inches (20 to 50 mm.) *Zero*—0 to 100%. *Gain*—0 to 6% PB. *Output Volume Damping*—Loop dynamic response adjustment

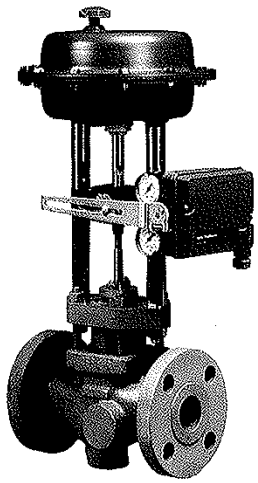
Operating Temperature Limits: — 40 to 248°F (— 40 to 120°C)

Typical Construction Materials: *Case and Cover*—Aluminum with epoxy paint. *Feedback Assembly*—Stainless steel. *Flapper and Nozzle*—Aluminum. *Input Module*—ECO. *Relay Metal Parts*—Aluminum and stainless steel

Valve Travel Range: 0.8 to 2 inches (20 to 50 mm)

Mounting: Fastens to post style actuator yoke with adjustable clamp

Bulletin Reference: 62.1:3660



Type 3660 Positioner with Type 1250 Actuator and Design GL Valve Body

2500-249 to 2503-249 Level-Trol® Controllers

These controllers sense the level of a liquid in a vessel and produce a standard pneumatic output signal. Because a displacer is used as the primary sensing element, these controllers may also be used to measure the level of a liquid-to-liquid interface or the density of a liquid. The controllers each have the displacer located in an external cage that mounts to the outside of a vessel, or the controllers mount directly to the outside of a vessel (without cage) and the displacer operates inside a vessel (see the following drawings.)

Input: *For Liquid Level or Liquid-to-Liquid Interface Level Measurements*—Ranges are determined by displacer length; nine standard displacers are available for ranges 0 to 14 in. up to 0 to 120 in. (0 to 356 mm up to 0 to 3048 mm.) *For Density Measurements*—Displacer volume determines upper range limit of the change in density

Output: *Proportional or Proportional-Plus-Reset Control*—3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) with either direct or reverse action. *On-Off Control*—0 to 20 or 0 to 35 psig (0 to 1.4 or 0 to 2.4 bar) with either direct or reverse action

Supply Pressure Requirements: *Proportional or Proportional-Plus-Reset Control*—20 psig for 3 to 15 psig output. 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output. 2.4 bar for 0.4 to 2.0 bar output.) *On-Off Control*—100% of required output pressure, but supply pressure should not exceed 35 psig (2.4 bar)
Air Consumption: Maximum of 27 scfh with 20 psig supply and 42 scfh with 35 psig supply (0.72 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 1.1 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

Control Modes: See following table

Type Number	Control Mode	% Proportional Band or Differential Gap
2500-249	Proportional	10 to 100% of the range
2500S-249	On-off with continuous bleed	20 to 100% of the range
2502-249 2502F-249(1)	Proportional-plus-reset	20 to 200% of the range
2503-249	On-off, Bleeds only when exhausting actuator diaphragm	25 to 40% of the range

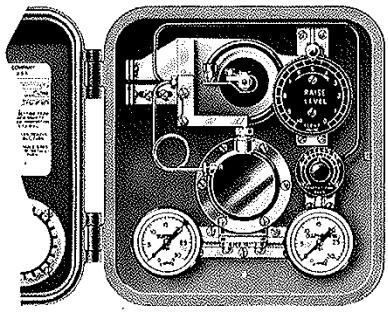
1. Has differential relief valve to limit reset windup in either direction (proportional to reset or vice versa).

Normal Operating Temperature: *Ambient*— − 40 to 160°F (− 40 to 71°C.) *Process*—Up to 1100°F (593°C.) Temperatures listed are with standard materials; depending upon the process and ambient temperatures, a heat insulator may be required.

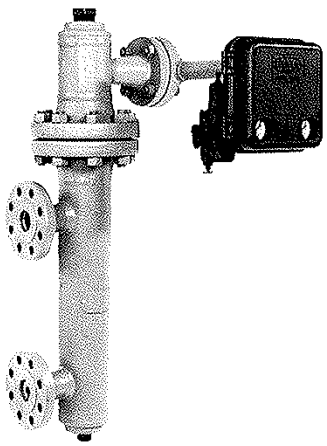
Typical Materials of Process Wetted Parts: *Cage, where used, and Cage Head*—Cast iron, steel or alloy steel, depending on pressure rating and controller type number. *Displacer*—304 stainless steel. *Torque Tube*—K-Monel. *Other Wetted Parts*—316 stainless steel

Mounting: *Controller with Cage*—1-1/2 and 2 in. screwed or 1-1/2 and 2 in. Classes 125 through 2500 flanged connections. The cage mounts to side of vessel with two connections that may be on the top and bottom, on the side, or in any combination of top, bottom or side of the cage. *Controller without Cage*—3 through 8 in. Classes 125 through 2500 flanged connections. Flange mounts to top or side of vessel with displacer inside vessel

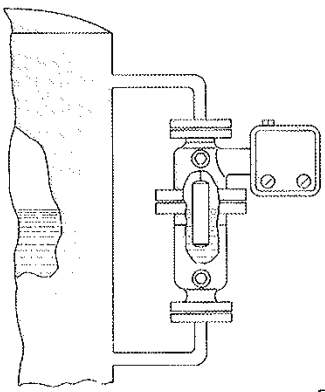
Bulletin Reference: 34.2:2500



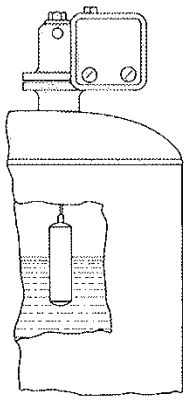
Type 2500



Typical 2500-249 Series



Controller with Displacer in Cage



Controller with Displacer in Tank

2506 & 2516 Multi-Trol Receiver Controllers

These receiver controllers use a pneumatic transmission signal, normally from a transmitter, as their input and produce a standard pneumatic output signal.

Input and Output:

INPUT		OUTPUT[1]	
Psig	Bar	Psig	Bar
3 to 15	0.2 to 1.0	3 to 15	0.2 to 1.0
		6 to 30	0.4 to 2.0
6 to 30	0.4 to 2.0	3 to 15	0.2 to 1.0
		6 to 30	0.4 to 2.0

1. With either direct or reverse action.

Supply Pressure Requirements: 20 psig for 3 to 15 psig output. 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output. 2.4 bar for 0.4 to 2.0 bar output)

Air Consumption: Maximum of 27 scfh with 20 psig supply and 42 scfh with 35 psig supply (0.72 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 1.1 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

Control Modes:

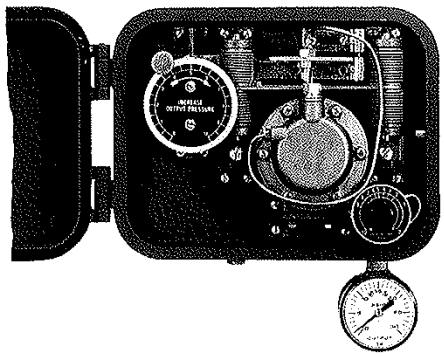
Type Number	Control Mode	% Proportional Band
2506	Proportional[1]	10 to 200%
2516	Proportional-plus-Reset	

1. May be changed from proportional to on-off or vice versa by repositioning a switch plate.

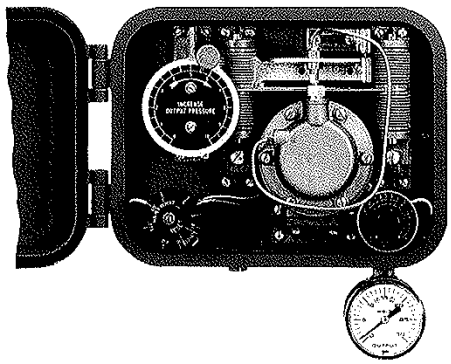
Normal Operating Temperature: *Ambient*— −40 to 160°F (−40 to 71°C) with standard materials

Mounting: Actuator yoke, actuator diaphragm casing, or directly mounted to transmitter

Bulletin Reference: 34.3:2506



Type 2506



Type 2516

2900-244V to 2901A-279V Level Controllers

The 2900 Series controllers, using a displacer as the sensing element, sense liquid level or liquid-to-liquid interface and produce a pneumatic output signal.

These controllers are each available with two different types of sensors—Type 244V and 279V. The sensors are basically the same except that the 279V can be used in vessels with smaller inside diameters.

Input: *Type*—Liquid level or liquid-to-liquid interface. *Ranges*—Horizontal displacer, 0 to 1/4 in. () to 6 mm.) Vertical displacer, 0 to 2 in. (0 to 51 mm)

Output: See following table

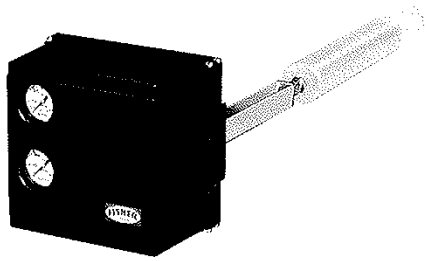
Supply Pressure Requirements: See following table

Control Mode: See following table

Typical Materials of Process Wetted Parts: *Displacer*—Solid plastic or stainless steel, depending on type of sensor. *Other Miscellaneous Parts*—Steel, stainless steel, and K-Monel

Mounting Connection Sizes and Styles: *Controllers with Type 244V Sensor*—2, 3 and 4 in. sizes. Styles are screwed, grooved or welding, depending on connection size. *Controllers with Type 279V Sensor*—2 in. screwed

Bulletin Reference: 34.2:2900

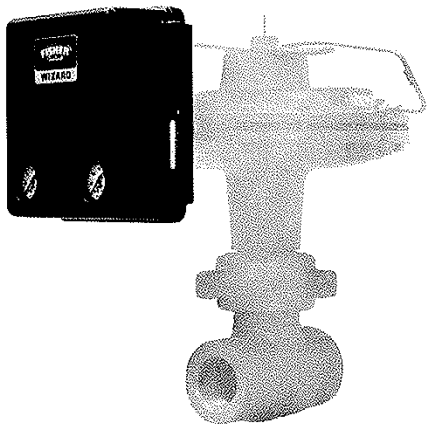


Type 2900-244V

TYPE NUMBER	CONTROL MODE	PROPORTIONAL BAND OR DIFFERENTIAL GAP	SUPPLY PRESSURE REQUIREMENT		OUTPUT	
			Psig	Bar	Psig	Bar
2900	Proportional or on-off, both with continuous bleed	Fixed proportional band of 100%	20 to 50	1.4 to 3.4	3 to 15 or 6 to 30 with either direct or reverse action	0.2 to 1.0 or 0.4 to 2.0 with either direct or reverse action
2901	Proportional or on-off, both with intermittent bleed					
2900A	On-off, continuous bleed	Fixed proportional band of 100%	20 to 75	1.4 to 5.2	0 (off) or full supply pressure (on) with direct or reverse action	
2901A	On-off, intermittent bleed					

4100Z Series Wizard® I Gauge Pressure Controllers

The 4100Z Series controllers sense gauge pressure with a bellows or a Bourdon tube and produce a pneumatic output signal. These controllers may be used with gas, steam and liquid applications. The following table lists the controller type numbers within the series, the available control modes, and the sensing element ranges and styles.



Type 4100Z Mounted to Actuator Diaphragm Casing

Input: *Type*—Gauge pressure. *Ranges*—See following table

Typical Materials of Process Wetted Parts: *Bellows and Bourdon Tubes*—Brass, steel and stainless steel, depending on the range. *Tubing*—Aluminum, brass, or stainless steel

Output: *Proportional Control*—3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar.) *On-Off Control*—0 or 20 psig or 0 or 35 psig (0 or 1.4 bar or 0 or 2.4 bar)

Supply Pressure Requirements: *Proportional Control*—20 psig for 3 to 15 psig output or 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output or 2.4 bar for 0.4 to 2.0 bar output.) *On-Off Control*—110% of required output pressure, but supply pressure should not exceed 35 psig (2.4 bar)

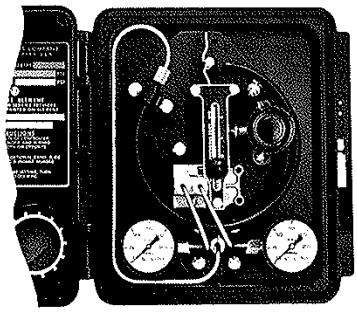
Air Consumption: Maximum of 50 scfh (1.3 normal m^3/hr at 0°C and 1.01325 bar, absolute) depending on nozzle size

Control Modes: See following table

Normal Operating Temperature: *Ambient and Process*— −40 to 150°F (−40 to 66°C)

Mounting: Actuator yoke, actuator diaphragm casing, or panel

Bulletin Reference: 34.3:4100Z



Type 4100Z

TYPE NUMBER	CONTROL ACTION	CONTROL MODE	% PROPORTIONAL BAND OR DIFFERENTIAL GAP	SENSING ELEMENT		
				Range		Style
				Psig	Bar	
4103Z	Direct	On-off	5 to 25% of bellows range	0 to 25 in 4 ranges	0 to 1.7 in 4 ranges	Bellows
4103ZR	Reverse					
4106Z	Direct	Proportional	Adjustable between a minimum that depends on the bellows being used (approximately 2%) and 65% of bellows range			
4106ZR	Reverse					
4100Z	Direct	Proportional	2 to 50% of Bourdon tube range	0 to 7500 in 10 ranges	0 to 517 in 10 ranges	Bourdon Tube
4100ZR	Reverse					
4101Z	Direct	On-off	10 to 25% of Bourdon tube range			
4101ZR	Reverse					
4102Z	Direct	On-off with output signal cutout on either high or low input signal	High set point—20 to 90% of Bourdon tube range. Low set point—5% of Bourdon tube range to 5% of this maximum range below the high set point			
4102ZR	Reverse	Proportional with output signal cutout on low input signal	2 to 50% of Bourdon tube range			
4104Z	Direct	On-off	10 to 25% of Bourdon tube range for 20 psig (1.4 bar) supply. 15 to 25% of Bourdon tube range for 35 psig (2.4 bar) supply.			
4104ZR	Reverse					

4150K & 4160K Series Wizard® II Gauge Pressure Controllers

The 4150K and 4160K Series controllers sense gauge pressure with a bellows or a Bourdon tube and produce a pneumatic output signal. Gauge pressure can mean a positive pressure, a vacuum, or a compound pressure (pressure that ranges from a vacuum to a positive pressure.) These controllers may be used with gas, steam and liquid applications.

The Type 4151K and 4153K have remote set point adjustment that provides a means of using pneumatic pressure to change the controller set point from a remote location. The Types 4160KF and 4160KFR have a differential reset relief valve to prevent proportional pressure from exceeding reset pressure (or vice versa) by more than a set value.

The following table lists the controller type number within the series, the available control modes, and the sensing element ranges and styles.

Input: *Type*—Gauge pressure. *Ranges*—See following table

Output: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) with either direct or reverse action

Supply Pressure Requirements: 20 psig for 3 to 15 psig output. 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output. 2.4 bar for 0.4 to 2.0 bar output)

Air Consumption: *Low-Consumption Controllers*—2.5 scfh with 20 psig supply and 4 scfh with 35 psig supply (0.0 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 0.11 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply). *Standard Controllers*—Maximum of 27 scfh with 20 psig supply and 42 scfh with 35 psig supply (0.72 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 1.1 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

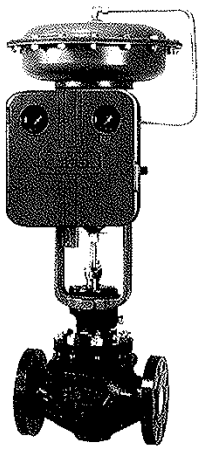
Control Modes: See following table

Normal Operating Temperature: − 40 to 160°F (− 40 to 71°C) with standard materials

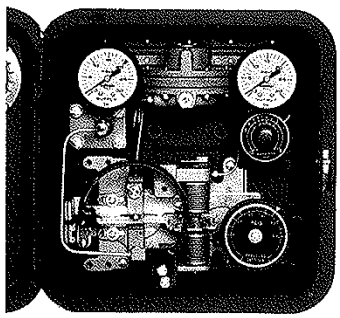
Typical Materials of Process Wetted Parts: *Bellows and Bourdon Tubes*—Brass, steel, and stainless steel, depending upon the range. *Tubing*—Copper or stainless steel

Mounting: Actuator yoke, panel, wall, or pipestand

Bulletin Reference: 34.3:4150K



Type 4150K Mounted to Actuator Yoke



Type 4160K

TYPE NUMBER	CONTROL MODE	% PROPORTIONAL BAND OR DIFFERENTIAL GAP	SENSING ELEMENT			
			Style	Measurement	Range	
4152KS	On-off	15 to 100% of bellows range	Bellows	Vacuum	0 to 30 inch Hg in 3 ranges	0 to 1.0 bar in 3 ranges
4152K	Proportional	3 to 100% of bellows range with 3-15 psig (0.2 to 1.0 bar) output or 6 to 100% of bellows range with 6-30 psig (0.4 to 2.0 bar) output		Compound Pressure	30 inch wc vac. to + 30 inch wc	75 mbar vac. to + 75 mbar
4153K					15 inch Hg vac. to + 7.5 psig	0.5 bar vac. to + 0.5 bar
4162K	Proportional-plus-Reset				30 inch Hg vac. to + 15 psig	1.0 bar vac. to + 1.0 bar
4150KS	On-off	15 to 100% of Bourdon tube range	Bourdon Tube	Positive Pressure	0 to 20,000 psig in 14 ranges	0 to 1379 bar in 14 ranges
4150K	Proportional	3 to 100% of Bourdon tube range with 3-15 psig (0.2 to 1.0 bar) output or 6 to 100% of Bourdon tube range with 6-30 psig (0.4 to 2.0 bar) output				
4151K						
4160K	Proportional-plus-Reset					
4160KF						

4195 Series Gauge Pressure Indicating Controllers

The 4195 Series gauge pressure indicating controllers show process pressure and set point on a process scale. The controllers compare process pressure with an operator-adjusted set point and deliver a pneumatic signal to a control element to change process pressure toward the set point.

The controllers are available for proportional-only, proportional-plus-reset, proportional-plus-reset-plus-rate, and differential gap control. Options include anti-reset windup, remote set point, and internal auto/manual station. The 4195 Series controllers are used throughout the power, chemical, oil, and gas industries for gas, steam, and liquid applications.

Input: *Type*—Gauge pressure. *Ranges*—See following table

Output: *Proportional*—3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) with either direct or reverse action. *On-Off*—0 and 20 or 0 and 35 psig (0 and 1.4 or 0 and 2.4 bar) with either direct or reverse action

Supply Pressure Requirements: 20 psig for 3 to 15 0 to 20 psig output. 35 psig for 6 to 30 or 0 to 35 psig output. (1.4 bar for 0.2 to 1.0 or 0 to 1.4 bar output. 2.4 bar for 0.4 to 2.0 or 0 to 2.4 bar output)

Steady-State Air Consumption: 3.5 scfh for 3 to 15 psig output; 5.0 scfh for 6 to 30 psig output. (0.1 m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 0.13 m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

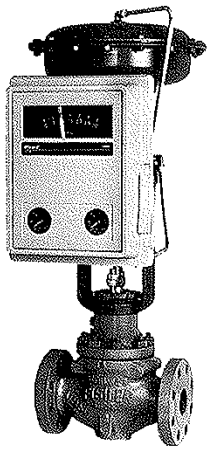
Control Modes: See following table

Normal Operating Temperature: − 40 to 160°F (− 40 to 70°C)

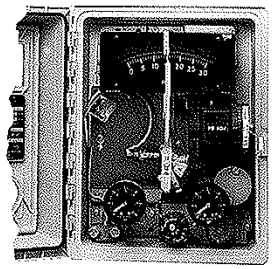
Typical Materials of Process Wetted Parts: *Capsular Input Element*—Ni-Span C or stainless steel. *Tubing*—Brass, aluminum, stainless steel, steel, or polyethelene. *Supply and output gauges*—Brass or stainless steel

Mounting: Actuator, panel, wall, or pipestand

Bulletin Reference: 34.5:4195



4195 Series Controller Mounted on Actuator of Control Valve



4195 Series

TYPE NUMBER(1)	CONTROL MODE	% PROPORTIONAL BAND OR DIFFERENTIAL GAP	SENSING ELEMENT			
			Style	Measurement	Range	
4195S	On-off	5 to 100% of process scale range	Capsular	Vacuum	0 to 30 inch Hg in 4 ranges	0 to 1 bar in 5 ranges
4195A	Proportional-only	5 to 500% of process scale range				
4195B	Proportional-plus-Reset			Compound Pressure	30 inch Hg vac. to 10 psig in 6 ranges	1 bar vac. to 1 bar in 8 ranges
4195C	Proportional-plus-Reset-plus-Rate			Positive Pressure	0 to 30 psig in 8 ranges	0 to 2 bar in 9 ranges
			Bourdon Tube	Positive Pressure	0 to 20,000 psig in 14 ranges	0 to 1400 bar in 16 ranges

1. Add suffix for anti-reset windup, M for remote set point, or E for internal auto/manual station (e.g. 4195 CFME).

4154K, 4159K & 4164K Wizard® II Differential Pressure Controllers

The Types 4154K, 4159K and 4164K controllers sense differential pressure with a bellows and produce a pneumatic output signal. These controllers may be used with gas, steam and liquid applications.

The Type 4159K has a remote set point adjustment that provides a means of using pneumatic pressure to adjust the controller set point from a remote location. The following table lists the controller control modes and bellows ranges.

Type Number	Control Mode	% Proportional Band	Bellows Range
4154K	Proportional	3 to 100% of bellows range with 3 to 15 psig (0.2 to 1.0 bar) output or 6 to 100% of bellows range with 6 to 30 psig (0.4 to 2.0 bar) output	0 to 30 psi (0 to 2.0 bar) in 4 ranges
4159K			
4164K	Proportional-plus-reset		

Input: *Type*—Differential pressure. *Ranges*—See following table

Output: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) with either direct or reverse action

Supply Pressure Requirements: 20 psig for 3 to 15 psig output. 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output. 2.4 bar for 0.4 to 2.0 bar output)

Air Consumption: *Low-Consumption Controllers*—2.5 scfh with 20 psig supply and 4 scfh with 35 psig supply (0.0 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 0.11 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply). *Standard Controllers*—Maximum of 27 scfh with 20 psig supply and 42 scfh with 35 psig supply (0.72 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 1.1 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

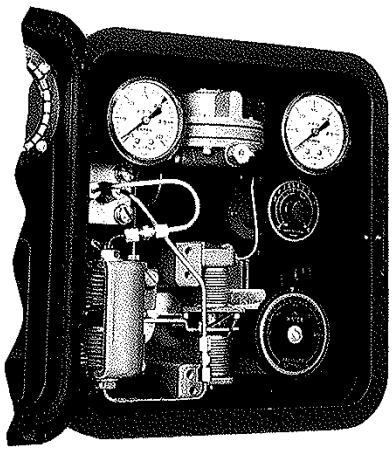
Control Modes: See following table

Normal Operating Temperature: − 40 to 160°F (− 40 to 71°C) with standard materials

Typical Materials of Process Wetted Parts: *Bellows and Bourdon Tubes*—Brass, steel, and stainless steel, depending upon the range. *Tubing*—Copper or stainless steel

Mounting: Actuator yoke, panel, wall, or pipestand

Bulletin Reference: 34.3:4150K



Type 4154K

4194 & 4194H Series Differential Pressure Indicating Controllers

The 4194 & 4194H Series differential pressure indicating controllers show process differential pressure and set point on an easy-to-read process scale. The controllers sense two different pressures and compare the difference between these pressures with an operator-adjusted set point. A pneumatic signal is then delivered to a control element to change the process differential pressure toward the set point.

The controllers are available for proportional-only, proportional-plus-reset, proportional-plus-reset-plus-rate, and differential gap control. Options include anti-reset windup, remote set point, and internal auto/manual station. The controllers are used in industry where process monitoring and accurate measurement of differential pressures are required.

Input: *Type*—Differential pressure. *Ranges*—See following table

Output: *Proportional or Proportional-plus-Reset*—3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar.) *Differential Gap*—0 and 20 or 0 and 35 psig (0 and 1.4 or 0 and 2.4 bar)

Supply Pressure Requirements: 20 psig for 3 to 15 or 0 & 20 psig output; 35 psig for 6 to 30 or 0 & 35 psig output. (1.4 bar for 0.2 to 1.0 or 0 & 1.4 bar output; 2.4 bar for 0.4 to 2.0 or 0 & 2.4 bar output)

Steady-State Air Consumption: 3.5 scfh for 3 to 15 psig output; 5.0 scfh for 6 to 30 psig output. (0.1 m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 0.13 m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

Control Modes: See following table

Normal Operating Temperature: – 40 to 180°F (– 40 to 70°C)

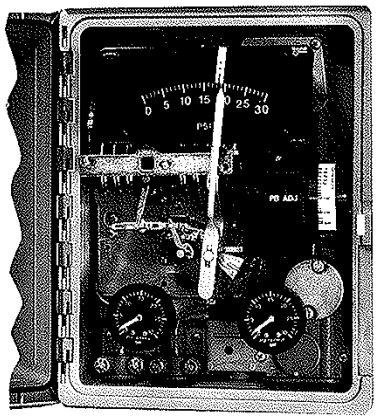
Typical Materials of Process Wetted Parts: *Capsular Element*—Ni-Span C. *Barton Type 199*—Stainless steel. *Tubing*—Brass or stainless steel

Mounting: *4194 Series*—Actuator, panel, wall or pipestand. *4194H Series*—Pipestand

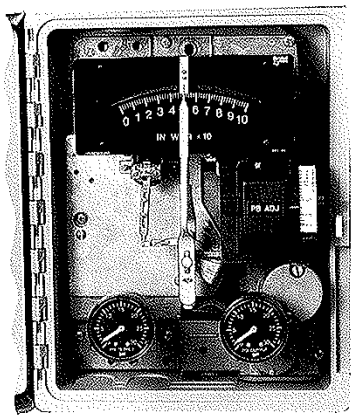
Bulletin Reference: *4194 Series*—34.4:4194. *4194H Series*—34.4:4194H

TYPE NUMBER(1)	CONTROL MODE	% PROPORTIONAL BAND OR DIFFERENTIAL GAP	SENSING ELEMENT			
			Style	Measurement	Range	
4194S	On-off	1 to 100% of process scale range	Capsular	Positive pressure	0 to 5 psid	0 to 0.4 bar
4194A	Proportional-only	5 to 500% of process scale range			0 to 10 psid	0 to 0.7 bar
4194B	Proportional-plus-Reset				0 to 20 psid	0 to 1.4 bar
4194C	Proportional-plus-Reset-plus-Rate				0 to 30 psid	0 to 2.0 bar
4194HS	On-off	1 to 100% of process scale range	Barton Type 199	Positive pressure	0 to 100 inch wc in 5 ranges	0 to 250 mbar in 5 ranges
4194HA	Proportional-only	5 to 500% of process scale range				
4194HB	Proportional-plus-Reset				0 to 75 psi in 3 ranges	0 to 5.2 bar in 3 ranges
4194HC	Proportional-plus-Reset-plus-Rate					

1. Add suffix F for anti-reset windup, M for remote set point, or E for internal auto/manual station (e.g., 4194HSFME).



4194 Series



4194H Series

4156K and 4166K Series Wizard® II Temperature Controllers

The 4156K and 4166K Series controllers sense temperature in various fluids by means of a gas-filled temperature bulb. They develop a pneumatic output signal proportional to the difference between the sensed temperature and a manually adjusted set point temperature.

The controllers are available for proportional-reset, proportional-only, and on-off control. The Type 4156K controller is available with or without remote set point adjustment. The Type 4166F has a differential reset relief valve to prevent reset pressure from exceeding feedback or proportional pressure by more than a set value. Where high-pressure or corrosive fluids are controlled, thermowells are available.

Input: *Type*—Temperature. *Ranges*—See following table

Output: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) with proportional or proportional-reset control; 0 and 20 or 0 and 35 psig (0 and 1.4 or 0 and 2.4 bar) with on-off control. Action is field-reversible between direct and reverse

Supply Pressure Requirements: 20 psig for 3 to 15 psig output. 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output. 2.4 bar for 0.4 to 2.0 bar output)

Air Consumption: Maximum of 27 scfh with 20 psig supply and 42 scfh with 35 psig supply (0.72 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 1.1 normal m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

Control Modes: See following table

Normal Ambient Operating Temperature: − 40 to 160°F (− 40 to 71°C) with standard materials

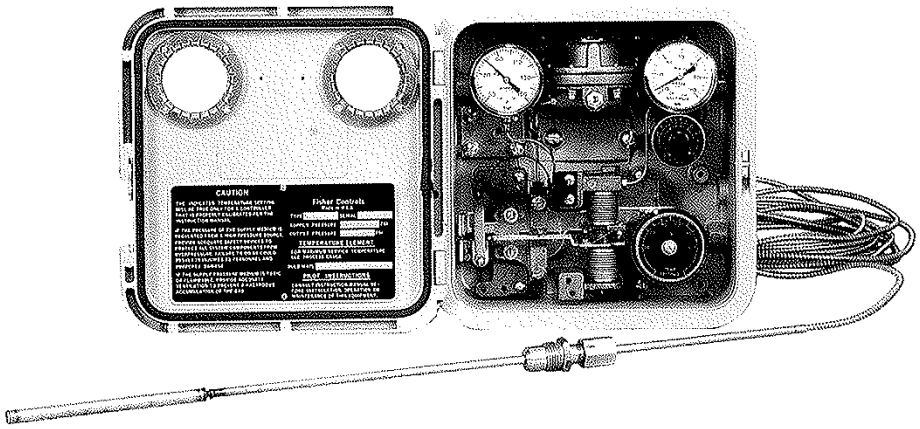
Typical Materials of Process Wetted Parts: *Thermal Element Assembly*—Stainless steel

Mounting: Actuator yoke or panel

Bulletin Reference: 34.6:4156K

Type Number	Control Mode	% Proportional Band or Differential Gap	Sensing Element Ranges[1]
4156KS	On-off	15 to 100% of sensing element range	0 to 1000°F (− 18 to 538°C) in 13 ranges
4156K	Proportional	3 to 100% of sensing element range with 3 to 15 psig (0.2 to 1.0 bar) output or 6 to 100% of sensing element range with 6 to 30 psig (0.4 to 2.0 bar) output	
4166K	Proportional-plus-Reset	6 to 200% of sensing element range with 3 to 15 psig (0.2 to 1.0 bar) output or 12 to 200% of sensing element range with 6 to 30 psig (0.4 to 2.0 bar) output	
4166KF[2]			

1. Sensing element ranges are in °F. Equivalent in °C is shown for convenience only.
2. Provides anti-reset windup.



Type 4156K

4196 Series Temperature Indicating Controllers

The 4196 Series temperature indicating controllers show process temperature and set point on an easy-to-read scale. The controllers compare process temperature with an operator-adjusted set point and deliver a pneumatic signal to a control element so that process temperature changes toward the set point.

Controllers within the 4196 Series include proportional-only, proportional-plus-reset and differential gap control models. Options include anti-reset windup, remote set point, and internal auto/manual station. The controllers are used in industries where accurate temperature control and process monitoring are required.

Input: *Type*—Temperature. *Ranges*—See following table

Output: *Proportional*—3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar) with either direct or reverse action. *On-Off*—0 and 20 or 0 and 35 psig (0 and 1.4 or 0 and 2.4 bar) with either direct or reverse action

Supply Pressure Requirements: 20 psig for 3 to 15 or 0 and 20 psig output. 35 psig for 6 to 30 or 0 and 35 psig output. (1.4 bar for 0.2 to 1.0 or 0 and 1.4 bar output. 2.4 bar for 0.4 to 2.0 or 0 and 2.4 bar output)

Steady-State Air Consumption: 3.5 scfh for 3 to 15 psig output; 5.0 scfh for 6 to 30 psig output. (0.1 m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 0.13 m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

Control Modes: See following table

Normal Operating Temperature: – 40 to 160°F (– 40 to 70°C)

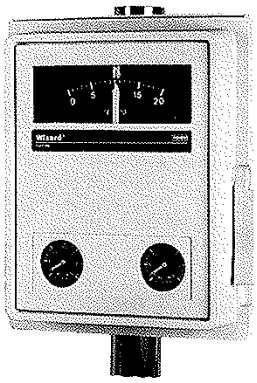
Typical Materials of Process Wetted Parts: *Thermal element assembly*—Ni-Span C/stainless steel. *Tubing*—Brass, aluminum, stainless steel, steel, or polyethelene. *Supply and output gauges*—Brass or stainless steel

Mounting: Actuator, panel, wall, or pipestand

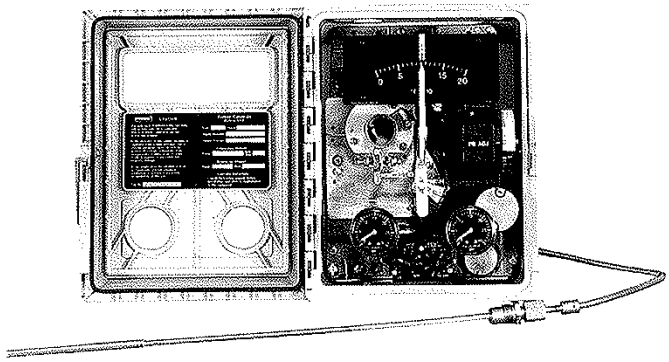
Bulletin Reference: 34.6:4196

Type Number[1]	Control Mode	% Proportional Band or Differential Gap	Operating Ranges	
4196S	On-off	5 to 100% of process scale range	– 100 to 600°F in 14 ranges	– 75 to 300°C in 12 ranges
4196A	Proportional-only	5 to 500% of process scale range		
4196B	Proportional-plus-Reset			
4196C	Proportional-plus-Reset-plus-Rate			

1. Add suffix F for anti-reset windup, M for remote set point, or E for internal auto/manual station (e.g., 4196 CFME).



Pipestand Mounted 4196 Series



4196 Series

5190 & 5190S Temperature Indicating Controllers

The Type 5190 and 5190S pneumatic indicating temperature controllers provide the accuracy, range and convenience of electrical temperature sensing and control without the need for external electrical power. An air-operated generator uses supply pressure from a conventional pneumatic pressure source to produce electrical power for the controller circuitry.

These indicating controllers compare the process temperature with an operator-adjusted set point and deliver a pneumatic signal to a control element. They are available with either proportional-plus-reset or proportional-plus-reset-plus rate control with a thermocouple or RTD sensor. The Type 5190S controller is the intrinsically safe version of the Type 5190.

Input: *Type*—Temperature. *Ranges*—See following table

Output: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Supply Pressure Requirement: 20 psig for 3 to 15 psig output; 35 psig for 6 to 30 psig output (1.4 bar for 0.2 to 1.0 bar output; 2.4 bar for 0.4 to 2.0 bar output)

Steady-State Air Consumption: 35 scfh for 3 to 15 psig output; 30 scfh for 6 to 30 psig output. (1.0 m^3/hr at 0°C and 1.01325 bar, absolute, with 1.4 bar supply and 0.8 m^3/hr at 0°C and 1.01325 bar, absolute, with 2.4 bar supply)

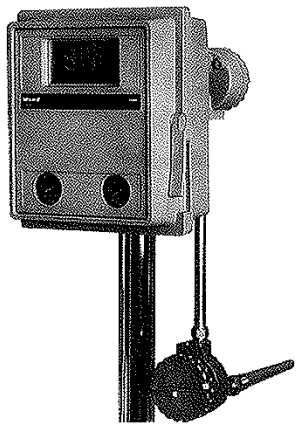
Control Modes: See following table

Normal Ambient Operating Temperature: − 40 to 160°F (− 40 to 70°C)

Typical Materials: *Case and Cover*—Reinforced polyester. *Inner Housing*—Aluminum. *Air-Supply-Wetted Parts*—Nitrile, brass, and copper

Mounting: Pipestand, panel, or wall

Bulletin Reference: 34.6.5190



Pipestand Mounted Type 5190 or 5190S Temperature Controller

Type Number	Control Mode	% Proportional Band	Sensor Element	Temperature Range	
5190 5190S	Proportional-plus-Reset Proportional-plus-Reset-plus-Rate	4 to 400% of input spar	Type E Thermocouple	0 to 200°F 0 to 500°F	0 to 500°C in 3 ranges
			Type J Thermocouple	− 100 to 1000°F in 5 ranges	0 to 500°C in 3 ranges
			Type K Thermocouple	0 to 1000°F in 3 ranges	0 to 500°C in 3 ranges
			Type T Thermocouple	0 to 200°F 0 to 500°F	0 to 100°C 0 to 300°C
			100 ohm RTD	− 50 to 600°F in 13 ranges	− 40 to 400°C in 9 ranges
			200 ohm RTD	20 to 45°F 0 to 100°C	- - -

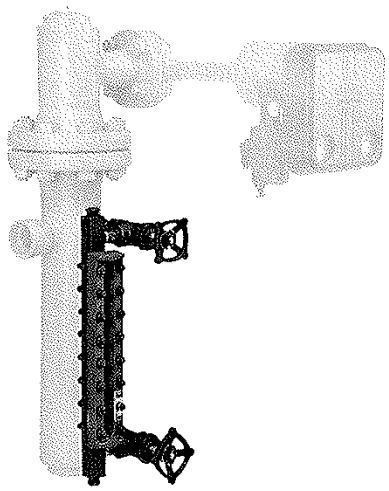
Jerguson Gauges

Jerguson gauges are used primarily on the displacer cages of transmitters and controllers to visually indicate level and interface of liquids. Both flat-glass and tubular-glass gauges are available in various configurations.

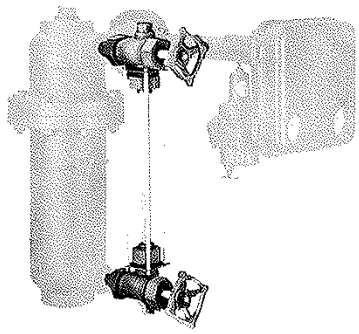
Flat-glass gauges are made in both reflex and transparent types. In reflex gauges, the liquid shows up black to indicate a contrast between the liquid and the surface above the liquid. Transparent gauges indicate the level, color and interface of the liquid. The maximum working pressure is dependent on the liquid temperature the the gauge cock construction.

Tubular-glass gauges use clear tubular glass for indicating the level and interface of a liquid. Guard rods are the standard safety protection for the tubular gauges with other protection devices available upon request. The maximum working pressure is dependent on glass length and gauge cock construction.

Bulletin Reference: 34.2:2500(S1)



Flat-Glass Gauge



Tubular-Glass Gauge

SB & SG Bourdon Tube Protectors

Bourdon tube protectors are accessory items used to prevent corrosive or clogging process fluids from entering the Bourdon tube sensors in controllers and transmitters. The protectors sense process pressure with a diaphragm, and transmit the pressure via a non-corrosive liquid to the transmitter or controller Bourdon tube. By properly selecting one of the many diaphragm materials, the Bourdon tube protectors make our transmitters and controllers compatible with many hard-to-handle process fluids.

The Type SB is the same as the Type SG with one exception—the Type SG has a flushing connection that allows clogging process fluids to be flushed from the Bourdon tube protector without disassembly of the protector.

Input: 0 to 2500 psig (0 to 172 bar) is standard; up to 10,000 psig (690 bar) available upon request.

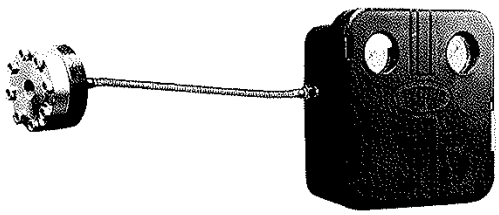
Output: Equal to input pressure

Normal Operating Temperature: *Process*— — 60 to 700°F (— 51 to 371°C)

Standard Diaphragm Materials: Stainless steel, tantalum, Monel nickel, Carpenter 20, or titanium

Mounting: Screws onto a threaded pipe. Process connection is 1/4, 3/8, 1/2, 3/4, 1 or 1-1/2 in. NPT

Bulletin Reference: 39:025




74652
1 1/2 INCH HF COMP SHOES

Contents

Introduction

Posi-Seal High-Performance Butterfly Valves meet the requirements of heavy-duty service as a cost effective alternative to ball, gate, and plug valves.

Posi-Seal's high-performance design begins with a dynamic, single offset seat that seals bubble-tight whether in vacuum, low pressure or high pressure service. Posi-Seal engineers streamlined the heavy ball of a ball valve to a thin valve disc—a ball segment. The valve disc gives a substantial weight savings and provides a single offset design that equalizes system back pressure across the disc when closed. This minimizes the risk that any sudden high pressure surge could pop open the valve. It also requires less torque to operate, which allows use of smaller, lower-cost actuators.

Rugged trunnion mounts complete the valve design, providing the rigid support needed to hold the disc in place against system pressure.

Dynamic Sealing Principle

Unlike most valves, which must seal against system differential pressure, Posi-Seal valves utilize system pressure to achieve true, dynamic sealing. In the fully closed position, the elastomer back-up ring of the disc seal is compressed, pre-loading the seal against the disc. This condition provides an initial static seal and achieves an effective closure at low pressure.

System pressure enters the T-slot which secures the disc seal ring, energizing the seal to provide concentrated unit loading between the seal and disc edge. As system pressure increases, the seal gets tighter—an example of the Posi-Seal dynamic sealing principle.

Seal Designs

Standard Seal*
(– 80° to 450°F; – 63° to 230°C)

Our original "workhorse" seal is a two-component design, consisting of a seal ring and a backup ring. It is utilized in both A-Series and B-Series valves.

The standard seal ring is an inert, low-friction, wear-resistant elastomer (TFE), with other materials being available to meet specific needs. The backup ring is a resilient elastomer, Viton; EPR and other materials are available also. The standard seal design can be furnished with a firesafe retaining ring for API-607 service.

Phoenix III® Firesafe Seal*
(– 100° to 450°F; – 73° to 230°F)

Here is the only true firesafe seal on the market. Unlike other "firesafe" valves, the Phoenix III doesn't rely on a fire to totally destroy the soft seal or trigger a spring-loaded mechanism to achieve a complete metal-to-metal closure.

With dynamic sealing, it delivers high performance in high pressure applications. The Phoenix III is designed to service hazardous, flammable fluids, gases and other critical media.

*Patented.

An industry first, the Phoenix III features triple-duty sealing. First, there's a resilient insert for bubbletight sealing in normal conditions. Then, twin metal-to-metal seating provides positive shutoff during and after a fire—even under partial soft-seal destruction.

Novex™ High Temperature Seal
(to 1500°F; 816°C)

The Novex all-metal seal provides high temperature sealing without troublesome non-metallic seal fillers or backup rings and springs. Its single component design utilizes the dynamic sealing principle to achieve up to ANSI Class VI shutoff. The Novex seal is retained in the valve body "T" slot. The ring has a smaller diameter than the disc, so it is hoopstretched when the valve closes. Unit loading is concentrated at the seal-to-disc contact point to maximize static sealing. As system pressure builds, the seal gets tighter because system pressure enters the "T" slot to assist sealing.

This advanced-design valve is ideal for handling corrosive steam over 250 pounds, erosive chemicals and abrasive slurries.

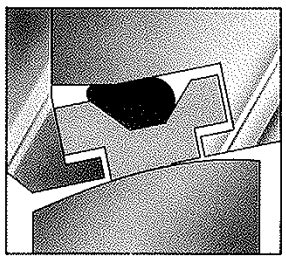
Cryo-Tight™ Seal*
(– 425° to 300°F; – 254° to 150°C)

Posi-Seal is first to meet the challenge of cryogenic applications with this two component ring. Fabricated from an inert, low-friction elastomer, the mechanically-locked seal ring fitted with a metal back-up ring is pre-loaded against the disc. This condition provides an initial static seal. System pressure enters the T-slot, energizing the seal and increasing the seal contact load against the disc. As pressure increases, so does the sealing power. There simply isn't a better valve for LNG, helium, nitrogen or oxygen. Also available in a firesafe design.
*Patented

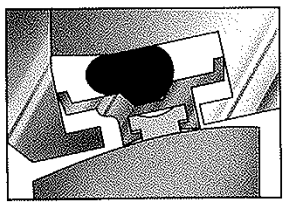
Actuators

A wide selection of manual and power actuators is available to match the operation of a Posi-Seal high-performance butterfly valve to the application. This selection includes handlevers, gear operators, double-acting and spring-return pneumatic actuators, and failsafe actuator constructions. For complete details on available actuators, their operating capabilities, and availability, contact your Posi-Seal representative.

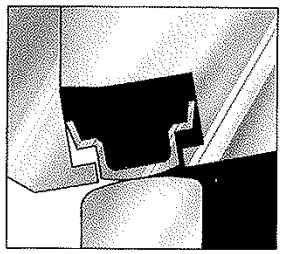
Standard Seal



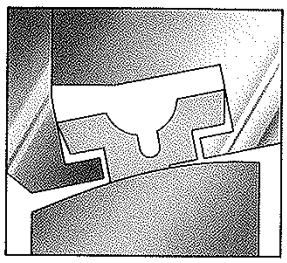
Phoenix III Fire-Safe Seal



Novex High Temperature Seal



Cryo-Tight Seal



General Service Butterfly Valves

A-Series high performance butterfly valves with the standard, two component dynamic design seal provide bubble-tight, bidirectional shutoff against full Class 150 through 1500 ANSI pressures. The standard TFE seal ring and Viton backup ring are well suited to most liquid and gas applications, while metal seals are available for high temperature service. Many other seal and backup ring materials are available to satisfy a broad range of more specific needs. Posi-Seal high-performance butterfly valves are supplied as manually-operated units or as engineered, power-actuated packages.

Available Configurations: Wafer or single flange body

Body Sizes: 3 through 72 in.

Seal Constructions: Standard or metal

End Connection Styles: Designed to fit between ANSI B16.5 Class 150, 300, 600, 900 or 1500 flanges

Shutoff Classification: Bubble-tight in accordance with MSS SP-61, for soft seal valves only

Maximum Working Pressure: Full ANSI rating for all Classes listed

Process Temperature Range (for Seal): From − 425° to 1500°F (− 254° to 815°C) depending upon seal material

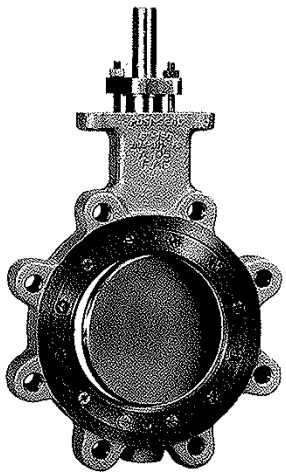
Maximum Flow Coefficients (Cv): From 2″ = 57 to 72″ = 257,838

Flow Characteristic: Approximately equal percentage

Flow Direction: Normal flow is with the flat side of the disc facing downstream

Typical Construction Materials: *Valve Body*—Carbon steel or stainless steel. *Valve Disc*—Carbon steel or stainless steel. *Valve Shaft*—Stainless steel. *Seal Ring*—TFE or Tefzel[1] depending upon application. *Backup Ring*—Fluoroelastomer or EPR. *Bearings*—Stainless steel or TFE composite. *Packing*—TFE or graphite

Data Sheets: BD101 through BD112



Cryogenic Butterfly Valves

Posi-Seal Cryo-Tight cryogenic butterfly valves feature a patented, two component dynamic seal which provides positive shutoff to − 425°F (− 254°C). In addition, this pressure-assisted seal provides shutoff against the full Class ANSI pressure range.

Available Configurations: Wafer or single flange body

Body Sizes: 3 through 48 in.

Seal Construction: Kel-F seal ring; no backup ring utilized for general cryogenic applications; aluminum backup ring for higher performance and firesafe LNG/LPG service.

End Connection Styles: Designed to fit between ANSI B16.5 Class 150, 300 or 600 flanges

Shutoff Capability: Less than 10cc/in/min of helium with back-up ring

Maximum Working Pressure: Up to 1440 psi (99.3 bar) depending upon valve construction and operating temperature

Process Temperature Range (for Seal): From − 425° to 300°F (− 254° to 149°C)

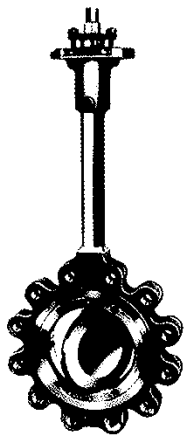
Maximum Flow Coefficients (Cv): From 3″ = 182 to 48″ = 92,638

Flow Characteristic: Approximately equal percentage

Flow Direction: Normal flow is with the flat side of the disc facing downstream

Typical Construction Materials: *Valve Body*—Stainless steel. *Body Extension*—Stainless steel. *Valve Disc*—Stainless steel. *Valve Shaft*—17-4PH or K Monel. *Seal Ring*—Kel-F. *Bearings*—TFE composite. *Packing*—TFE or graphite

Data Sheets: BD601 through BD608



1. Registered trademark of the 3M Company.

High Temperature Butterfly Valves

Novex™ high temperature butterfly valves feature an all-metal disc seal for tight shutoff at temperatures to 1500°F (816°C). A one-piece design, the metal seal avoids the delamination problems common to composite, high temperature seal configurations. This pressure-assisted seal design offers shutoff to ANSI Class VI specifications.

Available Configurations: Wafer or single flange body

Body Sizes: 3 through 48 in.

Seal Construction: Metal

End Connection Styles: Designed to fit between ANSI B16.5 Class 150, 300 flanges

Shutoff Classification: Meets MSS-SP-61, API598, and ANSI Class V andVI specifications

Maximum Working Pressure: Up to 720 psi (50 bar) depending upon body construction and operating temperature

Process Temperature Range (for Seal): − 20 to 1500°F (− 29 to 816°C)

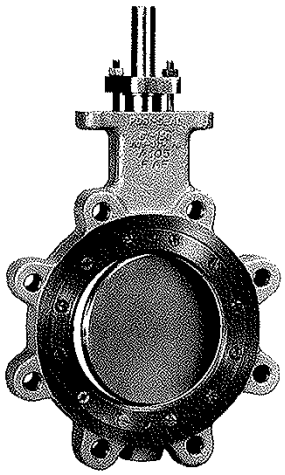
Maximum Flow Coefficients (Cv): From 2″ = 57 to 48″ = 92,638

Flow Characteristic: Approximately equal percentage

Flow Direction: Normal flow is with the flat side of the disc facing downstream

Typical Construction Materials: *Valve Body*—Carbon steel or stainless steel. *Valve Disc*—Carbon steel or stainless steel with nickel plating. *Valve Shaft*—Stainless steel. *Seal Ring*—Stainless steel. *Bearings*—Stainless steel. *Packing*—Graphite

Data Sheets: BD401 through BD406



Firesafe Butterfly Valves

Phoenix III® firesafe butterfly valves feature a unique triple seal consisting of twin metal seats that enclose a resilient insert material. This pressure-assisted seal design provides bubble-tight, bidirectional shutoff against the full pressure rating of the valve and complies with recognized industry firesafe standards. Certifications are available upon request.

Available Configurations: Wafer or single flange body

Body Sizes: 3 through 72 in.

Seal Constructions: Stainless steel with resilient insert and elastomer backup ring

End Connection Styles: Designed to fit between ANSI B16.5 Class 150, 300 or 600 flanges

Shutoff Classification: Bubble-tight in accordance with MSS SP-61

Maximum Working Pressure: Up to 1480 psi (102 bar) depending upon valve construction and operating temperature

Process Temperature Range (for Seal): From − 100° to 450°F (− 73° to 232°C) depending upon seal material

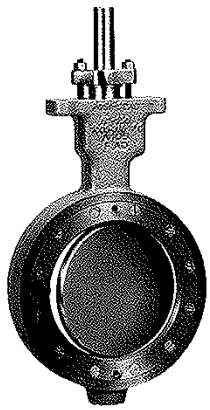
Maximum Flow Coefficients (Cv): From 3″ = 188 to 72″ = 257,838

Flow Characteristic: Approximately equal percentage

Flow Direction: Normal flow is with the flat side of the disc facing downstream

Typical Construction Materials: *Valve Body*—Carbon steel or stainless steel. *Valve Disc*—Carbon steel or stainless steel with nickel plating. *Valve Shaft*—17-4PH stainless steel. *Seal Ring and Insert*—Stainless steel and TFE or Tefzel. *Bearings*—Stainless steel. *Packing*—Graphite

Data Sheets: BD301 through BD312



B-Series Trimtite™ Valve

The B-Series Trimtite high-performance butterfly valve features a unique, one-piece body that retains the disc seal without use of a seal retainer ring. The one-piece design therefore eliminates a potential leak path from the seal area to the valve face.

The Trimtite design utilizes standard construction materials and the patented Posi-Seal two-component seal design to give long service life and outstanding performance over a broad range of liquid and gas applications. Interchangeability of stems and discs simplifies service and reduces maintenance costs.

Available Configuration: One-piece wafer or single flange body

Body Sizes: 3 through 24 in.

End Connection Style: Designed to fit between pipe flanges with ANSI Class 150 rating

Shutoff Classification: Bubble-tight in accordance with MSS SP-61

Maximum Working Pressure: Up to 285 psi (19.6 bar) depending upon valve construction and operating temperature

Process Temperature Range: From − 65° to 400°F (− 54° to 204°C) depending upon valve construction

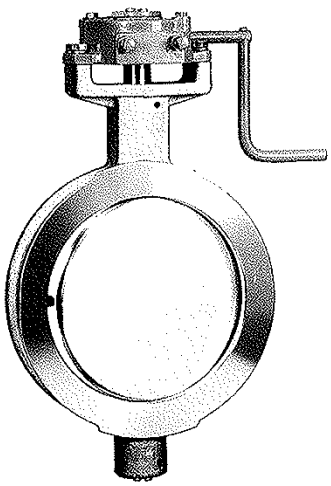
Maximum Flow Coefficients (Cv): From 3″ = 230 to 24″ = 21,950

Flow Characteristic: Approximately equal percentage

Flow Direction: Normal flow is with the flat side of the disc facing downstream

Typical Construction Materials: *Valve Body*—Carbon steel and stainless steel. *Valve Disc*—Carbon steel and stainless steel. *Valve Shaft*—Stainless steel. *Seal Ring*—TFE. *Back-Up Ring*—Viton or EPR. *Seal Retainer Strip*—Stainless steel. *Bearings*—Composite. *Shaft Seal*—Viton or EPR

Data Sheet: BD200



Handlever Actuator

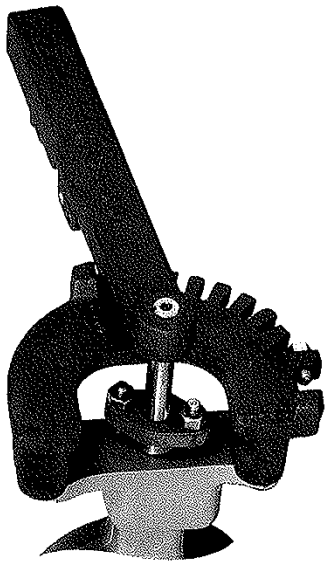
Lever-lock handlever manual actuator offers on/off and six individual locked positions for throttling control. Handle can be mounted in any of four quadrants and can be padlocked for tamper-resistant open/closed positioning. Available with limit switches for remote indication of valve position.

Available Configuration: Handlever for manual operation

Actuator Sizes: Two actuator sizes for 3″-8″ (76-203 mm) A-Series valves; one size for B-Series valves

Torque Output: Up to 1450 inch-pounds (164 nm) opening torque depending upon valve construction

Data Sheet: BB040 & BD200



Gear Actuator

M Series gear actuators are totally enclosed, weatherproof, worm-gear actuators. Two adjustable stops fitted in the gear housing allow corrected adjustment of disc position. The actuator is inherently self locking.

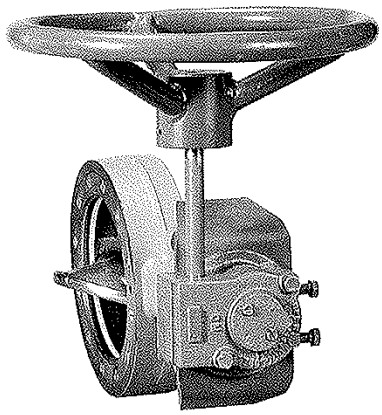
Available Configuration: Handwheel style for A-Series valves; handcrank style for B-Series valves. Actuator uses a worm and worm gear sector to transmit power from the handwheel or crank to the valve shaft. Offered in eight actuator sizes to match valve size and ANSI Class rating.

Maximum Usable Torque: From 2400 to 75,000 inch-pounds (271 to 8498 nm)

Typical Construction Materials: *Body Housing*—Cast iron. *Worm*—Steel, surface hardened. *Worm Gear*—Magnesium bronze. *Input Shaft*—Steel or stainless steel

Options: Locking plates, infinite positioning devices for setting repeatable stops between 0-90°, chain wheels, handwheel extensions

Data Sheet: BB030 & BD200



Fire Sentry™ Fail Safe Gear Actuator

The Fire Sentry actuator is a universal, thermally-activated fail safe (closed or open) manual operator. It is a heavy duty, totally enclosed, weatherproof unit designed for maintenance free on/off or throttling operation.

Fail safe actuation is achieved by use of a self contained, heavy duty alloy steel spring which on activation of fusible links, drives the gear segment and output shaft in the clockwise position. Positive, quick, reliable motion results in fail close or open valve actuation depending on mounting of the gear unit. The unit can be reset by simply installing new fusible links.

Available Configuration: Actuator uses a worm and worm gear sector to transmit power from the handwheel to the valve shaft. For use with 3″-18″ valve sizes

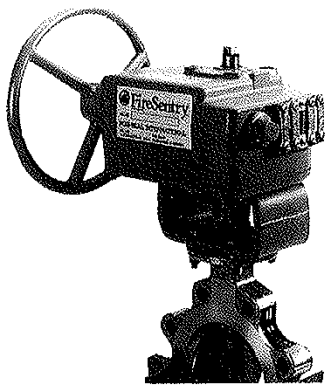
Maximum Pressure Drop: Up to 1480 psi (102 bar)

Maximum Usable Torques for Normal Operation: *Break Torque*—7980 in-lb (904 nm). *Approvals:* Research Laboratory of the Factory Mutual Insurance Company; Lloyd's Register of Shipping

Typical Construction Materials: *Body Housing*—Ductile iron. *Worm*—Steel, surface hardened. *Worm Gear*—Stainless steel. *Spring*—Heat treated alloy steel. *Crankshaft & Lever*—Ductile iron. *Fusible Link*—Subassembly manufacturing standard 165°F. *Bearings*—Hardened stainless steel.

Options: Release modes (lanyard, local or remote electric, pneumatic, or hydraulic), limit switches, chain drive on handwheel

Data Sheet: BB010 & BD313

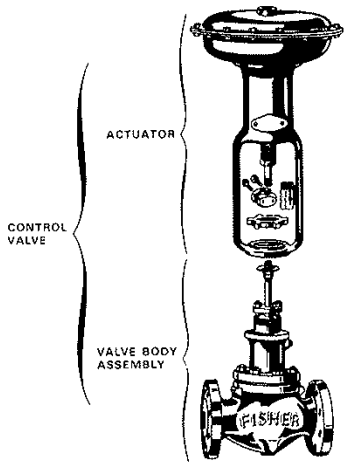


Contents

Introduction

If you've already determined that you need a control valve/instrument package to solve your control problem, you'll be happy to know that Fisher Controls offers an extensive selection of control valves and supporting instrumentation to suit your needs. However, if you have a local pressure control, flow control, flow control, or level control problem and have not yet considered using a Fisher regulator to solve it (instead of a control valve), first refer to section 7, Regulators.

Unlike the integral regulators presented in section 7, the control valves in this section consist of two separable and changeable elements: a valve body assembly and an actuator. therefore, the selection guides and product descriptions in this section are also divided into these two major subsections. A typical example of a valve body assembly and an actuator, and how they fit together, is shown below.



Note that a few selected actuator accessories are also included in this section as a third subsection, but primary measuring and controlling instrumentation is not included here. To find that information, refer to the inside front cover of this catalog. The Quick Reference guide located there will refer you to the electronic or pneumatic instrumentation you need to satisfy both your control room and field instrumentation requirements.

Fisher Controls conforms to several American National Standards relating to valve bodies. These American National Standards consist of more that 300 standards approved by the American National Standards Institute (ANSI). An American National Standard has the implied support of a consensus of those substantially concerned with its scope and provisions. It is intended as a guide to aid the manufacturer, the consumer and the general public. The existence of a standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing or using products, processes or procedures not conforming to the standard.

Control Valve Body Assemblies

Description

As illustrated in the 'Available Control Valve Body Constructions' table, Fisher Controls manufactures an extensive variety of valve body constructions. Therefore, the 'Control Valve Body Assemblies Selection' table has been provided as a quick reference guide to the valve body designs that may suit your application. This selection information should be used only as a general guide since it considers only a few of the necessary application parameters.

To use the selection table, you should know the general nature of the fluid you will control, the maximum inlet pressure that will be applied to the valve, and the maximum fluid temperature. If the maximum fluid temperature is not above those listed in the table for your inlet pressure requirement, you can enter the table directly. For maximum fluid temperatures above those listed in the table, first refer to the graphs on pages 6-6 and 6-7 to determine the pressure rating (ANSI Class) for your combination of maximum inlet pressure and maximum fluid temperature. Then use this ANSI Class designation to enter the selection table. Pressure/temperature ratings for selected alloy materials that are not covered by ANSI Standards are shown in the table on page 6-7.

ANSI pressure/temperature information in the 'Control Valve Body Assemblies Selection' table and in the graphs has been extracted from ANSI Standard 'Cast Iron Pipe Flanges and Flanged Fittings' (ANSI B16.1-1975) and ANSI Standard 'Steel Valves' (ANSI B16.34-1977) with the permission of the publisher, The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, New York 10017.

Please note that the maximum cold working inlet pressure depends not only on the body material, but also upon the specific size and construction of the valve. It is possible that not all constructions of a given valve design will conform to ANSI pressure/temperature ratings. Consult your Fisher sales office or sales representative for verification of valve selections under given service conditions.

Available Control Valve Body Constructions

VALVE BODY STYLES	STANDARD VALVE BODY SIZES	VALVE BODY END CONNECTIONS	VALVE BODY PRESSURE CAPABILITIES	VALVE BODY TEMPERATURE CAPABILITIES	VALVE BODY SHUTOFF CAPABILITIES[1]	STANDARD CONSTRUCTION MATERIALS[2]	
						Valve Body	Internal Parts
Globe Angle 3-Way Ball Butterfly Eccentric Disc	1/2 through 96 in.	NPT Screwed Flanged (Classes 125 through 2500 FF, RF or RTJ) Weld End (Socket or buttwelding)	Up to 50,000 psig (3448 bar)	−425 to +1100°F (−254 to +593°C)	ANSI Class II through VI	Cast Iron Ductile Iron Carbon Steels WCC LCC Alloy Steel WC9 Stainless Steel CF8M Nickel Alloys CN7M M35-1 CW2M	Cast Iron Carbon Steel WCB or WCC Stainless Steels S31600/CF8M S31600/CF8M + CoCr-A CG8M S17400/CB7Cu-1 S20910 S41600 S44004 Nickel Alloys N08020/CN7M N04400/M35-1 N06022/CW2M

1. See "Control Valve Seat Leakage Classifications" table for definition of ANSI leakage classes.
2. Standard materials vary depending upon product. Many other materials can be supplied on a special order basis.

Control Valve Seat Leakage Classifications[1]

ANSI B16.104-1976	MAXIMUM LEAKAGE				TEST MEDIUM	PRESSURE AND TEMPERATURE
Class II	0.5% valve capacity at full travel				Air	Service ΔP or 50 psid (3.5 bar, differential), whichever is lower, at 50° to 125°F (10° to 52°C)
Class III	0.1% valve capacity at full travel				Air	Service ΔP or 50 psid (3.5 bar, differential), whichever is lower, at 50° to 125°F (10° to 52°C)
Class IV	0.01% valve capacity at full travel				Air	Service ΔP or 50 psid (3.5 bar, differential), whichever is lower, at 50° to 125°F (10° to 52°C)
Class V	5×10^{-4} mL/min/psid/in. port dia. (5×10^{-12} m³/sec/bar,differential/mm port dia)				Water	Service ΔP at 50° to 125°F (10° to 52°C)
Class VI	Nominal Port Diameter		Bubbles per Minute	mL per Minute	Air	Service ΔP or 50 psid (3.5 bar, differential), whichever is lower, at 50° to 125°F (10° to 52°C)
	In.	mm				
	1	25	1	0.15		
	1-1/2	38	2	0.30		
	2	51	3	0.45		
	2-1/2	64	4	0.60		
	3	76	6	0.90		
	4	102	11	1.70		
	6	152	27	4.00		
	8	203	45	6.75		

1. Extracted from American National Standard for Control Valve Seat Leakage, ANSI B16.104-1976, with the permission of the publisher, Fluid Controls Institute, Inc.

Selection

Product type numbers and page references are provided along the right-hand side of the selection table to guide you to the appropriate valve body assembly product descriptions. To help you make your final selection, familiarize yourself with the following application considerations and contact your Fisher sales office or sales representative:

- Type of Application:
  - Throttling or on-off
  - Reducing or relief
- Type of fluid to be controlled:
  - Specific gravity
  - Temperature
  - Chemical composition, if unusual
  - Physical characteristics (dirty, viscous, erosive, fibrous)
- Range of flowing inlet pressure
- Pressure drop:
  - Range of flowing pressure drop
  - Maximum at shutoff
- Flow rate:
  - Minimum controlled flow
  - Normal flow
  - Maximum flow
- Maximum permissible noise level, if critical
- Shutoff classification required (see control valve seat leakage classification table)
- Line size and schedule

Control Valve Body Assemblies Selection

MAXIMUM COLD WORKING INLET PRESSURE	GENERAL NATURE OF FLUID						VALVE BODY STYLES						STANDARD SIZES (IN.)	TYPE NUMBER	SEE PAGE
	Clean	Dirty	Viscous	Corrosive	Abrasive Slurry	Fibrous Slurry	Globe	Angle	3-Way	Ball	Butterfly	Eccentric Disc			
Consistent with ANSI Class 125— Up to 150°F: Class 125A = 175 psig Class 125B = 200 psig (up to 66°C: Class 125A = 12.1 bar Class 125B = 13.8 bar)	A	B	A	C	D	D			●				1 - 6	YS	6-21
	A	B	B	C	B	D	●						1 - 8	ES	6-16
							●						1 - 4	ESR	
	A	B	B	C	C	C					●		2 - 60	7600	6-28
	A	C	D	C	D	D	●						1 - 8	ED	6-12
							●						1 - 4	EDR	
	A	D	D	C	D	D	●						1 - 8	ET	6-17
							●						1 - 4	ETR	
									●				1 - 6	YD	6-21
	A	D	D	D	D	D	●						1 - 6	EK	6-14
							●						1 - 4	EKR	
							●						6 - 12	KB or KBR	6-20
	B	A	A	C	D	D	●						1 - 4	EZ	6-18
250 psig up to 150°F (17.2 bar up to 66°C)	A	D	B	D	D	D	●						1/2 - 2	GS	6-19
Consistent with ANSI Class 150— Up to 100°F: CF8M = 275 psig WCC = 290 psig WC9 = 290 psig (up to 38°C: CF8M = 19.0 bar WCC = 20.0 bar WC9 = 20.0 bar	A	A	B	C	B	D	●						1 or 2	D[1]	6-22
								●					1 or 2	DA[1]	
	A	A	B	C	C	A				●			2 - 12	V100	6-25
	A	B	A	C	D	D			●				1 - 6	YS	6-21
	A	B	B	C	B	D	●						1 - 8	ES	6-16
							●						1 - 4	ESR	
								●					1 - 6	EAS	
	A	B	B	C	C	C					●		2 - 24	7600	6-28
	A	B	B	C	D	D						●	2 - 36	8510	6-28
	A	C	D	C	D	D	●						1 - 8	ED	6-12
							●						1 - 4	EDR	
								●					1 - 6	EAD	
	A	D	D	A	D	D	●						1/2 - 4	RSS	6-20
	A	D	D	C	D	D	●						1/2 - 1	B[1]	6-11
							●						1 - 8	ET	6-17
							●						1 - 4	ETR	
								●					1 - 6	EAT	
									●				1 - 6	YD	6-21
	A	D	D	D	D	D	●						1/2 - 4	GL	6-19
							●						1 - 6	EK	6-14
							●						1 - 4	EKR	
							●						6 - 12	KB or KBR	6-20
	B	A	A	C	D	D	●						1 - 4	EZ	6-18
	B	B	B	C	A	B				●			1 - 8	V500	6-27
	B	B	B	C	C	A				●			2 - 12	V150	6-26
	B	C	B	A	D	D	●						1/2 - 4	CE	6-11

A. Designed primarily for this category of service.
B. Normally applicable for this category of service in standard materials and/or constructions.
C. Applicable for this category of service in optional materials and/or constructions.
D. Other designs are normally more applicable for this service.

1. This type is not a standard construction for this pressure rating (its standard constructions have higher pressure ratings), but it is an economical design and can be provided at this lower pressure rating to suit your needs.

—Continued—

Control Valve Body Assemblies Selection (Continued)

MAXIMUM COLD WORKING INLET PRESSURE	GENERAL NATURE OF FLUID						VALVE BODY STYLES						STANDARD SIZES (IN.)	TYPE NUMBER	SEE PAGE
	Clean	Dirty	Viscous	Corrosive	Abrasive Slurry	Fibrous Slurry	Globe	Angle	3-Way	Ball	Butterfly	Eccentric Disc			
Consistent with ANSI Class 250—	A	B	A	C	D	D			●				1/2 - 6	YS	6-21
Up to 150°F:	A	B	B	C	B	D	●						1/2 - 8	ES	6-16
Class 250A = 400 psig							●						1 - 4	ESR	
Class 250B = 500 psig	A	B	B	C	C	C					●		2 - 60	7600	6-28
(up to 66°C:	A	C	D	C	D	D	●						1 - 8	ED	6-12
Class 250A = 27.6 bar							●						1 - 4	EDR	
Class 250B = 34.5 bar)	A	D	D	C	D	D	●						1 - 8	ET	6-17
							●						1 - 4	ETR	
									●				1/2 - 6	YD	6-21
	A	D	D	D	D	D	●						1 - 6	EK	6-14
							●						1 - 4	EKR	
							●						6 - 10	KB or KBR	6-20
	B	A	A	C	D	D	●						1/2 - 4	EZ	6-18
600 psig up to 100°F (41.4 bar up to 38°C)	A	D	D	D	D	D	●						6 or 8	KB or KBR	6-20
720 psig up to 100°F (49.6 bar up to 38°C)	A	D	D	D	D	D	●						10 or 12	KB or KBR	6-20
Consistent with ANSI Class 300—	A	A	B	C	B	D	●						1 or 2	D[1]	6-22
								●					1 or 2	DA[1]	
Up to 100°F:	A	A	B	C	C	A				●			2 - 8	V100	6-25
CF8M = 720 psig										●			10[2] or 12[2]		
WCC = 750 psig	A	B	A	C	D	D			●				1/2 - 6	YS	6-21
WC9 = 750 psig															
(up to 38°C:	A	B	B	C	B	D	●						12 or 16	ELS	6-14
CF8M = 49.6 bar							●						1/2 - 8	ES	6-16
WCC = 51.7 bar							●						4 x 2 - 12 x 8	EWS	6-16
WC9 = 51.7 bar)							●						1 - 4	ESR	
or								●					1 - 6	EAS	
ANSI Class 600—															
Up to 100°F	A	B	B	C	C	C					●		2 - 24	7600	6-28
CF8M = 1440 psig	A	B	B	C	D	D						●	2 - 36	8510	6-28
WCC = 1500 psig	A	C	D	C	D	D	●						1 - 8	ED	6-12
WC9 = 1500 psig							●						4 x 2 - 12 x 8	EWD	
(up to 38°C:							●						1 - 4	EDR	
CF8M = 99.3 bar								●					1 - 6	EAD	
WCC = 103.4 bar							●						12 x 8	EWND	6-18
WC9 = 103.4 bar)	A	D	B	C	D	D				●			4 - 24	V250	6-27

A. Designed primarily for this category of service.
B. Normally applicable for this category of service in standard materials and/or constructions.
C. Applicable for this category of service in optional materials and/or constructions.
D. Other designs are normally more applicable for this service.

1. This type is not a standard construction for this pressure rating (its standard constructions have higher pressure ratings), but it is an economical design and can be provided at this lower pressure rating to suit your needs.
2. Not available in Class 600 rating.

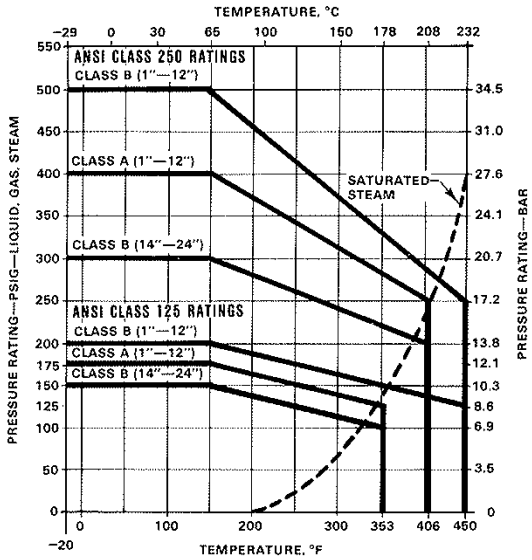
—Continued—

Control Valve Body Assemblies Selection (Continued)

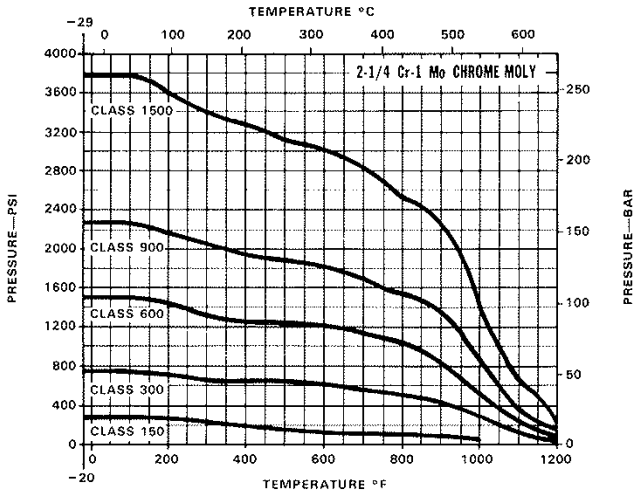
MAXIMUM COLD WORKING INLET PRESSURE	GENERAL NATURE OF FLUID						VALVE BODY STYLES						STANDARD SIZES (IN.)	TYPE NUMBER	SEE PAGE
	Clean	Dirty	Viscous	Corrosive	Abrasive Slurry	Fibrous Slurry	Globe	Angle	3-Way	Ball	Butterfly	Eccentric Disc			
Consistent with ANSI Class 300— Up to 100°F: CF8M = 720 psig WCC = 750 psig WC9 = 750 psig (up to 38°C): CF8M = 49.6 bar WCC = 51.7 bar WC9 = 51.7 bar) or ANSI Class 600— Up to 100°F CF8M = 1440 psig WCC = 1500 psig WC9 = 1500 psig (up to 38°C): CF8M = 99.3 bar WCC = 103.4 bar WC9 = 103.4 bar)	A	D	D	C	D	D	●						1/2 - 1	B[1]	6-11
							●						1 - 8	ET	6-17
							●						4 x 2 - 12 x 8	EWT	
							●						1 - 4	ETR	
								●					1 - 6	EAT	
							●						12 x 8	EWNT	6-18
									●				1/2 - 6	YD	6-21
	A	D	D	D	D	D	●						1/2 - 4	GL	6-19
							●						1 - 6	EK	6-14
							●						1 - 4	EKR	
								●					6	EAP	6-15
	B	A	A	C	A	D		●					2 x 3 - 6 x 8	461	6-21
	B	A	A	C	D	D	●						1/2 - 4	EZ	6-18
	B	B	B	C	A	B				●			1 - 8	V500	6-27
	B	C	B	A	D	D	●						1/2 - 4	CE	6-11
1500 psig up to 450°F (103 bar up to 232°C)	A	D	D	C	D	D	●						1/2 - 1	B	6-11
Consistent with ANSI Class 900— Up to 100°F: CF8M = 2160 psig WCC = 2250 psig WC9 = 2250 psig (up to 38°C: CF8M = 148.9 bar WCC = 155.1 bar WC9 = 155.1 bar)	A	B	B	C	B	D	●						12 or 16	ELS	6-14
							●						8 x 6 or 12 x 8	EWS	6-16
	A	B	B	C	C	C					●		2 - 24	7600	6-28
	A	B	D	C	D	D		●					1 or 2	DBAQ	6-23
	A	C	D	C	D	D	●						8 x 6 or 12 x 8	EWD	6-12
							●						8 x 6 or 12 x 8	EWND	6-18
	A	D	B	C	D	D				●			4 - 24	V250	6-27
	A	D	D	C	D	D	●						8 x 6 or 12 x 8	EWNT	6-18
							●						8 x 6 or 12 x 8	EWT	6-17
	B	A	A	C	A	D		●					2 x 3 - 6 x 8	461	6-21
Consistent with ANSI Class 1500— Up to 100°F: CF8M = 3600 psig WCC = 3750 psig WC9 = 3750 psig (up to 38°C: CF8M = 248.1 bar WCC = 258.6 bar WC9 = 258.6 bar)	A	A	B	C	B	D	●						1 or 2	D	6-22
								●					1 or 2	DA	
	A	B	B	C	B	D	●						1 - 6	EHS	6-23
	A	B	B	C	C	C					●		2 - 24	7600	6-28
	A	B	D	C	D	D		●					1 or 2	DBAQ	6-23
	A	C	D	C	D	D	●						2 - 14	EHD	6-23
	A	D	D	C	D	D	●						8 or 10	EHP	6-23
							●						2 - 14	EHT	6-23
	B	A	A	C	A	D		●					2 x 3 - 6 x 8	461	6-21
Consistent with ANSI Class 2500— Up to 100°F: CF8M = 6000 psig WCC = 6250 psig WC9 = 6250 psig (up to 38°C: CF8M = 413.6 bar WCC = 431.0 bar WC9 = 431.0 bar)	A	A	B	C	B	D	●						1 or 2	D	6-22
								●					1 or 2	DA	
	A	B	B	C	B	D	●						1 - 6	EHS	6-23
	A	B	B	C	C	C					●		2 - 12	7600	6-28
	A	B	D	C	D	D		●					1 or 2	DBAQ	6-23
	A	C	D	C	D	D	●						2 - 14	EHD	6-23
	A	D	D	C	D	D	●						2 - 14	EHT	6-23
	B	A	A	C	A	D		●					2 x 3 - 3 x 4	461	6-21
10,000 psig up to 250°F (690 bar up to 121°C)	A	A	B	C	B	D	●						2	D	6-22
								●					2	DA	

A. Designed primarily for this category of service.
B. Normally applicable for this category of service in standard materials and/or constructions.
C. Applicable for this category of service in optional materials and/or constructions.
D. Other designs are normally more applicable for this service.

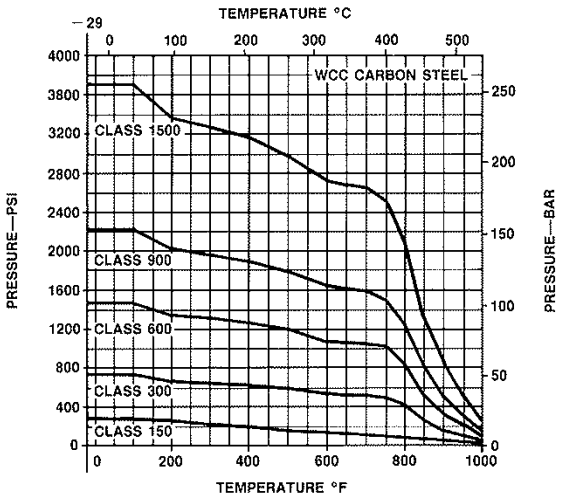
1. This type is not a standard construction for this pressure rating (its standard constructions have higher pressure ratings), but it is an economical design and can be provided at this lower pressure rating to suit your needs.



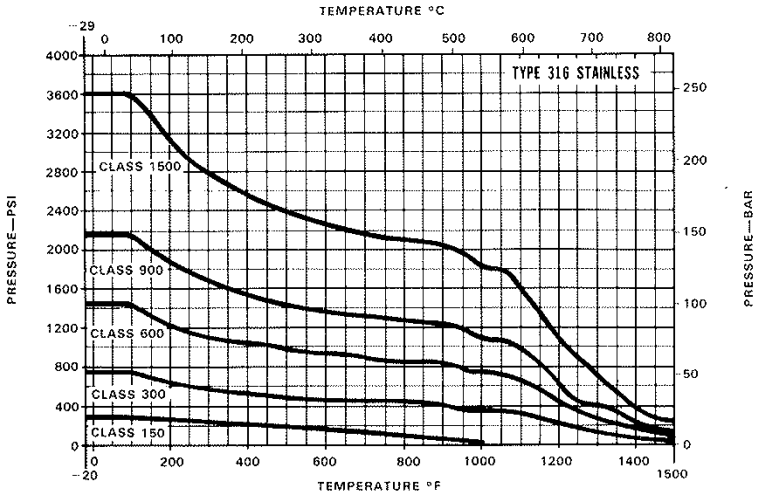
Use This Graph to Determine ANSI Class Designation for a Gray Cast Iron Valve Body Assembly



Use This Graph to Determine ANSI Class Designation for a CF8M Stainless Steel Valve Body Assembly



Use This Graph to Determine ANSI Class Designation for a WCC Carbon Steel Valve Body Assembly



Use This Graph to Determine ANSI Class Designation for a WC9 Alloy Steel Valve Body Assembly

Use This Table to Determine Pressure Rating for a Nickel Alloy Valve Body Assembly

TEMPERATURE	M30C[1]			CN7M[1]			CW2M		
	150[2]	300[2]	600[2]	150[2]	300[2]	600[2]	150[2]	300[2]	600[2]
°F	Psig								
to 100	195	515	1030	195	515	1030	290	750	1500
200	175	450	905	175	455	915	260	730	1465
300	160	425	845	165	430	855	230	695	1390
400	155	410	820	---	---	---	200	695	1390
500	155	410	820	---	---	---	170	665	1330
600	140	410	820	---	---	---	140	605	1210
700	110	410	820	---	---	---	110	570	1135
800	80	390	785	---	---	---	80	510	1015
°C	Bar								
to 38	13.4	35.5	71.0	13.4	35.5	71.0	20.0	51.7	103.4
93	12.1	31.0	62.4	12.1	31.4	63.1	17.9	50.3	101.0
149	11.0	29.3	58.3	11.4	29.6	59.0	15.9	47.9	95.8
204	10.7	28.3	56.5	---	---	---	13.8	47.9	95.8
260	10.7	28.3	56.5	---	---	---	11.7	45.9	91.7
316	9.7	28.3	56.5	---	---	---	9.7	41.7	83.4
371	7.6	28.3	56.5	---	---	---	7.6	39.3	78.3
427	5.5	29.9	54.1	---	---	---	5.5	35.2	70.0

1. These body materials are not ASME code-approved materials. Valves constructed of these materials also are not included in ANSI B16.34-1977 pressure/temperature ratings and must not be installed in systems requiring conformance to ANSI standards.
2. The designations "150", "300", and "600" are used to indicate relative pressure-retaining capabilities and are not designations of ANSI pressure/temperature rating classes.

Actuators

Description

Almost all of the valve body assemblies in this Control Valves section require the addition of an actuator before they can respond to a control signal. And Fisher Controls manufactures a wide assortment of actuators to suit most any need. The following selection tables provide a quick reference guide for you.

Selection

Enter the actuator table with the particular type of application and type of required control action in mind. The actuator styles, type numbers and page references are provided along the right-hand side of the selection table to guide you to the appropriate product descriptions.

Note that this selection information should only be used as a general guide. Final actuator selection and sizing (e.g., physically and mathematically matching a particular actuator capability to a set of application requirements) should be done with the assistance of your Fisher sales office or sales representative. Contact him with your particular application requirements, including:

- Power sources available for actuator operation:
  Type of sources (pneumatic, electric, etc.)
  Power output capabilities
- Control signal which actuator will receive:
  Type of signal (pneumatic, electric, etc.)
  Range
- Special performance capabilities, such as:
  Fail-safe action
  Split-range operation
  High-speed stroking, etc.

Actuators

TYPICAL CONTROL	MAXIMUM STEM TRAVEL		MAXIMUM USABLE THRUST		ACTUATOR STYLE									TYPE NUMBER	SEE PAGE
					Pneumatic										
					Spring-opposed Diaphragm	Piston	Spring and Piston	Electrohydraulic Piston	Electromechanical	Lever	Float(1)	Manual Handwheel	Manual Handlever		
	In.	mm	lb	N											
For Use on Globe, Angle, and Other Sliding-Stem Valves															
Proportional (Throttling) Control	3/4	19	133	592							•			617	6-37
			416(2)	1850(2)	•									513 or 513R	6-29
			1175	5230						•				607	6-37
	1-1/8	29	10,621	4725	•									1250R	6-32
			37,931	16,875	•									1250	6-32
	2	51	87	387							•			618	6-37
			1610	7162		•								585, 585R	6-35
			2350	10,500						•				608	6-37
	3	76	5000	22,200				•						350 Series	6-36
			10,300	45,800				•						323	6-36
			17,000	75,600								•		1008	6-38
	4-1/8	105	37,900	169,000	•									657	6-30
			45,000	200,000	•									667	6-31
	8-1/8	206	30,000(3)	135,500(3)		•	•							470 Series	6-32
	24	610	20,100	89,400		•								490	6-34
Two-Position (On/Off) Control	3/4	19	416(2)	1850(2)	•									513 or 513R	6-29
			1175	5230						•				607	6-37
	1-1/8	29	10,621	4725	•									1250R	6-32
			37,931	16,875	•									1250	6-32
	2	51	1610	7162		•								585, 585R	6-35
			2350	10,500						•				608	6-37
	3	76	5000	22,200				•						350 Series	6-36
			17,000	75,600								•		1008	6-38
	4-1/8	105	37,900	169,000	•									657	6-30
			45,000	200,000	•									667	6-31
	8-1/8	206	30,000(3)	135,500(3)		•	•							470 Series	6-32
	24	610	29,800	133,000		•								490	6-34

—Continued—

Actuators (Continued)

TYPICAL CONTROL	MAXIMUM STEM TRAVEL		MAXIMUM USABLE THRUST		ACTUATOR STYLE									TYPE NUMBER	SEE PAGE
					Pneumatic										
					Spring-opposed Diaphragm	Piston	Spring and Piston	Electrohydraulic Piston	Electromechanical	Lever	Float(1)	Manual Handwheel	Manual Handlever		
	In.	mm	lb	N											
For Use on Globe, Angle, and Other Sliding-Stem Valves															
Proportional (Throttling) or Two-Position (On/Off) Control	8-1/8	206	10,300	45,800				●						320	6-36
			19,500	86,700		●	●							470 Series	6-32
			33,00(3)	147,000(3)		●								480 Series	6-33
For Use on Butterfly and Ball Valves															
Proportional (Throttling) or Two-Position (On/Off) Control	4-1/8	105	3440	15,300	●									656	6-29
	8-1/8	206	33,000(3)	147,000(3)		●								480 Series	6-33
	90°	90°	7031 in.-lb	794 N•m				●						354	6-36
			10,360 in.-lb	1170 N•m	●									1051 or 1052	6-31
			45,000 in.-lb	5080 N•m		●								1061	6-35
			33,500 in.-lb	3780 N•m				●						321	6-36
			16,000 in.-lb	1800 N•m								●		1076	6-38
For Use on Eccentric-Disc Valves															
Proportional (Throttling) or Two-Position (On/Off) Control	90°	90°	1000 in.-lb	113 N•m									●	1083	6-39
			10,360 in.-lb	1170 N•m	●									1051 or 1052	6-31
			16,000 in.-lb	1800 N•m								●		1076	6-38
			45,000 in.-lb	5080 N•m		●								1061	6-35
			33,500 in.-lb	3780 N•m				●						321	6-36
For Operating Louvers, Dampers or Similar Equipment															
Proportional or Two-Position Control	4-1/8	105	3440	15,300	●									656	6-29
	8-1/8	206	33,000(3)	147,000(3)		●								480 Series	6-33

1. Also see the following table of float-operated sensors. These sensors may also be used to operate control valves, but require the use of a lever actuator such as the Type 607 or 608.
2. Based on a 6 to 30 psig (0.4 to 2.0 bar) operating pressure range.
3. This thrust or torque can only be produced with a travel or rotation less than that given in the "Maximum Stem Travel" column.
4. This actuator construction is compatible with the travel requirements of any Fisher valve on which it can be mounted.

Accessory Equipment for Control Valves

Control valves may require many different types of accessory equipment, depending upon the specific application requirements. The following table only references selected accessory equipment and its use. For information a about additional accessories (e.g., seat ring pullers, solenoid valves, limit switches, auxiliary handwheels, travel stops), and to help you select the required accessory equipment for your needs, contact your Fisher sales office or sales representative.

Accessory Equipment for Control Valves

SELECTED ACCESSORIES	USE			TYPE NUMBER	SEE PAGE
Air signal relays	For high-volume, pneumatic boosting			2625	6-40
Noise abatement equipment	To eliminate excessive fluid noise from turbulent flow	For liquid flow		Cavitrol® trims	8-3
		For gas or vapor flow		Whisper Trim® cages 6010, 6011	8-2 8-3
Pressure gauges	For indication of positive air or gas pressures			J500 Series, J510 Series	7-53
Signal transducers	To convert an electrical transmission signal to a proportional, pneumatic output signal			546, 646	3-13
Strainers	To remove dirt, scale or other solid substances from the flow stream just upstream from the control valve			260 Series	10-2
Switching valves	To provide two-position (on/off) control, fail-safe operation or venting of pneumatic actuators	Pneumatic input, pneumatic output		164A	7-52
				167A	7-52
				168 or 168H Series	7-53
Valve positioners	To provide a close correlation between the value of a proportional signal to an actuator and the actuator stem or shaft position	Pneumatic input, pneumatic output		3610 Series	(1)
				3582 Series, 3660	4-16
		Electrical input, pneumatic output		3620 Series 3582i, 3661	3-14 3-15
Valve position switch	To operate electric alarms, signal lights, relays, etc., in response to a linear or rotary motion valve position			304	6-39
Valve position transmitters	To provide valve stem or shaft position information to an indicating gauge or meter at a remote location through a proportional output signal	Pneumatic operation	For linear stem motion	3583 3583C	6-41
		Electronic operation	For linear or rotary shaft motion	4200	6-41

1. These positioners are compatible only with certain rotary-shaft actuators. Therefore, they are identified only in the actuator product description(s) for which they are compatible.

B Globe-Style Control Valve

The Design B control valve body assembly is a very economical, general purpose construction. It is used for either throttling or on/off control of low flow rates for a wide variety of liquids and gases as well as steam. All bodies are machined from bar stock materials to allow for broad material selection and improved material availability. For these reasons, the Design B is also used for handling corrosive fluids, where material selection is based on individual requirements for corrosion protection. This valve body assembly is typically operated by a Type 513 direct-acting or Type 513R reverse-acting actuator (actuator action can be easily reversed without additional parts).

Available Configurations: Flangeless, single-port control valve body assemblies with stem-guided valve plug, screwed-in seat ring, metal-seat construction, and push-down-to-close valve plug action.

Body Sizes: 1/2, 3/4, or 1 in.

End Connection Styles: NPT screwed; socket welding ends

Shutoff Classifications: ANSI Class IV or V depending upon specific construction, application, and shutoff requirements

Maximum Inlet Pressures and Pressure Drops: Up to 1500 psig (103 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From −50 to +450°F (−46 to +232°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): 1/2 in. = 2.5, 3/4 in. = 4.0, 1 in. = 7.4.

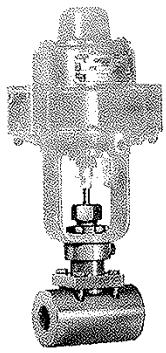
Flow Characteristic: Equal Percentage

Flow Directions: Flow up through the seat ring.

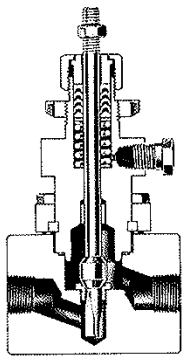
Typical Construction Materials: *Valve Body, Bonnet*—Carbon steel, stainless steel or any other available bar stock material. *Valve Plug, Valve Plug Stem, Seat Ring*—Stainless steel for carbon steel and stainless steel bodies, same as the body for other materials unless otherwise specified. *Guide Bushing*—Stainless steel. *Packing*—TFE V-ring, TFE-impregnated composition

Additional Options: Packing lubricator and isolating valve

Bulletin Reference: 51.1:B



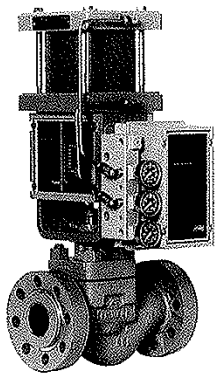
Type 513R-B Control Valve (Type 513R Actuator on Design B Valve Body Assembly)



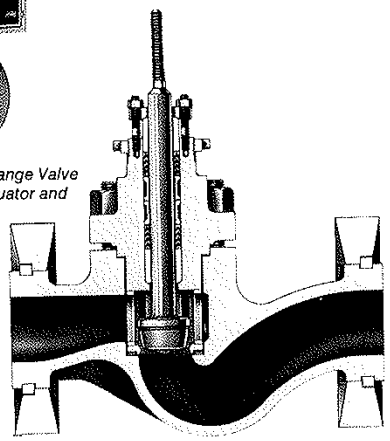
Design B

CE Globe-Style Control Valve

Design CE globe-style control valve body assemblies are ideal for economical control of corrosive fluids encountered in chemical processing or other industries. They are also well suited to controlling non-lubricating, viscous, or other hard-to-handle fluids. These valve bodies may be operated by a variety of actuators.



Design CE Separable-Flange Valve Body with Type 585 Actuator and 3611JP Positioner



Design CE

Available Configurations: The Design CE is a single port, globe-style control valve body assembly with stem guiding, metal-seat or soft-seat construction, and push-down-to-close valve plug action.

Body Sizes: .5, .75, 1, 1.5, 2, 3, or 4 in.

End Connection Style: Raised face separable flanges to mate with Class 150, 300, or 600 flanges.

Shutoff Classification: ANSI Class IV, V, or VI depending upon specific construction.

Maximum Inlet Pressures and Pressure Drops: Up to 1500 psig (103 bar) depending upon specific construction and temperature requirements.

Process Temperature Capabilities: From -20 to 450 F (-29 to 232 C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (Cv): .5 in. = 4.65, .75 in. = 10.3, 1 in. = 12.6, 1.5 in. = 27.8, 2 in. = 49.1, 3 in. = 116, 4 in. = 196.

Flow Characteristics: Equal percentage or linear

Flow Direction: Normally flow up through seat ring

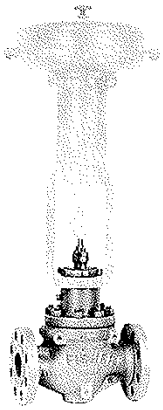
Typical Construction Materials: *Valve Body, Bonnet, and Flanges*—steel, stainless steel, and other alloy materials. *Valve Plug, Valve Plug Stem, and Seat Ring*—stainless steel and other alloy materials. *Packing*—TFE V-ring, TFE composition, or graphite laminate/filament

Additional Options: Restricted capacity trim (reduced size valve trim parts) permits sizing the body for future demands while allowing for accurate control of temporary low flow requirements.

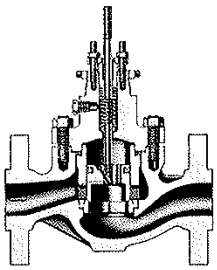
Bulletin Reference: 51.1:CE

ED Series easy-e® Control Valves

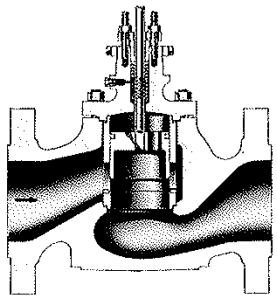
The ED Series are general purpose constructions which are used for either throttling or on/off control of a wide variety of non-gritty and non-sticky liquids and gases as well as steam. They are used over a broad range of pressure drops and temperatures where good shutoff (ANSI Class II or III) is adequate. In addition, the ED Series have a pressure-balancing valve plug, designed to permit the use of lower thrust, lower cost actuators. These valve body assemblies can be operated by any one of a variety of actuators.



Type 667-ED Control Valve (Type 667 Actuator on Design ED Valve Body Assembly)



Design ED



Design EWD

Available Configurations: *Common Characteristics*—Single-port control valve body assemblies with bolted-on bonnet, pressure-balancing cage-guided valve plug, cage-retained seat ring, and metal seat construction. *Design Descriptions*—See table

Body Sizes: See table

End Connection Styles: See table

Shutoff Classification: ANSI Class II or III depending upon specific construction, application, and shutoff requirements

Maximum Inlet Pressures and Pressure Drops: Up to 1500 psi (103 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 425 to + 1100°F (− 254 to + 593°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): See table

Flow Characteristics: Equal percentage, linear, or quick opening

Flow Direction: Normally flow in through the cage openings and out through the seat ring

Typical Construction Materials: *Valve Body, Bonnet*—Cast iron, carbon steel or stainless steel. *Bottom Flange (Design EDR Only)*—Same material as body. *Valve Plug*—Hardened stainless steel. *Cage*—Cast iron, hardened stainless steel or cobalt-base Alloy 6. *Valve Plug Stem*—Stainless steel. *Seat Ring*—Hardened stainless steel or cobalt-base Alloy 6. *Packing*—TFE V-ring, TFE-impregnated composition graphite laminate/filament, or laminated graphite

Additional Options: *Whisper Trim® cage* for the reduction of noise from turbulent gas or vapor flow. *Cavitrol® cage* for reduction of cavitation, cavitation noise and cavitation damage from flowing liquids. *Outlet-port liner* to protect the body casting from damage on erosive applications. *Restricted-capacity trim* (reduced size valve plug, cage and seat ring) permits sizing the body for future demands while allowing for accurate control of present low flow requirements. *Extension bonnets* to protect packing on high or low temperature service. *Bellows seal bonnet* for positive stem sealing of hard-to-handle fluids. *Drilled and tapped bonnet connections* for leak-offs, temperature or pressure gauges, etc. *Packing lubricator* and isolating valve. *Valve body drain* plug. *Variety of construction materials* for special service

Bulletin References: *Design EWD*—51.1:EW. *All Others*—51.1:ED

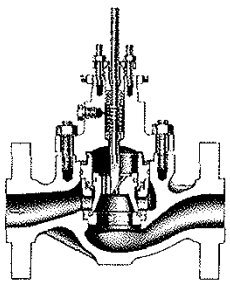
DESIGNATION			Design ED	Design EAD	Design EWD	Design EDR
CONFIGURATION			Typical globe-style configuration with push-down-to-close valve plug action	Angle-style version of the Design ED, generally used to facilitate piping or where a self-draining valve body is desired	Globe-style configuration with push-down-to-close valve plug action and oversized end connections, generally used to eliminate the need for line swages or to minimize fluid velocity at the valve body outlet. Threaded-in seat ring also available.	Globe-style configuration with push-down-to-open valve plug action and a construction that permits easy access to the internal valve body parts through the bottom of the body without having to remove the actuator
BODY SIZES & MAXIMUM FLOW COEFFICIENTS (C_v)[1]			1 inch = 17.2 1-1/4 inch = 17.2 1-1/2 inch = 35.8 2 inch = 59.7 2-1/2 inch = 99.4 3 inch = 136 4 inch = 224 6 inch = 394 8 inch = 818	1 inch = 19.0 2 inch = 47.2 3 inch = 148 4 inch = 156 6 inch = 328	4 inch ends on 2 inch body = 82.2 6 inch ends on 4 inch body = 271 8 inch ends on 4 inch body = 286 8 inch ends on 6 inch body = 508 12 inch ends on 6 inch body = 565 12 inch ends on 8 inch body = 1160	1 inch = 17.2 1-1/2 inch = 35.8 2 inch = 59.7 2-1/2 inch = 99.4 3 inch = 136 4 inch = 224
END CONNECTION STYLES	**Screwed**		NPT	– – –	– – –	NPT
	Flanged	**Iron**	Class 125 or 250	– – –	– – –	Class 125 or 250
		Steel	Class 150, 300 or 600	Class 150, 300 or 600	Class 300, 600 or 900[2]	Class 150, 300 or 600
	Welding Ends		Buttwelding or socket	Buttwelding or socket	Buttwelding	Buttwelding or socket

1. The flow coefficients shown are for an equal percentage characteristic. The flow coefficients for the linear and quick opening characteristics are normally greater.
2. Only sizes available in Class 900 rating are 8 inch ends on 6 inch body and 12 inch ends on 8 inch body.

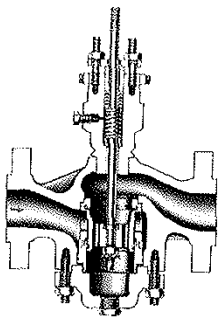
EK-Series easy-e® Control Valves

The EK Series are general purpose constructions which are used for either throttling or on/off control of a wide variety of clean liquids and gases. They are applicable from − 20 to + 400°F (− 29 to + 204°C) over a broad range of pressure drops where excellent shutoff (ANSI Class VI) is required. In addition, the EK Series have a pressure-balancing valve plug, designed to permit the use of lower thrust, lower cost of actuators. These valve body assemblies can be operated by any one of a variety of actuators.

Type 667-EK Control Valve (Type 667 Actuator on Design EK Valve Body Assembly)



Design EK



Design EKR

Available Configurations: *Common Characteristics*—Single-port, globe-style control valve body assemblies with pressure-balancing cage-guided valve plug, cage-retained seat ring and soft seat construction. *Design EK*—This configuration has a bolted-on bonnet and push-down-to-close valve plug action. *Design EKR*—This configuration has a screwed-in bonnet, bolted-on bottom flange, push-down-to-open valve plug action and a construction that permits easy access to the internal valve body parts through the bottom of the body without having to remove the actuator

Body Sizes: 1, 1-1/2, 2, 2-1/2, 3 or 4 in. (EK-Series), and 6 in. (Design EK only)

End Connection Styles: NPT screwed; flanged iron (Class 125 or 250) or steel (Class 150, 300 or 600); for Design EK only, buttwelding or socket welding ends

Shutoff Classification: ANSI Class VI

Maximum Inlet Pressures and Pressure Drops: Up to 1480 psig (102 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 20 to 400°F (− 29 to + 204°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v)*: 1 in. = 20.6, 1-1/2 in. = 39.1, 2 in. = 69.3, 2-1/2 in. = 104, 3 in. = 145, 4 in. = 219, 6 in. = 427

Flow Characteristics: Linear, equal percentage (with restricted-capacity cage only), or quick opening

Flow Direction: Flow in through the cage openings and out through the seat ring

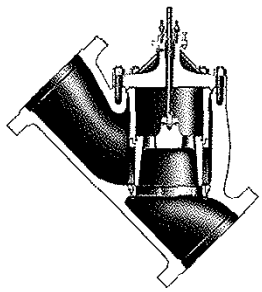
Typical Construction Materials: *Valve Body, Bonnet*—Cast iron, carbon steel or stainless steel. *Bottom Flange (Design EKR only)*—Same material as body, *Valve Plug, Seat ring*—Stainless steel with nitrile, Viton†, nylon or TFE seals. *Valve Plug Stem*—Stainless steel. *Cage*—Cast iron (electroless nickel coated). *Packing*—TFE V-ring or TFE-impregnated composition

Additional Options: *Restricted-capacity cage* (standard diameter cage with reduced-size flow openings) permits sizing the body for future demands while allowing for accurate control of present low flow requirements. *Drilled and tapped bonnet connections* for leak-offs, temperature or pressure gauges, etc. *Packing lubricator* and isolating valve. *Valve body drain* plug

Bulletin Reference: 51.1:EK

EL-Series easy-e® Control Valves

The EL Series are large valve body assemblies with a slant-type body design to provide much higher flow capacity than is possible with conventional globe or angle bodies of the same size. A hanging-cage design eliminates gasketing problems caused by thermal expansion and contraction of the cage assembly. Also, because of this cage design, the cage adaptor, cage, and seat ring can be removed in one piece in most standard constructions.



Design ELD

Available Configurations: *Common Characteristics*—Single-port control valve body assemblies with push-down-to-close, cage-guided valve plug and metal-seat construction. *Design Descriptions*—See table

*The flow coefficients show are for a linear characteristic. The flow coefficients for the quick opening characteristic are somewhat larger, and the flow coefficients for the restricted, equal percentage characteristic are much smaller.
†Trademark of Du Pont Co.

Body Sizes: See table

End Connection Styles: See table

Shutoff Classifications: See table

Maximum Inlet Pressures and Pressure Drops: Up to 2250 psig (155 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 20 to + 450°F (− 29 to + 232°C) for standard constructions

Maximum Flow Coefficients (C_v): See table

Flow Characteristics: Equal percentage, linear, or quick opening

Flow Direction: *Designs ELD and ELT*—Normally flow in through the cage openings and out through the seat ring. *Design ELS*—Normally flow up through the seat ring and out through the cage openings

Typical Construction Materials: *Valve Body and Bonnet*—Carbon steel or alloy steels. *Valve Plug*—Hardened stainless steel with carbon-filled TFE piston ring (ELD) or spring-loaded seal ring (ELT). *Valve Plug Stem*—Stainless steel. *Cage and Cage Adaptor*—Electroless nickel coated carbon steel. *Seat Ring*—Hardened stainless steel. *Packing*—TFE V-ring, TFE-impregnated composition graphite laminate/filament, or laminated graphite

Additional Options: *Whisper Trim®cage* for the reduction of noise from turbulent gas or vapor flow. *High and low temperature constructions* for applications where the fluid temperature is outside the − 20 to 450°F (− 29 to + 232°C) range. *Drilled and tapped bonnet connections* for leak-offs, temperature or pressure gauges, etc. *Packing lubricator* and isolating valve. *Variety of construction materials* for special service

Bulletin Reference: 51.1:EL

DESIGNATION		Design ELD	Design ELS	Design ELT
CONFIGURATION		Balanced valve plug design for general applications with high pressure drops and high temperature	Unbalanced valve plug design for high temperature applications where good shutoff is required	Balanced valve plug design for high pressure drop applications up to 450°F (232°C) where good shutoff is required
BODY SIZES AND MAXIMUM FLOW COEFFICIENTS (C_v)(1)		12 inch = 1970 16 inch = 3310	12 inch = 1690 16 inch = 2910	12 inch = 1970 16 inch = 3310
END CONNECTION STYLES	Flanged	Classes 300, 600, & 900(2)	Classes 300, 600, & 900(2)	Classes 300, 600, & 900(2)
	Buttwelding ends	Schedules 40, 80, & 120	Schedules 40, 80, & 120	Schedules 40, 80, & 120
ANSI SHUTOFF CLASSIFICATION	Standard	Class II	Class IV	Class IV
	Optional	Class III	Class V	Class V

1. The flow coefficients shown are for an equal percentage characteristic. The flow coefficients for the linear and quick opening characteristics are normally greater.
2. 12 inch size only.

EAP easy-e® Control Valve

The Design EAP features an angle style body with single-port construction for either on/off or throttling control of steam, as well as a wide variety of non-gritty and non-sticky liquids and gases. Its temperature capability extends to 950°F (510°C) over a broad range of pressure drops, with excellent metal-to-metal shutoff capability achieved without temperature-limiting elastomers. In addition, the Design EAP uses use a primary valve plug that has a pilot valve plug designed to permit the use of lower thrust, lower cost actuators. It can be operated by any one of a variety of actuators.

Available Configuration: Angle style single-port control valve body assembly with bolted-on bonnet, pilot valve plug and cage-guided primary valve plug, cage with integral seat ring, metal-seat construction, and push-down-to-close valve plug action.

Body Size: 6 in.

End Connection Styles: Class 600 flanged

Shutoff Classification: ANSI Class V

Maximum Inlet Pressures and Pressure Drops: Up to 2250 psi (155 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 20 to + 950°F (− 29 to + 510°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficient (C_v): 383

Flow Characteristic: Linear

Flow Direction: In through the cage windows and down through the integral seat ring of the cage

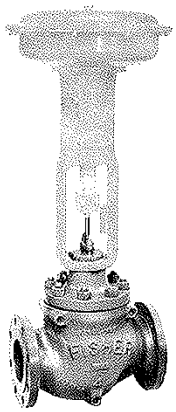
Typical Construction Materials: *Valve Body, Bonnet (plus bonnet spacer if used)*—Carbon steel or stainless steel. *Piston Ring*—Graphite. *Cage*—Stainless steel. *Valve Plug and Stem Assembly*—Nickel alloy and/or stainless steel. *Packing*—Low-chloride graphite laminate/filament, TFE V-ring

Additional Options: *Extension bonnets* to protect backing on high or low temperature service. *Drilled and tapped bonnet connections* for leak-offs, temperature or pressure gauges, etc. *Valve body drain* plug. *Variety of construction materials* for special service

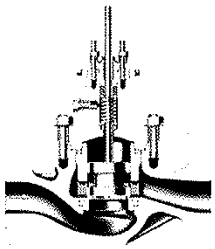
Bulletin Reference: 51.1:EP

ES-Series easy-e® Control Valves

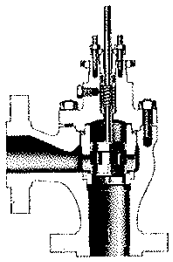
The ES Series are general purpose constructions which are normally used for either throttling or on/off control of a wide variety of non-gritty liquids and gases as well as steam. They are applicable over a broad range of pressure drops and temperatures where excellent shutoff (up to ANSI Class VI) is required. The ES Series may be operated by a variety of actuators.



Type 657-ES Control Valve (Type 657 Actuator on Design ES Valve Body Assembly)



Design ES



Design EAS

Available Configurations: *Common Characteristics*—Single-port control valve body assemblies with bolted-on bonnet, cage-guided valve plug, cage-retained seat ring, and either metal-to-metal or soft seats. *Design Descriptions*—See table

Body Sizes: See table

End Connection Styles: See table

Shutoff Classifications: ANSI Class IV, V, or VI depending upon specific construction, application, and shutoff requirements

Maximum Inlet Pressures and Pressure drops: Up to 1500 psi (103 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 425 to + 1100°F (− 254 to + 593°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): See table

Flow Characteristics: Equal percentage, linear, or quick opening

Flow Direction: Normally flow in through the seat ring and out through the cage openings

Typical Construction Materials: *Valve Body, Bonnet*—Cast iron, carbon steel or stainless steel. *Bottom Flange (Design ESR Only)*—Same material as body. *Valve Plug*—Hardened stainless steel. *Cage*—Hardened stainless steel or cobalt-base Alloy 6. *Valve Plug Stem*—Stainless steel. *Seat Ring*—Metal Seat, hardened stainless steel or cobalt-base Alloy 6; Soft Seat, hardened stainless steel with TFE disc. *Packing*—TFE V-ring, TFE-impregnated composition, graphite laminate/filament, or laminated graphite

Additional Options: *Whisper Trim® cage* for reduction of noise from turbulent gas or vapor flow. *Cavitrol® cage* for reduction of cavitation, cavitation noise and cavitation damage from flowing liquids. *Outlet-port liner (Design EAS only)* to protect the body casting from damage on erosive applications. *Restricted-capacity trim* (reduced-size valve plug, cage and seat ring) permits sizing the body for future demands while allowing for accurate control of temporary low-flow requirements. *Extension bonnets* to protect packing on high or low temperature service. *Bellows seal bonnets* for positive sealing of hard-to-handle fluids. *Drilled and tapped bonnet connections* for leak-offs, pressure or temperature gauges, etc. *Packing lubricator* and isolating valve. *Valve body drain* plug. *Variety of construction materials* for special service

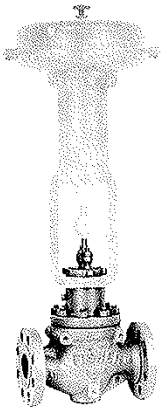
Bulletin References: *Design EWS*—51.1:EW. *All Others*—51.1:ES

DESIGNATION			Design ES	Design EAS	Design EWS	Design ESR
CONFIGURATION			Typical globe-style configuration with push-down-to-close valve plug action	Angle-style version of the Design ES, generally used to facilitate piping or where a self-draining valve body is desired	Globe-style configuration with push-down-to-close valve plug action and oversized end connections, generally used to eliminate the need for line swages or to minimize fluid velocity at the valve body outlet. Threaded-in seat ring also available	Globe-style configuration with push-down-to-open valve plug action and a construction that permits easy access to the internal valve body parts through the bottom of the body without having to remove the actuator
BODY SIZES & MAXIMUM FLOW COEFFICIENTS (C_v)[1]			1/2 inch = 4.09 3/4 inch = 9.00 1 inch = 17.4 1-1/4 inch = 17.4 1-1/2 inch = 33.4 2 inch = 56.2 2-1/2 inch = 82.7 3 inch = 121 4 inch = 203 6 inch = 357 8 inch = 808	1 inch = 23.5 2 inch = 40.8 3 inch = 128 4 inch = 148 6 inch = 310	4 inch ends on 2 inch body = 67.5 6 inch ends on 4 inch body = 271 8 inch ends on 4 inch body = 269 8 inch ends on 6 inch body = 478 12 inch ends on 6 inch body = 476 12 inch ends on 8 inch body = 1020	1 inch = 16.9 1-1/2 inch = 33.4 2 inch = 56.2 2-1/2 inch = 82.7 3 inch = 121 4 inch = 203
END CONNECTION STYLES	Screwed		NPT	- - -	- - -	NPT
	Flanged	Iron	Class 125 or 250	- - -	- - -	Class 125 or 250
		Steel	Class 150, 300 or 600	Class 150, 300 or 600	Class 300, 600 or 900[2]	Class 150, 300 or 600
	Welding Ends		Buttwelding or socket	Buttwelding or socket	Buttwelding	Buttwelding or socket

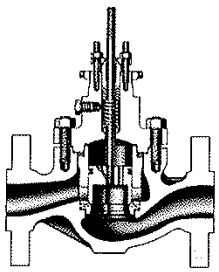
1. The flow coefficients shown are for an equal percentage characteristic. The flow coefficients for the linear and quick opening characteristics are normally somewhat greater.
2. Only sizes available in Class 900 rating are 8 inch ends on 6 inch body and 12 inch ends on 8 inch body.

ET-Series easy-e® Control Valves

The ET Series are general purpose constructions which are used for either throttling or on/off control of a wide variety of non-gritty and non-sticky liquids and gases. They are applicable up to 450°F (232°C) over a broad range of pressure drops with very good shutoff (up to ANSI Class IV or V) capability. In addition, the ET Series have a pressure-balancing valve plug, designed to permit the use of lower thrust, lower cost actuators. These valve bodies can be operated by any one of a variety of actuators.



Type 667-ET Control Valve (Type 667 Actuator on Design ET Valve Body Assembly)



Design ET

Available Configurations: *Common Characteristics*—Single-port control valve body assemblies with bolted-on bonnet, pressure-balancing cage-guided valve plug, cage-retained seat ring, and metal-seat or soft-seat construction. *Design Descriptions*—See table

Body Sizes: See table

End Connection Styles: See table

Shutoff Classifications: ANSI Class IV or V depending upon specific construction, application, and shutoff requirements

Maximum Inlet Pressures and Pressure Drops: Up to 1500 psig (103 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 425 to + 400°F (− 254 to + 204°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): See table

Flow Characteristics: Equal percentage, linear, or quick opening

Flow Direction: Normally flow in through the cage openings and out through the seat ring

Typical Construction Materials: *Valve Body, Bonnet*—Cast iron, carbon steel or stainless steel. *Bottom Flange (Design ETR Only)*—Same material as body. *Valve Plug Stem*—Stainless steel. *Valve Plug*—Hardened stainless steel with carbon-filled TFE valve plug seal ring and Viton* or ethylene-propylene backup ring. *Cage*— Cast iron, hardened stainless steel or cobalt-base Alloy 6. *Seat Ring*—Metal Seat, hardened stainless steel or cobalt-base Alloy 6; Soft Seat, hardened stainless steel with TFE disc. *Packing*—TFE V-ring, TFE-impregnated composition, graphite laminate/filament, or laminated graphite

Additional Options: *Whisper Trim® cage* for the reduction of noise from turbulent gas or vapor flow. *Cavitrol® cage* for reduction of cavitation, cavitation noise and cavitation damage from flowing liquids. *Outlet-port liner* to protect the body casting from damage on erosive applications. *Restricted-capacity trim* (reduced-size valve plug, cage and seat ring) permits sizing the body for future demands while allowing for accurate control of present low flow requirements. *Extension bonnets* to protect packing on low temperature service. *Bellows seal bonnet* for positive stem sealing of hard-to-handle fluids. *Drilled and tapped bonnet connections* for leak-offs, temperature or pressure gauges, etc. *Packing lubricator* and isolating valve. *Valve body drain* plug. *Variety of construction materials* for special service

Bulletin References: *Design EWT*—51.1:EW. *All Others*—51.1:ET

DESIGNATION			Design ET	Design EAT	Design EWT	Design ETR
CONFIGURATION			Typical globe-style configuration with push-down-to-close valve plug action	Angle-style version of the Design ET, generally used to facilitate piping or where a self-draining valve body is desired	Globe-style configuration with push-down-to-close valve plug action and oversized end connections, generally used to eliminate the need for line swages or to minimize fluid velocity at the valve body outlet. Threaded-in seat ring also available	Globe-style configuration with push-down-to-open valve plug action and a construction that permits easy access to the internal valve body parts through the bottom of the body without having to remove the actuator
BODY SIZES & MAXIMUM FLOW COEFFICIENTS (C_v)[1]			1 inch = 17.2 1-1/4 inch = 17.2 1-1/2 inch = 35.8 2 inch = 59.7 2-1/2 inch = 99.4 3 inch = 136 4 inch = 224 6 inch = 394 8 inch = 818	1 inch = 19.0 2 inch = 47.2 3 inch = 148 4 inch = 156 6 inch = 328	4 inch ends on 2 inch body = 82.2 6 inch ends on 4 inch body = 271 8 inch ends on 4 inch body = 294 8 inch ends on 6 inch body = 508 12 inch ends on 6 inch body = 565 12 inch ends on 8 inch body = 1160	1 inch = 17.2 1-1/2 inch = 35.8 2 inch = 59.7 2-1/2 inch = 99.4 3 inch = 136 4 inch = 224
END CONNECTION STYLES	Screwed		NPT	– – –	– – –	NPT
	Flanged	Iron	Class 125 or 250	– – –	– – –	Class 125 or 250
		Steel	Class 150, 300 or 600	Class 150, 300 or 600	Class 300, 600 or 900[2]	Class 150, 300 or 600
	Welding Ends		Buttwelding or socket	Buttwelding or socket	Buttwelding	Buttwelding or socket

1. The flow coefficients shown are for an equal percentage characteristic. The flow coefficients for the linear and quick opening characteristics are normally greater.
2. Only sizes available in Class 900 rating are 8 inch ends on 6 inch body and 12 inch ends on 8 inch body.

*Trademark of DuPont Co.

EWN-Series easy-e® Globe-Style Control Valves

Design EWND and EWNT globe-style control valve body assemblies are used for applications requiring maximum aerodynamic noise attentuation capability and high capacity. The **Whisper Trim®** III cage can reduce noise up to 30 decibels below the normal valve noise level, and the expanded outlet design minimizes regeneration of valve noise. The EWN Series globe valves are especially adapted for thermal cycling applications.

Available Configurations: *Common Characteristics*—Single-port, globe-style valve body assemblies with bolted-on bonnet, cage-guided balanced valve plug. *Whisper Trim®* III cage, and push-down-to-close valve plug action. *Design EWND*—This configuration provides high temperature service where low leakage is not required. *Design EWNT*—This configuration provides low leakage at lower temperatures than the Design EWND body

Body Sizes: 8 in. ends on 6 in. body or 12 in. ends on 8 in. body

End Connection Styles: Class 300, 600, and 900 flanges; buttwelding ends

Shutoff Classification: ANSI Class II, III, or IV depending upon specific construction

Maximum Inlet Pressures and Pressure Drops: Up to 2250 psig (155 bar) depending on specific construction and temperature requirements

Process Temperature Capabilities: From − 325 to + 1100°F (− 198 to + 593°C) depending on specific construction and pressure requirements

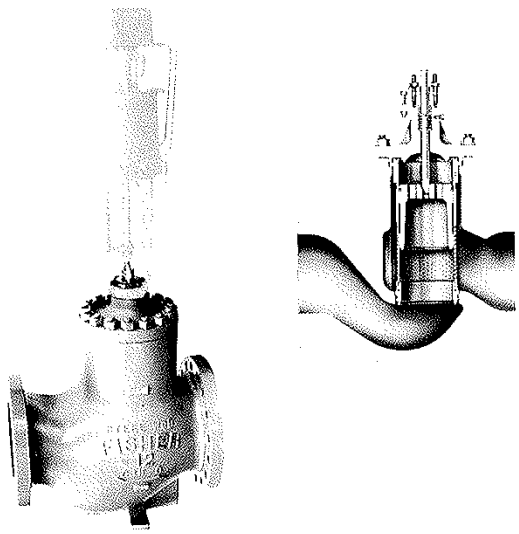
Maximum Flow Coefficients: From 85 C_g to 35,200 C_g (this is equivalent to a C_v range from 2.4 to 1173)

Flow Characteristic: Linear

Flow Direction: Up through the valve body seat ring and out through the cage openings

Typical Construction Materials: *Valve Body, Bonnet, and Flanges*—Carbon steel or stainless steel. *Valve Plug and Seat Ring*—Hardened stainless steel or hardened stainless steel with cobalt-base Alloy 6 facing. *Cage and Stem*—Hardened stainless steel. *Packing*—TFE V-ring or graphite laminate/filament

Bulletin Reference: 51.1:EWN

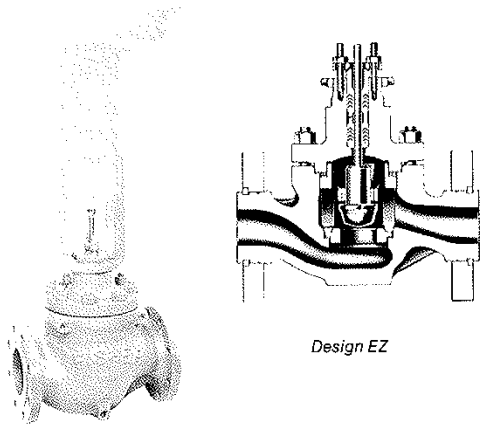


Type 470-EWNT Control Valve (Type 470 Actuator on Design EWNT Valve Body Assembly)

*The flow coefficients shown are for an equal-percentage characteristic. The flow coefficients for linear and quick opening characteristics are normally somewhat greater

EZ easy-e® Control Valve

The Design EZ valve is used for either throttling or on/off control of non-lubricating, viscous, or other hard-to-handle fluids. It is available in a variety of standard control valve body materials. The Design EZ can be operated by any one of a variety of actuators.



Design EZ

Type 657-EZ Control Valve (Type 657 Actuator on Design EZ General-Service Valve Body Assembly)

Available Configurations: Single-port control valve body assembly with bolted-on bonnet, post-guided valve plug, clamped-in seat ring, and metal-to-metal seats, integral end flanges.

Body Sizes: 1/2, 3/4, 1, 1-1/2, 2, 3, or 4 in.

End Connection Styles: NPT screwed; flanged iron (Class 125 or 250) or steel (Class 150, 300 or 600); buttwelding or socket weld.

Shutoff Classifications: ANSI Class IV or V

Maximum Inlet Pressures and Pressure Drops: Up to 1500 psig (103 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 325 to + 1100°F (− 198 to + 593°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v)*: 1/2 in. = 4.09; 3/4 in. = 9.00; 1 in. = 13.2; 1-1/2 in. = 28.1; 2 in. = 53.8; 3 in. = 114; 4 in. = 190.

Flow Characteristics: Equal percentage, linear, or quick opening

Flow Direction: Up through the seat ring

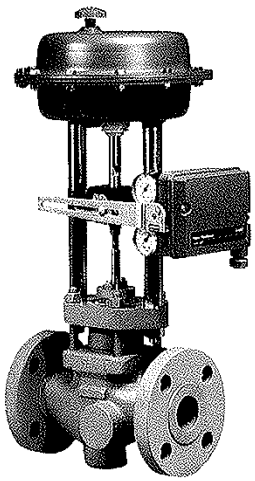
Typical Construction Materials: *Valve Body, Bonnet*—Cast iron, carbon steel, alloy steel and stainless steel. *Trim*—Stainless steel and other alloy materials. *Valve Plug Stem*—Stainless steel and other alloy materials. *Packing*—TFE V-ring, TFE-impregnated composition, graphite laminate/filament, or laminated graphite

Additional Options: *Restricted-capacity trim* (reduced-size valve trim parts) permits sizing the body for future demands while allowing for accurate control of temporary low-flow requirements. *Micro-Form, Micro-Flute, and Micro-Flow valve plugs* are also available for accurate control of very low flow requirements. *Extension Bonnets* to protect packing on high or low temperature service. *Bellows seal bonnets* for positive sealing of hard-to-handle fluids. *Drilled and tapped bonnet connections* for leak-offs, pressure or temperature gauges, etc. *Packing lubricator* and isolating valve. *Valve body drain* plug. *Variety of construction materials* for special service

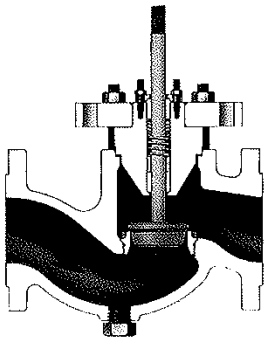
Bulletin Reference: 51.1:EZ

GL Globe-Style Control Valves

Design GL globe-style control valve body assemblies are used for many general applications over a wide variety of pressure drops and temperatures. The multiple trim material options make this valve ideal for economical control of corrosive fluids often encountered within chemical processing applications.



Design GL Valve Body with Type 1250R Actuator and Type 3660 Positioner



Design GL

Available Configurations: The Design GL is a globe-style, single-port control valve body assembly, metric designed with stem-guided valve plug, screwed-in seat ring, metal seat or soft seat construction and push-down-to-close valve plug action.

Body Sizes: *ANSI*—.5, 1, 1.5, 2, 3, or 4 in.; *DIN and JIS*—15, 25, 40, 50, 80, or 100 mm

End Connection Styles: Raised face flanges or ring type joint flanges.

Shutoff Classification: ANSI Classes IV, V, VI or DIN Classes DGA, GLB, HGA depending upon specific construction.

Maximum Inlet Pressures and Pressure Drops: Up to 580 psig (40 bar) depending upon specific construction and temperature requirements.

Process Temperature Capabilities: From -50 to 842°F (-50 to 450°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): Linear* .5 in.(15 mm) = 5.74, 1 in.(25 mm) = 12.7, 1.5 in.(40 mm) = 35.1, 2 in.(50 mm) = 53.2, 3 in.(80 mm) = 126, 4 in.(100 mm) = 184

Flow Characteristics: Equal percentage, linear, or quick opening

Flow Direction: Up through port

Typical Construction Materials: *Valve Body, Bonnet*—steel, stainless steel, and other alloy materials. *Trim*—stainless, and other alloy materials. *Packing*—TFE V-ring, TFE/composition, graphite laminate/filament

Additional Options: TFE seat, body drain plug, taped and plugged bonnet, lubricator and lubricator/isolating valve for packing lubrication, cast bonnet extension and bellows seal extension.

Bulletin Reference: 51.1:GL

*Flow coefficients shown are for a linear characteristic. Flow coefficients for a quick opening characteristic are normally somewhat greater, while flow coefficients for an equal percentage characteristic are normally somewhat smaller.

GS Globe-Style Control Valve

The Design GS globe-style control valve body assembly is a very economical, general purpose construction. It is frequently used for either throttling or on/off control of low flow rates for steam as well as for a wide variety of sticky or non-gritty liquids or gases. It is adaptable for controlling very low flow rates by using optional Micro-Flute or Micro-Form valve plugs. The GS control valve body assembly may be operated by a variety of actuators.

Available Configurations: Single-port, globe style control valve body assembly with screwed-on bonnet, screwed-in seat ring and metal-to-metal seating. This configuration has a bronze body and a stem-guided valve plug with push-down-to-close valve plug action

Body Sizes: 1/2, 3/4, 1, 1-1/4, 1-1/2, or 2 in.

End Connection Style: NPT screwed

Shutoff Classification: ANSI Class IV or VI depending upon specific construction, application, and shutoff requirements

Maximum Inlet Pressures and Pressure Drops: Up to 250 psig (17.2 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From −20 to +425°F (−29 to +218°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): 1/2 in. = 6.32, 3/4 in. = 8.65, 1 in. = 13.0, 1-1/4 in. = 22.2, 1-1/2 in. = 29.1, 2 in. = 53.0†

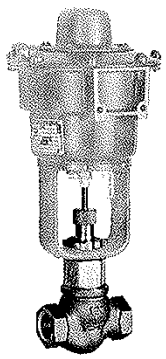
Flow Characteristics: Equal percentage, or quick opening

Flow Direction: Normally flow up through the seat ring

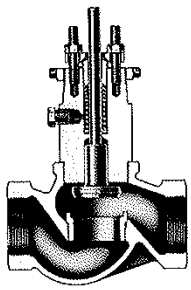
Typical Construction Materials: *Valve Body*—bronze. *Bonnet*—brass. *Valve Plug, Valve Plug Stem, Seat Ring*—Stainless steel. *Packing*—TFE V-ring, TFE-impregnated composition, graphited

Additional Options: *Micro-Flute and Micro-Form valve plugs* for accurate control of very low rates. *Packing lubricator* and isolating valve

Bulletin Reference: 51.1:GS



Type 513-GS Control Valve (Type 513 Actuator on Design GS Valve Body Assembly)



Design GS

†The flow coefficients shown for the Design GS body are for an equal percentage characteristic. The flow coefficients for the quick opening characteristic are about the same.

KB & KBR Globe-Style Control Valves

The Designs KB and KBR are large, high capacity, double-port control valve body assemblies. They are used for either throttling or on/off control of a wide variety of clean liquids and gases. In addition to providing high capacity with excellent shutoff capability, these double-ported constructions embody a pressure-balancing valve plug which permits the use of lower thrust, lower cost actuators. These valve bodies can be operated by any one of a variety of actuators.

Available Configurations: *Common Characteristics*—Double-port, globe-style control valve body assemblies with bolted-on bonnet and bottom flange, port-guided valve plug, bolted-in seat rings, soft seats, and convenient side handhole plate and bottom flange for easy inspection and maintenance of internal valve body parts. *Design KB*—This configuration has push-down-to-close valve plug action. *Design KBR*—This configuration has push-down-to-open valve plug action

Body Sizes: 6, 8, 10, or 12 in.

End Connection Styles: Flanged iron (Class 125 or 250) or steel (Class 150, 300, or 600)

Shutoff Classification: ANSI Class VI

Maximum Inlet Pressures: Up to 720 psig (49.6 bar) depending upon specific construction and temperature requirements

Maximum Pressure Drops: Up to 290 psi (20.0 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 20 to + 400°F (− 29 to + 204°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v)*: 6 in. = 436, 8 in. = 688, 10 in. = 1260, 12 in. = 1790

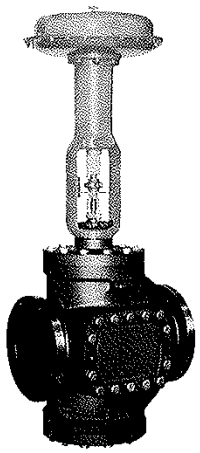
Flow Characteristics: Modified parabolic or quick opening

Flow Direction: Flow up through the top seat ring and down through the bottom seat ring

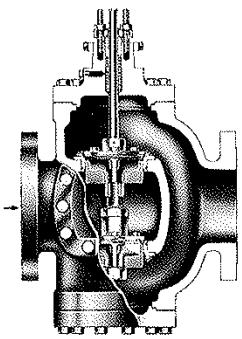
Typical Construction Materials: *Valve Body, Bonnet*—Cast iron or carbon steel, *Valve Plug*—Bronze or stainless steel with nitrile or Viton† O-rings. *Valve Plug Stem*—Stainless steel. *Seat Ring*—Bronze or stainless steel. *Packing*—TFE V-ring or TFE-impregnated composition

Additional Options: *Drilled and tapped bonnet connections* for leak-offs, temperature or pressure gauges, etc. *Packing lubricator* and isolating valve. *Valve body drain* plug.

Bulletin Reference: 51.1:K



Type 667-KB Control Valve (Type 667 Actuator on Design KB Valve Body Assembly)



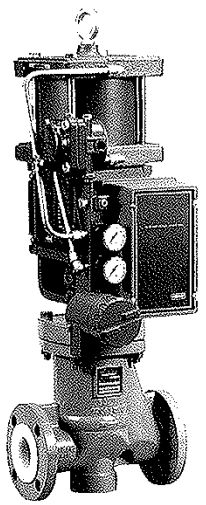
Design KB

*Trademark of Du Pont Co.

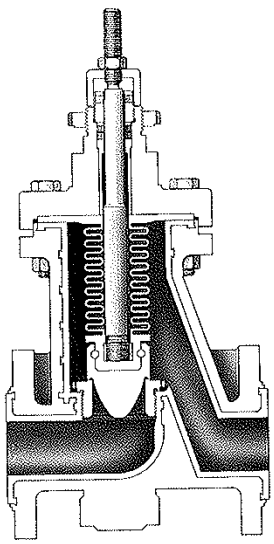
†Trademark of Du Pont Co.

RSS Globe-Style Control Valves

The Design RSS is a lined, globe-style control valve body assembly, designed for applications involving severely corrosive and toxic flowing fluids. With carbon or glass-filled PTFE trim parts, the Design RSS may be applied to most media within its temperature and pressure limitations.



Design RSS Valve Body with Type 585 Actuator and 3611JP Positioner



Design RSS

Available Configuration: Single-port, globe-style control valve body assembly with stem guided valve plug, screw in seat ring, and push-down-to-close valve plug action

Body Sizes: .5, .75, 1, 1.5, 2, 3, or 4 in.

End Connection Styles: Mates with Class 150 raised face flange

Shutoff Classification: Class VI

Maximum Inlet Pressures and Pressure Drops: Up to 285 psig (19.7bar) depending upon temperature requirements

Process Temperature Capabilities: From -20 to 350°F (-29 to 177°C) for pressure service, or from -20 to 200°F (-29 to 93°C) for vacuum service, depending upon pressure requirements

Maximum Flow Coefficients (C_v): .5 in. = 4.5, .75 in. = 4.5, 1 in. = 11.5, 1.5 in. = 28.6, 2 in. = 44.3, 3 in. = 106.9, 4 in. = 166.0

Flow Characteristic: Equal percentage (standard) or others on request

Flow Direction: Up through the seat ring

Typical Construction Materials: *Body, Bonnet*—ductile iron/PFA liner, or stainless steel/PFA liner. *Bellows tip, Plug, and Seat ring*—carbon-filled PTFE, or glass-filled PTFE. *Bellows seal, Packing*—PTFE

Additional Options: Bonnet tapped for remote venting, purging, or gauge mounting. Chlorine Service construction materials.

Bulletin Reference: 51.1:RSS

YD & YS 3-Way Control Valves

The Designs YD and YS are a versatile pair of 3-way valve body designs. The Design YD is used for either on/off or throttling control in both converging (flow mixing) and diverging (flow splitting) services. It has a unique pressure-balancing valve plug that is designed to permit the use of lower thrust, lower cost actuators on high pressure drop applications of up to 1480 psi (102 bar).

The Design YS, on the other hand, is a single-seated construction used primarily in converging service only for either on/off or throttling control with pressure drops to 760 psi (52.4 bar). Its use in diverging service is limited to very low pressure drop, on/off applications.

These valve bodies can be operated by any one of a variety of actuators.

Available Configurations: *Common Characteristics*—Three-way control valve bodies with bolted-on bonnet, cage-guided valve plug, cage-retained seat rings, and metal-seat construction. *Design YD*—This configuration has a pressure-balancing valve plug design for high pressure drop of up to 1440 psi (99 bar) flow-mixing or flow-splitting service. *Design YS*—Single-seated configuration normally for flow-mixing service up to 760 psi (52.4 bar) drop

Body Sizes: 1/2, 3/4, 1, 1-1/2, 2, 2-1/2, 3, 4, or 6 in.

End Connection styles: NPT screwed; flanged iron (Class 125 or 250) or steel (Class 150, 300, or 600); socket or buttwelding ends

Shutoff Classifications: *Design YD*—ANSI Class II or IV depending upon specific construction, application, and shutoff requirements. *Design YS*—ANSI Class IV or V depending upon specific construction, application, and shutoff requirements

Maximum Inlet Pressures: Up to 1480 psi (102 bar) depending upon specific construction and temperature requirements

Maximum Pressure Drops: *Design YD*—Up to 1480 psi (102 bar) depending upon specific construction and temperature requirements. *Design YS*—Up to 760 psi (52.4 bar) for flow-mixing service depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 425 to + 800°F (− 254 to + 427°C) depending on specific construction and pressure requirements

Maximum Flow Coefficients (C_v): Up to a maximum for each body size of 1/2 in. = 6.30, 3/4 in. = 14.1, 1 in. = 20.5, 1-1/2 in. = 25.1, 2 in. = 85.6, 2-1/2 in. = 94.2, 3 in. = 185, 4 in. = 316 and 6 in. = 567, depending on service and flow direction

Flow Characteristic: Linear

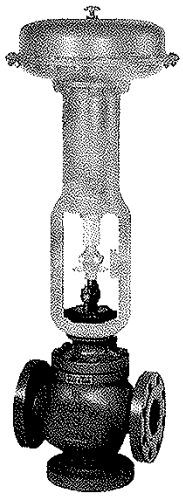
Flow Directions: See table and figures

Typical Construction Materials: *Valve body and Bonnet*—Cast iron, carbon steel or stainless steel. *Valve Plug*—Stainless steel or austenitic cast iron. *Valve Plug Stem and Seat Rings*—Stainless steel. *Cages*—Stainless steel, electroless-nickel-coated stainless steel or electroless-nickel-coated cast iron. *Plug-Cage Seals*—Standard cage O-ring and backup ring are ethylene propylene, nitrile or Viton*, while standard seal ring is TFE. *Packing*—TFE V-ring, TFE-impregnated composition, graphite laminate/filament, or laminated graphite

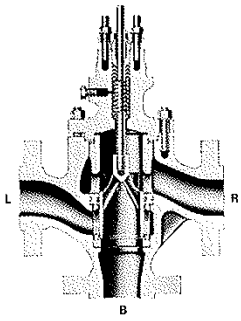
Additional Options: *Extension bonnets* to protect packing on high or low temperature service. *Drilled and tapped bonnet connections* for leak-offs, pressure or temperature gauges, etc. *Packing lubricator* and isolating valve

Bulletin Reference: 51.1:YD

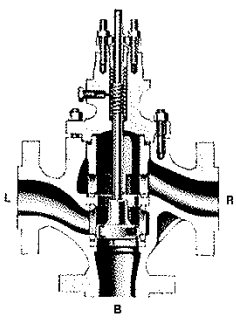
BODY DESIGN	SERVICE	FLOW DIRECTION
YD	Converging	R to B L to B
	Diverging	B to R B to L
YS	Converging	R to L B to L
	Diverging	L to R L to B



Typical of Design YD or YS with Type 667 Actuator



Design YD

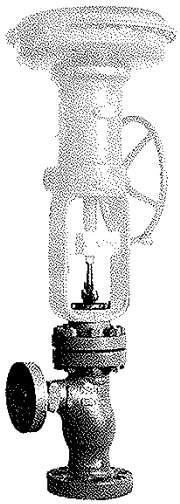


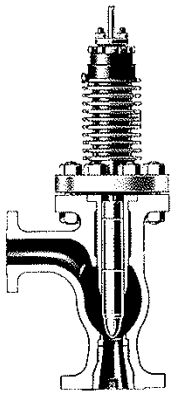
Design YS

461 Increased-Outlet, Angle-Style Control Valves

The Design 461 is a self-cleaning, increased-outlet, angle-style control valve body assembly. It is frequently used for either throttling or on/off control of liquids and gases which are gritty (erosive), sticky, or which have a tendency to produce solid-particle buildup on internal valve parts. The Design 461 also features a venturi-type outlet which is used in liquid flow applications where flashing occurs. This control valve body assembly may be operated by a variety of actuators.

*Trademark of Du Pont Co.





Design 461

Type 657-461 Control Valve (Type 657 Actuator on Design 461 Valve Body Assembly)

Available Configuration: Single-port, increased-outlet, angle-style control valve body assembly with a bolted-on bonnet, a cylinder-guided valve plug, a seat ring that is held in place by a screwed-in seat ring retainer, metal-seat construction, and push-down-to-close valve plug action

Body Sizes: 2 in. inlet x 3 in. outlet, 3 in. inlet x 4 in. outlet, 4 in. inlet x 6 in. outlet, or 6 in. inlet x 8 in. outlet

Shutoff Classifications: ANSI Class IV, or V depending upon specific construction, application and shutoff requirements

End Connection styles: Class 300, 600, 900, 1500, or 2500 flanged; welding ends

Maximum Inlet Pressures and Pressure Drops: Up to 6250 psig (431 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 20 to + 1100°F (− 29 to + 593°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): 2 x 3 in. = 106, 3 x 4 in. = 123, 4 x 6 in. = 332, 6 x 8 in. = 716

Flow Characteristic: Modified parabolic

Flow Direction: Flow down past the valve plug and out through the seat ring

Typical Construction Materials: *Valve Body, Bonnet*—Carbon steel or alloy steels. *Valve Plug, Valve Plug Stem, Valve Plug Guide Cylinder, Seat ring Retainer*—Stainless steel. *Seat Ring*—Stainless steel with cobalt-base Alloy 6 facing. *Packing*—TFE V-ring, graphited composition graphite laminate/filament

Additional Options: *Extension bonnets* to protect packing on high or low temperature service. *Pressure equalization piping* from valve body inlet to area above valve plug to flush solid particles out of bonnet cavity and back into the flow stream. *Flushing-oil connection* on side of body to allow use of flushing oil between liner and valve plug to prevent solid-particle buildup. *Warm-up connection* can be provided for recirculating fluid to warm up the system prior to startup. *Body-outlet extension nozzle* for tank-mounted valves to reduce tank damage from cavitation or erosion

Bulletin Reference: 51.2:461

D Globe-Style & DA Angle-Style Control Valves

The Designs D and DA control valve body assemblies are especially useful for either throttling or on/off control of steam, or of liquids or gases which are gritty (erosive), sticky, or which have a tendency to produce solid-particle buildup on internal valve parts. They are frequently used in power plants, and in gas and oil production and distribution systems. They are also adaptable for controlling very low flow rates by using an optional Micro-Flute valve plug. Both the Designs D and DA may be operated by one of a variety of actuators.

Available Configurations: *Common Characteristics*—Single-port control valve body assemblies with screwed-on bonnet, post-guided valve plug, screwed-in seat ring, metal seat construction, and push-down-to-close valve plug action. *Design D*—Globe-style configuration. *Design DA*—Angle-style configuration generally used to facilitate piping or when a self-draining valve body is desired

Body Sizes: 1 or 2 in.

End Connection Styles: NPT screwed; Class 600, 1500, 2500 flanged; API 5000 lb. or 10,000 lb. (Specification A, B, or C) flanged; socket or buttwelding ends

Shutoff Classification: ANSI Class IV or V depending upon specific construction, application, and shutoff requirements

Maximum Inlet Pressures and Pressure Drops: Up to 10,000 psig (690 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 20 to + 450°F (− 29 to + 232°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): *Design D*—1 in. = 12.3, 2 in. = 34.5. *Design DA (Flow Down)*—1 in. = 16.8, 2 in. = 44.9

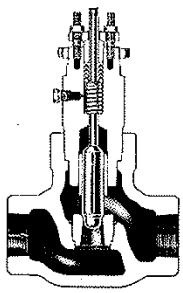
Flow Characteristic: Equal percentage

Flow Directions: *Design D*—Flow up through the seat ring and out past the valve plug. *Design DA*—Flow in either direction through the valve

Typical Construction Materials: *Valve Body, Bonnet*—Carbon steel, alloy steel or stainless steel. *Valve Plug, Stem, Seat ring*—Stainless steel or stainless steel with either cobalt-base Alloy 6 facing or tungsten carbide insert, or nickel alloy. *Guide Bushing*—Stainless steel, or nickel alloy. *Packing*—TFE V-ring or TFE-impregnated composition

Additional Options: *Micro-Flute valve plug* for control of very low flow rates. *Packing lubricator* and isolating valve

Bulletin Reference: 51.2:D



Design D

Type 657-D Control Valve (Type 657 Actuator on Design D Valve Body Assembly)

DBAQ Angle-Style Control Valves

The Design DBAQ is a small, general purpose control valve body assembly which is used for either throttling or on/off control of a wide variety of non-sticky liquids and gases as well as steam. It is generally used to facilitate piping or when a self-draining valve body is desired. This design may be operated by a variety of actuators.

Available Configurations: Single-port, angle style control valve body assembly with bolted-on bonnet, cage-guided valve plug, cage-retained seat ring, metal-seat construction and push-down-to-close valve plug action.

Body Sizes: 1 or 2 in.

End Connection Styles: Class 900, 1500, or 2500 flanged; socket or buttwelding ends

Shutoff Classifications: ANSI Class IV or V depending upon specific construction, application, and shutoff requirements

Maximum Inlet Pressures and Pressure Drops: Up to 6250 psig (431 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 425 to + 1500°F (− 254 to + 816°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): 1 in. = 11.0, 2 in. = 33.8

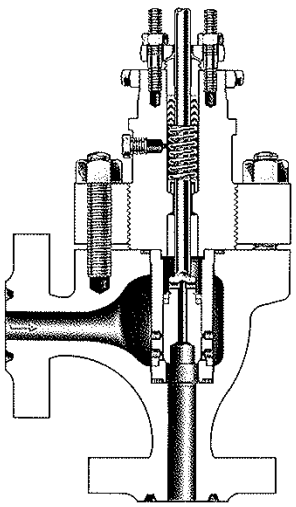
Flow Characteristic: Equal percentage

Flow Direction: Flow up through the seat ring and out through the cage openings

Typical Construction Materials: *Valve Body, Bonnet, Body and Bonnet Flanges*—Carbon steel, alloy steel or stainless steel. *Valve Plug, Seat Ring*—High-vanadium, high-chromium steel, stainless steel, or stainless steel with cobalt-base Alloy 6 facing. *Valve Plug Stem*—Stainless steel. *Cage*—Stainless steel or solid cobalt-base Alloy 6. *Packing*—TFE V-ring, TFE-impregnated composition graphite laminate/filament, or laminated graphite

Additional Options: *Whisper Trim® cage* for reduction of noise from turbulent gas or vapor flow. *Cavitrol® cage* for reduction of cavitation, cavitation noise and cavitation damage from flowing liquids. *Fabricated extension bonnet* to protect packing on high or low temperature service. *Packing lubricator* and isolating valve

Bulletin Reference: 51.2:DBQ

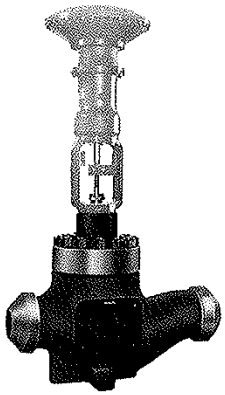


Design DBAQ

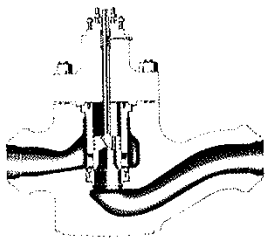
EH-Series High-Pressure Control Valves

The EH Series valves are high-pressure globe valve bodies suited for the control of a variety of liquids and gases as well as steam. The high capacity of these valves makes them ideal for high-pressure, high-flow applications in the power, process, oil production, chemical refining, and other industries.

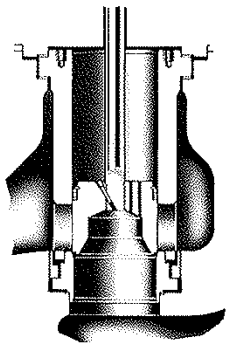
The EH Series valves may be operated by any one of a variety of actuators.



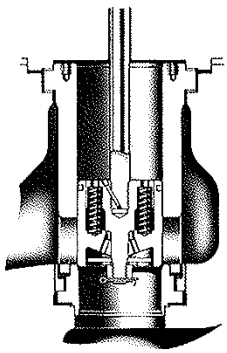
667-EH Series Control Valve (Type 667 Actuator on EH Series Valve Body Assembly)



Design EHD Valve Body Assembly



Design EHT Trim Parts



Design EHP Trim Parts

Available Configurations: *Common Characteristics*—Single-port and globe style control valve body assemblies with metal seats, cage guided valve plugs, and push-down-to-close valve plug action. *Design Descriptions*—See table

Body Sizes: See table

End Connection Styles: See table

Shutoff Classifications: *Design EHD*—ANSI Class II, III, or IV depending on size. *Design EHP*—ANSI Class V. *Design EHS*—ANSI Class IV or V. *Design EHT*—ANSI Class IV or V

Maximum Inlet Pressures and Pressure Drops: Up to 6250 psig (431 bar) for Designs EHD, EHS, and EHT and up to 2200 psig (152 bar) for Design EHP depending upon specific construction and temperature requirements

Process Temperature Capabilities: *Designs EHD, EHP, and EHS*—From − 100 to + 1100°F (− 38 to + 593°C) depending upon specific construction and service requirements. *Design EHT*—From − 40 to + 450°F (− 40 to + 232°C) depending upon specific construction and service requirements. Consult your Fisher representative for higher temperatures

Maximum Flow Coefficients (C_v): See table

Flow Characteristics: Linear, equal percentage, or modified equal percentage

Flow Direction: Normally flow in through the cage openings and out through the seat ring

Typical Construction Materials: *Valve Body, Bonnet*—Carbon steel, alloy steel, or stainless steel. *Valve Plug, Seat Ring*—Stainless steel, nickel alloy, or stainless steel with cobalt-base Alloy 6 faced seat. *Cage*—Stainless steel or stainless steel with chrome-coated bore. *Stem*—Stainless steel. *Packing*—TFE V-ring, TFE-impregnated composition or graphite laminate/filament. *Gaskets*—Stainless steel laminated graphoil

Additional Options: *Whisper Trim® III cage* for reduction of noise from turbulent gas or vapor flow *Cavitrol® III cage* for reduction of cavitation damage. *Design EHS Micro-Form plug* for control of low flow rates. Packing lubricator and isolating valve. Sour gas trims available.

Bulletin Reference: 51.2:EH(10), 51.2 EH(15), 51.2 EH(20)

DESIGNATION		Design EHD	Design EHP	Design EHS	Design EHT
CONFIGURATION		Globe valve design with a pressure-balancing valve plug, which minimizes the required actuator thrust, and is used where good shutoff is adequate	Globe valve design with a pilot valve plug that loads and unloads the main valve plug with inlet pressure. This provides the reduced-thrust associated with a pressure-balancing plug when the valve is being stroked and the improved shutoff associated with a pressure-loaded unbalanced plug when the valve is shut off	Globe valve design with a conventional unbalanced valve plug but provides excellent shutoff capability	Globe valve design with a pressure-balancing valve plug like the Design EHD, but will provide better shutoff capability over its comparatively limited temperature range
BODY SIZES AND MAXIMUM FLOW COEFFICIENTS (C_v)[1]		2 inch = 51.3 3x2 inch = 51.3 3 inch = 86.4 4x3 inch = 86.4 4 inch = 164 6x4 inch = 164 6 inch = 348 8x6 inch = 348 8 inch = 912 10 inch = 912 12 inch = 1830 14 inch = 1830 20 inch = 2600	8 inch = 864 10 inch = 864 12 inch = 932 14 inch = 932	1 inch = 13.0 1-1/2 x 1 inch = 13.0 2x1 inch = 13.0 2 inch = 45.9 3x2 inch = 45.9 3 inch = 82.5 4x3 inch = 82.5 4 inch = 151 6 inch = 370 8x6 inch = 370	2 inch = 51.3 3x2 inch = 51.3 3 inch = 86.4 4x3 inch = 86.4 4 inch = 164 6x4 inch = 164 6 inch = 348 8x6 inch = 348 8 inch = 912 10 inch = 912 12 inch = 1830 14 inch = 1830
END CONNECTION STYLES	Flanged	Class 900, 1500, or 2500	Class 1500 or 2500	Class 900, 1500, or 2500	Class 900, 1500, or 2500
	Buttweld	Class 1500 or 2500	Class 1500 or 2500	Class 1500 or 2500	Class 1500 or 2500
	Socketweld	Class 1500 or 2500	- - -	Class 1500 or 2500	Class 1500 or 2500

1. The flow coefficients shown are for an equal percentage characteristic. The flow coefficients for the linear and quick opening characteristics are normally greater.

V100 Vee-Ball® Valves for General Control Applications

The Design V100 **Vee-Ball** control valve body assemblies are characterized ball valves which were designed primarily for throttling control of fibrous slurries and gritty (erosive) fluids. However, their straight-through flow design provides the high capacity and wide rangeability that are required in many other applications. Therefore, the **Vee-Ball** valve is also ideal for the control of gas, steam, and liquids, as well as fibrous slurries.

Available Configurations: Flangeless ball valve body assemblies with stub-type valve shafts, partial ball with V-notch characterization and metal-seat, soft-seat or flow ring (clearance flow) construction

Body Sizes: 1, 1-1/2, 2, 3, 4, 6, 8, 10, or 12 in.

End Connection Style: Flangeless body is designed to fit between pipe flanges with Class 150, 300, or 600 ratings and is retained by line flange bolts

Shutoff Classification: *Appropriate for forward only*—Metal ball seal, 0.001% of valve capacity at full travel (1/10 of ANSI Class IV). *Appropriate for bi-directional flow*—TCM ball seal, 2 mL/min/in. of nominal valve size at 50 psi differential (3.4 bar, differential); Flow ring, 2% of valve capacity at full travel

Maximum Inlet Pressures: Up to 1480 psig (102 bar) depending upon specific construction and temperature requirements

Maximum Pressure Drops: Up to 1480 psi (102 bar) depending upon valve size, style of seating and bushing material

Process Temperature Capabilities: From − 50 to + 750°F (− 46 to + 399°C) depending upon pressure requirements, style of seating and bushing material

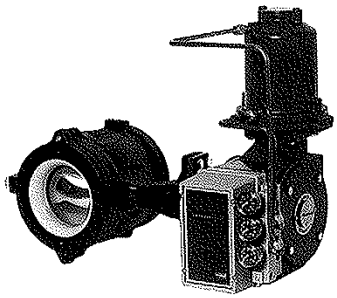
Maximum Flow Coefficients (C_v) : 1 in. = 27.5, 1-1/2 in. = 88.8, 2 in. = 130, 3 in. = 319, 4 in. = 513, 6 in. = 1040, 8 in. = 1756, 10 in. = 3100, 12 in. = 4910

Flow Characteristic: Approximately equal percentage

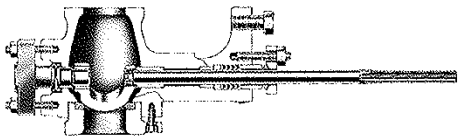
Flow Direction: Normal flow is into the convex side of the V-notch ball. Bi-directional flow is permissible with soft seat and flow ring constructions

Typical Construction Materials: *Valve Body*—Carbon steel or stainless steel. *V-notch Ball*—Stainless steel, chrome plated. *Ball Seal (Seat)*—Spring tempered stainless steel or TFE-filled composition material. *Flow Ring*—Same material as body. *Stub Shafts (Drive and Follower)*—Stainless steel. *Stub-Shaft Bushings*—Plastic alloy lined stainless steel, cobalt-base Alloy 6, or S44004 stainless steel. *Packing*—TFE V-ring, TFE and composition, or graphite ribbon

Bulletin Reference: 51.3:V100



Design V100 Vee-Ball Valve with Type 1061 Actuator and 3610JP Positioner



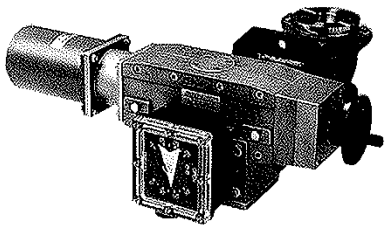
Design V100

V100 Vee-Ball® Valve for Basis Weight Control

The Design V100 Vee-Ball valve is combined with the SKF electronic actuator to meet the precision control requirements of basis weight control.

The Design V100 ball valve, with its straight-through, high-capacity design meets the control needs of the basis weight system. The V-notch ball of the valve creates a shearing effect as it rotates into its seal, allowing tight shutoff against fibrous slurries.

The SKF actuator responds to a computer-generated control signal. The 90 degree rotation of the actuator typically is split into discrete, repeatable steps. Limit switches control the maximum travel in the open or closed directions by interrupting the stepping motor signal.



Design V100 Valve with a SKF Actuator and Control Cabinet

Available Configurations: Flangeless ball valve body assembly with splined valve shaft and partial ball with V-notch characterization

Body Sizes: 2, 3, 4, 6, 8, 10, or 12 in.

End Connection Style: Flangeless body is designed to fit between pipe flanges with Class 150, 300 or 600 ratings and is retained by line flange bolts

Shutoff Classification: *Forward Flow Only*—Metal Ball Seal, 0.001% of valve capacity at full travel (1/10 of ANSI Class IV.) *Appropriate for bi-directional flow*—TCM ball seal, 2 mL/min/in. of nominal valve size at 50 psi differential (3.4 bar, differential); Flow ring, 2% of valve capacity at full travel

Maximum Inlet Pressure: Up to 1480 psi (102 bar) depending upon specific construction and temperature requirements

Maximum Pressure Drops: Up to 1480 psig (102 bar) depending upon valve size, style of seating and bushing material

Actuator Rotation: 90 degrees

Resolution (for 90 Degrees Rotation): Size 20 actuator, 5600 steps; Size 30 actuator, 8800 steps; Size 40 actuator, 11,300 steps

Stroking Time: Adjustable, from 20 to 280 seconds for Size 20, to 440 seconds for Size 30, and to 560 seconds for Size 40

Power Supply: 24 volts dc at 100 milliamperes and an ac power source of 117, 220 or 240 volts at 50/60 hertz

Typical Construction Materials: *Valve Body*—Carbon steel or stainless steel. *V-notch Ball*—Stainless steel, chrome plated. *Ball Seal*—TFE-filled composition, stainless steel or alloy steel. *Flow Ring*—Same material as body. *Drive Shaft and Guide Post*—Hardened stainless steel. *Packing*—TFE V-ring.

Bulletin Reference: 51.3:V100 and 51.3:V100(S1)

V150 Vee-Ball® Valve

The Design 150 Vee-Ball control valve body assemblies are characterized ball valves which provide high capacity for gas, steam, liquids, and fibrous slurries. The straight-through flow design provides high capacity and wide rangeability for many different applications in the various process industries.

Available Configurations: Flanged ball valve body assemblies, partial ball with V-notch characterization and metal-seat, soft-seat, or flow ring construction.

Body Sizes: 2, 3, 4, 6, 8, 10, or 12 in.

End Connection Style: Flanged body designed to fit between Class 150 raised face mating flanges and retained by line flange bolts

Shutoff Classification: *Appropriate for forward flow only*—TCM ball seal, 2mL/min/in. of nominal valve size at 50 psi (3.4 bar) differential; Metal ball seal, 0.001% of valve capacity at full travel (1/10 of ANSI Class IV).

Maximum Inlet Pressure: Up to 285 psig (20 bar) depending upon specific construction and temperature requirements

Maximum Pressure Drops: Up to 285 psig (20 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From − 50 to 450°F (− 46 to 232°C) depending upon specific construction requirements

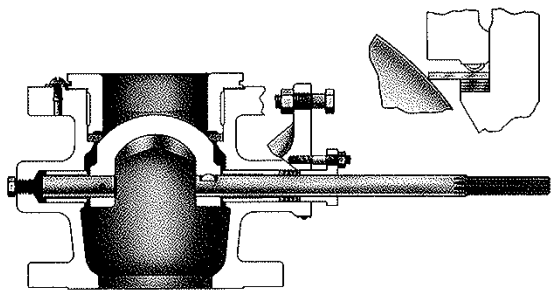
Maximum Flow Coefficients (Cv): 2 in. = 132, 3 in. = 336, 4 in. = 490, 6 in. = 960, 8 in. = 1530, 10 in. = 2860, 12 in. = 4640.

Flow Characteristic: Approximately equal percentage

Flow Direction: Normal flow is into the convex side of the V-notch ball

Typical Construction Materials: *Valve Body*—carbon steel or stainless steel. *V-notch Ball*—chrome plated stainless steel. *Ball Seal*—TCM, TCM III or stainless steel. *Packing*—PTFE and carbon-filled PTFE, or graphite ribbon

Bulletin Reference: 51.3:V150



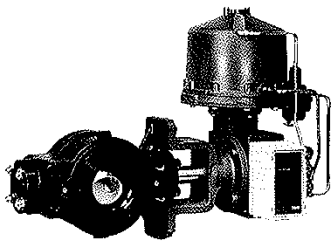
Design V150

*The flow coefficients shown apply when line size equals body size. When line size exceeds body size, the flow coefficients will be somewhat smaller.

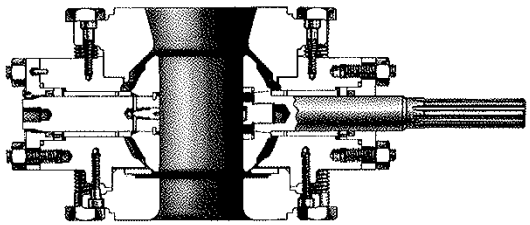
V250 Hi-Ball® Ball Valve for High Pressure

The Design V250 Hi-Ball rotary shaft valve body typically is used for throttling pressure and flow control within gas transmission lines, gas distribution systems, and liquid pipelines.

Depending upon size, the Design V250 can be installed between ANSI Class 600 or 900 flanges. It is available with either a single ball seal construction for tight shutoff or a flow ring construction for higher temperature capabilities. The valve body is available also with a dual seal construction that has a ball seal at both the body inlet and outlet for bidirectional flow shutoff.



Design V250 Valve with Type 1061 Actuator and Type 3610JP Positioner



Design V250

Available Configuration: Flangeless ball valve body assembly with reduced port ball, pressure-balanced drive shaft with TFE-lined bushings and pressure-assisted shaft sealing

Body Sizes: 4 through 24 in.

End Connection Style: Flangeless body design retained by line flange bolts and designed to fit between ANSI raised-face or ring-type joint flanges.

Shutoff Capability: *Single and Dual Seal*—0.0001% of maximum valve capacity. *Seal Ring*—1% of maximum valve capacity

Maximum Inlet Pressure: *4 through 12 in.*—Consistent with ANSI Class 600 or 900. *16, 20 & 24 in.*—Consistent with ANSI Class 600

Maximum Pressure Drop: *Single and Dual Seal*—2220 psi (153 bar) at 100°F (38°C) and 1490 psi (103 bar) at 180°F (82°C) except where further limited by pressure-temperature rating of the valve body. *Flow Ring*—Limited by the pressure-temperature rating of the valve body

Material Temperature Capability: *Single and Dual Seal*— − 50 to 180°F (− 46 to 82°C). *Flow Ring*— − 50 to 200°F (− 46 to 93°C)

Maximum Flow Coefficients (Cv): From 2 in. = 499 to 24 in. = 18,300

Flow Characteristic: Modified equal percentage

Flow Direction: *Single Seal*—Forward flow only. *Flow Ring*—Forward or reverse flow. *Dual Seal*—Bi-directional flow

Standard Construction Materials: *Valve Body*—Carbon steel. *Drive and Follower Shafts*—Stainless steel. *Ball*—Alloy steel. *Bearings*—TFE lined stainless steel. *O-Rings*—Nitrile.

Optional: Sour gas trim materials. Buried service adaption. Dual seal configuration for bi-directional shutoff.

Bulletin Reference: 51.3:V250

V500 Rotary Control Valve Body

The Design V500 rotary control valve body controls erosive, coking, and other hard-to-handle fluids, providing either throttling or on-off operation. The flanged Design V500 rotary control valve body combines globe valve ruggedness with the efficiency of a rotary valve.

Available Configurations: Flanged valve body assembly with eccentric valve plug, metal seat ring, and splined valve shaft.

Body Sizes: 1, 1.5, 2, 3, 4, 6, or 8 in.

End Connection Styles: Raised face flanges or ring type joint flanges.

Shutoff Classification: 0.01% of valve capacity at full travel, for either flow direction.

Maximum Inlet Pressures: Consistent with applicable ANSI or DIN flange ratings.

Maximum Pressure Drops: Up to 1500 psi (103.4 bar) depending upon specific construction and temperature requirements.

Process Temperature Capabilities: From − 20 to 400 F (− 29 to 204 C) depending upon specific construction and pressure requirements.

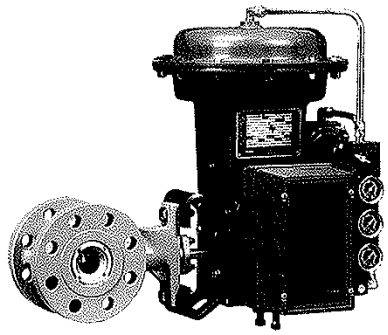
Maximum Flow Coefficients (Cv): 1 in. = 16.8, 1.5 in. = 31.0, 2 in. = 57.4, 3 in. = 142, 4 in. = 255, 6 in. = 717, 8 in. = 1050

Flow Characteristic: Modified linear

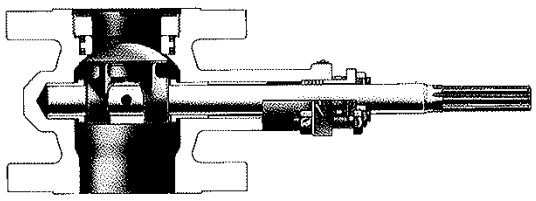
Flow Direction: *Reverse flow (standard)*—past valve plug and through seat ring. *Forward flow*—through seat ring and past valve plug.

Typical Construction Materials: *Valve body and retainer*—steel or stainless steel. *Seat ring, valve plug, bearings*—stainless steel or other alloy materials. *Packing rings*—TFE, TFE/bound composition, or graphite ribbon.

Bulletin Reference: 51.3:V500



Design V500 Valve with Type 1052 Actuator and Type 3610JP Positioner



Design V500

7600 Series Butterfly Control Valves

The 7600 Series butterfly control valve body assemblies are flangeless, heavy-duty constructions with a swing-through disc. They are designed for either throttling or on/off control of steam, or of a wide variety of liquids and gases, including those which are gritty (erosive), sticky, or which have a tendency to produce solid-particle buildup on internal valve parts. They are used for inlet pressure to 6170 psig (425 bar) with pressure drops to 2100 psi (145 bar) where low leakage rates are not required. They can be operated by any one of a variety of actuators.

Available Configurations: Flangeless, heavy-duty butterfly control valve body assemblies with a swing through conventional or *Fishtail*® disc

Body Sizes: 2 through 60 in.

End Connection Style: Flangeless body is designed to fit between pipe flanges with Class 125 through 2500 ratings and is retained by line flange bolts

Shutoff Classifications: From 0.06 to 4.6% of maximum capacity for liquid flow depending upon specific construction

Maximum Inlet Pressures: Up to 6170 psig (425 bar) depending upon specific construction and temperature requirements

Maximum Pressure Drops: Up to 2100 psi (145 bar) depending upon specific construction and temperature requirements

Process Temperature Capabilities: From cryogenic to 1500°F (816°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (C_v): From 2 in. = 110 to 60 in. = 19,400

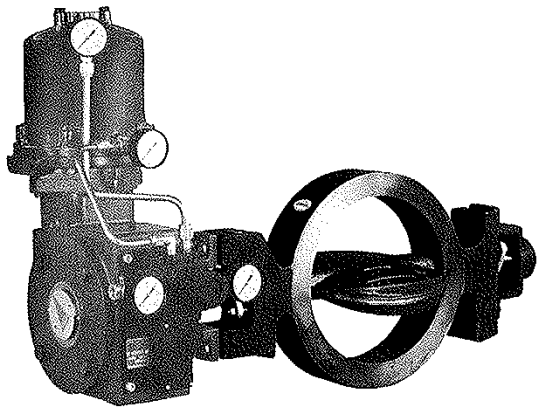
Flow Characteristic: Approximately equal percentage

Flow Directions: *Conventional Disc*—Flow in either direction. *Fishtail Disc*—Flow so that tail is on downstream edge of disc

Typical Construction Materials: *Valve Body, Disc*—Cast iron, carbon steel or stainless steel. *Valve Shaft*—Stainless steel. *Bushings*—TFE-coated fiberglass. *Packing*—TFE V-ring (many others available)

Additional Options: *Tandem linkage and pipe tee* for mounting two valves to form a 3-way valve assembly. *Knife-edged disc* for dislodging solid particles deposited on the body bore. *Step seats* for lower leakage rates. *Various packing box configurations* for vacuum service or to accommodate the need for purging or lubricating

Bulletin Reference: 51.4:7600



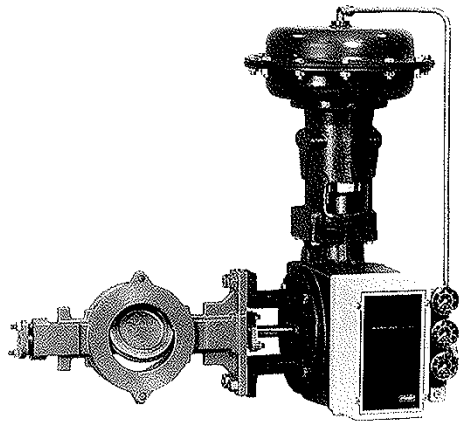
Type 7600 Valve Body with Type 1061 Actuator

8510 ēdisc® Control Valve

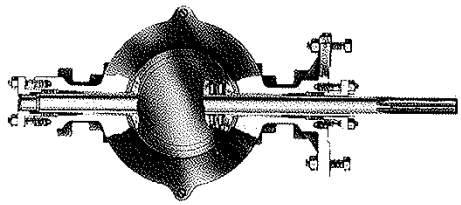
The Type 8510 ēdisc valve body features an eccentrically-mounted disk and a TFE or CF8M stainless steel seal ring to provide excellent shutoff in either flow direction.

The action of the eccentrically-mounted disk minimizes moving contact between the disk and its seal to reduce seal wear and seating torque requirements. The valve body combines with a variety of power and manual actuators to form a reliable, high-performance control valve.

The Type 8510 is suited to many liquid and gas applications which require extremely low leakage. Constructions are available for temperatures up to 1000°F (538°C).



Type 8510 Valve Body with Type 1052 Actuator and Type 3610J Positioner



Type 8510

Available Configuration: Flangeless control valve body assembly with elastomer or metal seal ring and eccentrically-mounted disk.

Body Sizes: 2 through 36 in.

End Connection Style: Flangeless body is designed to fit between pipe flanges with Class 150, 300, or 600 ratings and is retained by line flange bolts.

Shutoff Classifications: *TFE Seal Ring*—2 mL/min of air per inch of body size at a pressure drop of 50 psi (3.4 bar) is standard; Class VI is optional. *CF8M Seal Ring*—0.001% of maximum valve capacity

Maximum Shutoff Pressure Drop: Up to 740 psi (51 bar) depending upon specific valve construction and temperature condition

Process Temperature Capability: – 20 to 800°F (– 29 to 427°C) depending upon specific construction and pressure requirements

Maximum Flow Coefficients (Cv): From 2 in. = 80.2 to 36 in. = 50,000

Flow Characteristic: Approximately linear

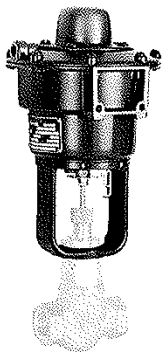
Flow Direction: Standard (forward flow) is with the seal retainer facing upstream; reverse flow is permissible but results in lower capacity

Typical Construction Materials: *Valve body*—Carbon steel or stainless steel. *Valve Disk*—Alloy steel or stainless steel. *Seal Ring*—TFE or CF8M. *Bearings*—TFE lined or all stainless steel or alloy steel. *Packing*—TFE V-ring, TFE-composition, or graphite.

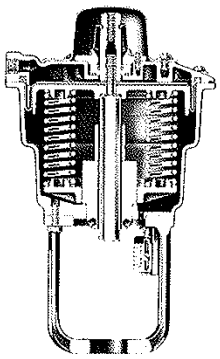
Bulletin Reference: 51.6:8510

513 & 513R Actuators

The Types 513 and 513R actuators are primarily used on small globe-style and angle-style valve body assemblies to provide either proportional or two-position control. The compact, lightweight Type 513 actuator may be easily modified without additional parts to a Type 513R.



Type 513-GS Control Valve (Type 513 Actuator on Design GS Valve Body Assembly)



Type 513

Available Configurations: Spring-return (uses 8 springs), pneumatic diaphragm actuator with yoke mounting and with guided stem for reciprocating motion. *Type 513*—Direct-acting configuration, which uses increasing operating pressure to extend its stem. *Type 513R*—Reverse-acting configuration, which uses increasing operating pressure to retract its stem.

Actuator Sizes: Two sizes with effective diaphragm area of 26 in.^{2} (168 cm^2)

Maximum Stem Travel: 3/4 in. (19 mm)

Maximum Usable Thrust: Up to 572 lb (2544 N) depending on construction and operating pressure range

Typical Operating Pressure Ranges: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Diaphragm Casing Pressure: 50 psig (3.4 bar)

Operating Temperature Capabilities: From − 40 to + 180°F (− 40 to + 82°C) with nitrile diaphragm

Typical Construction Materials: *Diaphragm Case*—Aluminum. *Yoke*—Size 20, aluminum; Size 32, cast iron. *Stem*—Steel. *Diaphragm*—Nitrile-covered fabric

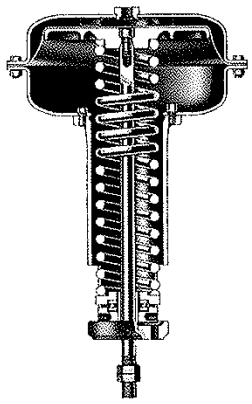
Yoke Mounting Boss Diameters: 1-1/4 or 2-1/8 in. (32 or 54 mm) depending on actuator size

Typical Accessories: *Adjustable travel stop* to limit stem extension. *Manual handwheel* for use either in case of pneumatic supply pressure failure, or to limit stem travel in either direction. *Series 3582* pneumatic or *Type 3582i* electro-pneumatic stem positioners. *Series 546* or *Type 646* electro-pneumatic input signal transducers. *Type 4200* electronic stem position indicator. *Type 304* stem position switch

Bulletin Reference: 61.1:513

656 Actuator

The Type 656 actuator was designed to operate equipment requiring the movement of lever arms. Typical applications include either proportional or two-position control of butterfly valves, built-in turbine valves, louvers and dampers.



Type 656

Available Configurations: Direct-acting (increasing operating pressure extends stem), spring-return, pneumatic diaphragm actuators for bracket mounting. Has a guided stem that requires a free link to connect the end of the stem to the lever in order to operate equipment requiring the movement of a lever around a pivot point

Actuator Sizes: Three sizes with effective diaphragm areas from 48 to 215 in.^{2} (310 to 1387 cm^2)

Maximum Stem Travels: From 2-1/8 to 4-1/8 in. (54 to 105 mm) depending on actuator size

Maximum Usable Thrusts: *In "Up" Direction*—From 1056 to 3440 lb. (4700 to 15,300 N) depending on actuator construction and operating pressure range. *In "Down" Direction*—From 704 to 2400 lb (3130 to 10,700 N) depending on actuator construction and operating pressure range

Typical Operating Pressure Ranges: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Diaphragm Casing Pressures: From 40 to 125 psig (2.8 to 8.6 bar) depending on construction

Operating Temperature Capabilities: From − 40 to + 180°F (− 40 to + 82°C) with nitrile diaphragm

Typical Construction Materials: *Diaphragm Case*—Steel. *Spring Barrel*—Cast iron. *Stem*—Steel. *Diaphgragm*—Nitrile-covered fabric

Mounting: Four mounting holes (3/8 in. UNC for Sizes 30 and 40, 1/2 in. UNC for Size 60) are in the yoke base to provide a means for mounting the actuator to a support bracket

Typical Accessories: *Manual handwheel* for use either in case of pneumatic supply pressure failure, or to limit stem travel in the upward direction. *Series 3582* pneumatic or *Type 3582i* electro-pneumatic stem positioners. *Series 546* or *Type 646* electro-pneumatic input signal transducers. *Type 304* stem position switch

Bulletin Reference: 61.1:656

657 & 657-8 Actuators

The Type 657 actuator is general purpose construction. It is used on a wide variety of globe-style and angle-style control valve body assemblies for either proportional or two-position control and is available in several sizes to accommodate an extensive variety of requirements.

Available Configurations: Direct-acting (increasing operating pressure extends stem), spring-return, pneumatic diaphragm actuators with yoke mounting and with guided stem for reciprocating motion

Actuator Sizes: Eleven sizes with maximum diaphragm areas from 50 to 450 in.² (323 to 2903 cm²).

Maximum Stem Travels: From 3/4 to 4-1/8 in. (19 to 105 mm) depending on actuator size.

Maximum Usable Thrusts: Net downward force from 1750 to 37,900 lb. (7780 to 169,000 N) and net upward force from 1240 to 25,300 lb. (5520 to 113,000 N) depending on construction and the operating pressure range.

Typical Operating Pressure Ranges: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Diaphragm Casing Pressures: From 40 to 125 psig (2.8 to 8.6 bar) depending on construction

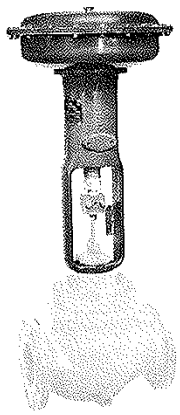
Operating Temperature Capabilities: From − 40 to + 180°F (− 40 to + 82°C) with nitrile diaphragm

Typical Construction Materials: *Diaphragm Case*—Steel. *Yoke*—Cast iron. *Stem*—Steel. *Diaphragm*—Nitrile-covered fabric

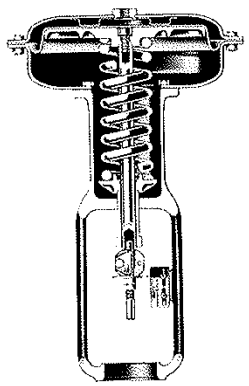
Yoke Mounting Boss Diameters: From 2-1/8 to 7 in. (54 to 178 mm) depending on actuator size.

Typical Accessories: *Manual handwheel* for use either in case of pneumatic supply pressure failure, or to limit stem travel in the upward direction. *Series 3582* pneumatic or *Type 3582i* electro-pneumatic stem positioners. *Series 546* or *Type 646* electro-pneumatic input signal transducers. *Type 304* stem position switch

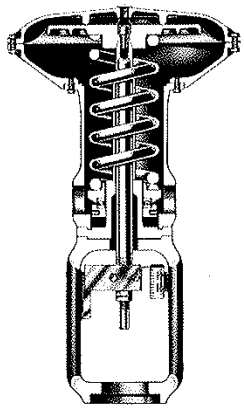
Bulletin Reference: 61.1:657



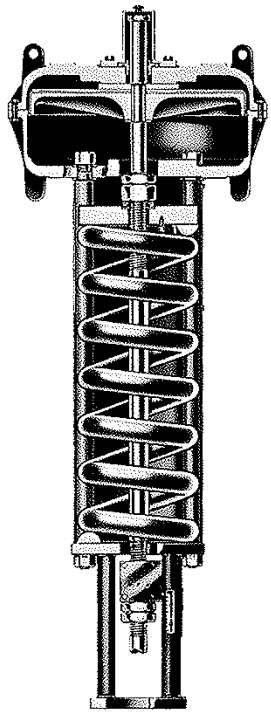
Type 657-ES Control Valve (Type 657 Actuator on Design ES Valve Body Assembly)



Typical Type 657, Sizes 30 through 87



Type 657, Size 80



Type 657, Size 100

Available Configurations: Direct-acting (increasing operating pressure extends stem), spring-return, pneumatic diaphragm actuators with yoke mounting and with guided stem for reciprocating motion

Actuator Sizes: Eleven sizes with maximum diaphragm areas from 50 to 450 in.² (323 to 2903 cm²).

Maximum Stem Travels: From 3/4 to 4-1/8 in. (19 to 105 mm) depending on actuator size.

Maximum Usable Thrusts: Net downward force from 1750 to 37,900 lb. (7780 to 169,000 N) and net upward force from 1240 to 25,300 lb. (5520 to 113,000 N) depending on construction and the operating pressure range.

Typical Operating Pressure Ranges: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Diaphragm Casing Pressures: From 40 to 125 psig (2.8 to 8.6 bar) depending on construction

Operating Temperature Capabilities: From − 40 to + 180°F (− 40 to + 82°C) with nitrile diaphragm

Typical Construction Materials: *Diaphragm Case*—Steel. *Yoke*—Cast iron. *Stem*—Steel. *Diaphragm*—Nitrile-covered fabric

Yoke Mounting Boss Diameters: From 2-1/8 to 7 in. (54 to 178 mm) depending on actuator size.

Typical Accessories: *Manual handwheel* for use either in case of pneumatic supply pressure failure, or to limit stem travel in the upward direction. *Series 3582* pneumatic or *Type 3582i* electro-pneumatic stem positioners. *Series 546* or *Type 646* electro-pneumatic input signal transducers. *Type 304* stem position switch

Bulletin Reference: 61.1:657

667 Actuators

The Type 667 actuator is a general purpose construction which is used on a wide variety of globe-style and angle-style control valve body assemblies for either proportional or two-position control. Several actuator sizes are available to handle a wide variety of applications.

Available Configurations: Reverse-acting (increasing operating pressure retracts stem), spring-return, pneumatic diaphragm actuator with yoke mounting and with guided stem for reciprocating motion

Actuator Sizes: Eleven sizes with maximum diaphragm areas from 50 to 450 in.^{2} (323 to 2900 cm^2)

Maximum Stem Travels: From 3/4 to 4-1/8 in. (19 to 105 mm) depending on actuator size

Maximum Usable Thrusts: Actuator in down position—Net downward force from 140 to 1350 lb (623 to 6000 N) and net upward force from 2000 to 45,000 lb (8900 to 200,000 N) depending on construction and the operating pressure range

Maximum Diaphragm Casing Pressures: From 50 to 110 psig (3.4 to 7.6 bar) depending on construction

Operating Temperature Capabilities: From − 40 to + 180°F (− 40 to + 82°C) with nitrile diaphragm

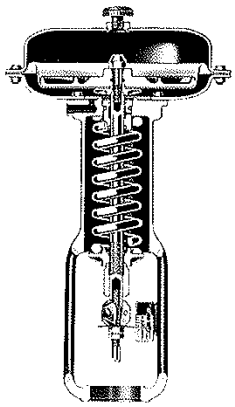
Typical Construction Materials: *Diaphragm Case*—Steel. *Yoke*—Cast iron. *Stem*—Steel. *Diaphragm*—Nitrile-covered fabric

Yoke Mounting Boss Diameters: From 2-1/8 to 7 in. (54 to 178 mm) depending on actuator size

Typical Accessories: *Manual handwheel* for use either in case of pneumatic supply pressure failure, or to limit stem travel in the downward direction. *Series 3582* pneumatic or *Type 3582i* electro-pneumatic stem positioners. *Series 546* or *Type 646* electro-pneumatic input signal transducers. *Type 304* stem position switch

Bulletin Reference: 61.1:657

Type 667-ED Control Valve (Type 667 Actuator on Design ED Valve Body Assembly)



Typical Type 667, Sizes 30 through 87

1051 & 1052 Actuators

The Type 1051 and 1052 diaphragm rotary actuators are spring-return actuators for on-off or throttling control. The Type 1051 actuator uses a valve positioner for throttling control, and the adjustable-spring Type 1052 actuator can be used for throttling with or without a positioner. The actuator linkage is completely enclosed, yet the valve body packing remains accessible for minor adjustments without removing any parts. These actuators generally mount on Design V100 or Type 8550 rotary valves, or splined-shaft butterfly valves.

Available Configurations: *Common Characteristics*—Direct-acting (increasing operating pressure extends stem), spring-return, pneumatic diaphragm actuator with bracket and enclosed linkage for rotary-shaft output of up to 90°. *Type 1051*—Has non-adjustable spring. *Type 1052*—Has adjustable spring

Actuator Sizes: Four sizes with torque capabilities up to 12,100 in.-lb (1370 N•m) depending on construction

Maximum Rotation: 90° with optional 60° travel stops

Typical Positioner Signal Pressure: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Positioner Signal Pressure: 35 psig (2.4 bar)

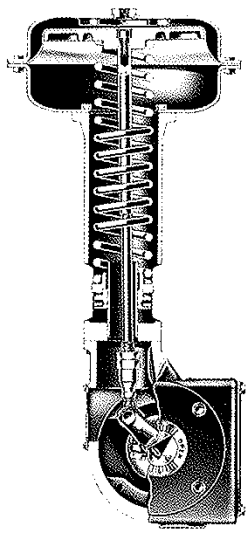
Maximum Diaphragm Casing Pressure: Up to 80 psig (5.5 bar) depending on construction

Operating Temperature Capabilities: From − 40 to + 180°F (− 40 to + 82°C) with nitrile diaphragm

Typical Construction Materials: *Actuator*—Diaphragm Case, pressed steel; Mounting Yoke, cast iron; Spring Barrel, Housing, and Cover, aluminum or cast iron; Stem, cadmium-plated steel; Diaphragm, nitrile. *Positioner*—Case, Cover and Beam, aluminum

Typical Accessories: Top-mounted handwheel. *Series 3610* pneumatic or *Series 3620* electro-pneumatic stem positioners. *Type 304* stem position switch

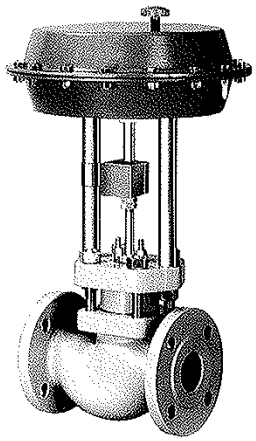
Bulletin Reference: 61.1:1051



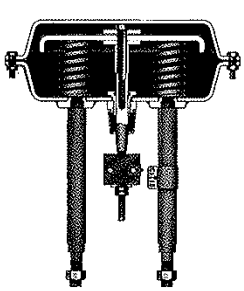
Type 1052

1250 & 1250R Actuators

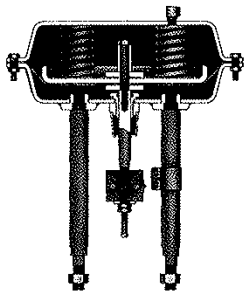
The Type 1250 direct acting actuator and the reverse acting Type 1250R actuator can provide throttling or on-off operation for the Design GL control valve body. The Type 1250 actuator provides fail open action while the Type 1250R actuator provides fail closed action.



Type 1250-GL Control Valve (Type 1250 Actuator on Design GL Valve Body Assembly)



Type 1250



Type 1250R

Available Configurations: *Type 1250*—direct acting, pneumatic, spring opposed diaphragm actuator. *Type 1250R*—same as 1250 except reverse acting.

Actuator Sizes: Three sizes with effective diaphragm areas from 34.9 to 104.6 in. sq (225 to 675cm sq)

Maximum Stem Travel: From .75 to 1 1/8 in. (20 to 30mm) depending on actuator size.

Maximum Usable Thrusts: *Type 1250*—Up to 3793lb. (16875 bar). *Type 1250R*—Up to 1062lb. (4725 bar) depending on actuator size

Typical Operating Pressure Ranges: From 3 to 15 psig (0.2 to 1.0 bar) or from 6 to 30 psig (.04 to 2.0 bar)

Maximum Diaphragm Casing Pressure: 80 psig (5.5 bar) depending upon actuator size

Operating Temperature Capabilities: From − 65 to 212°F (− 55 to 100°C) depending upon specific construction

Typical Construction Materials: *Diaphragm Casing, Diaphragm Plate, Leg Post*—steel; *Diaphragm*—nitrile on nylon or silicon elastomer; *Stem*—chrome plated steel

Typical Accessories: Silicon elastomer diaphragm, side mounted handwheel

Bulletin Reference: 61.1:1250

470 Series Actuators

The 470 Series actuators are general purpose constructions. They are used for either proportional or two-position control on a wide variety of globe-style, angle-style and ball valves. The 470 Series are available in many types and sizes as shown below to accommodate an extensive variety of requirements. The integral 3570 Series positioners are field reversible without additional parts to provide either direct (increasing signal pressure extends stem) or reverse-acting proportional control.

Basic Configurations Available: *Common Characteristics*—Pneumatic piston actuator with yoke mounting and with guided stem for reciprocating motion. *Basic Type 470*—Double-acting actuator with standard clamp-type stem connector for use on globe-style and angle-style control valves, with up to 4 in. (102 mm) stem travel (depending upon actuator size), and with integral Type 3570 pneumatic stem positioner for either direct (increasing input signal extends stem) or reverse-acting proportional control. *Basic Type 472*—Direct-acting (increasing cylinder operating pressure extends stem), spring-return actuator with standard clamp-type stem connector, with up to 3 in. (76 mm) stem travel (depending upon actuator size), and with integral Type 3572 pneumatic stem positioner for proportional control. *Basic Type 473*—Reverse-acting (increasing cylinder operating pressure retracts stem), spring-return actuator with standard clamp-type stem connector, with up to 3 in. (76 mm) stem travel (depending upon actuator size), and with integral Type 3573 pneumatic stem positioner for proportional control

Optional Configurations Available: The following optional configurations are available as modifications to the basic actuator configurations described above. One or more of these options may be used together to modify a basic actuator configuration to suit your needs. *-1 Added to Basic Type Number*—Eliminates integral stem positioner from basic actuator configuration. This option is used for two-position control applications. *-4 Added to Basic Type Number*—Adds a hydraulic snubber to the basic actuator configuration. This option is used to minimize vertical instability of the actuator stem in certain severe applications. *-5 Added to Basic Type Number*—Adds a side-mounted handwheel to the basic actuator configuration. The handwheel can be used either as a travel stop in the up or down direction, or as a means to manually position the stem. when this option is added to the basic actuator Type 472 or Type 473, a -MO suffix is added to the basic type number instead of a -5. *-8 Added to Basic Type Number*—Replaces standard clamp-type stem connector used on basic actuator configuration with a clevis-type connector, and extends maximum stem travel to 4-1/8 in. (105 mm). This option is used to adapt a basic actuator configuration for use on a ball valve in actuator Sizes 60, 64, 68, 80 and 100. *-16 Added to Basic Type Number*—Extends maximum stem travel to 8 in. (203 mm) for standard actuators or to 8-1/8 in. (206 mm) for clevis-connected actuators in Sizes 60, 68, 80 and 100 only

Actuator Sizes: Ten sizes with effective piston areas from 16-1/2 to 221-1/2 in.^{2} (106.5 to 1429 cm^2)

Maximum Stem Travels: From 1-1/2 to 8-1/8 in. (38 to 206 mm) depending on actuator size

Maximum Usable Thrusts: From 7600 to 30,000 lb. (33,820 to 133,500 N) depending on construction and cylinder operating pressure

Typical Positioner Signal Pressure Ranges: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Positioner Signal Pressure: 50 psig (3.4 bar)

Cylinder Operating Pressures: *Minimum*—35 psig (2.4 bar) for valves with low torque requirements or 50 psig (3.4 bar) for all other valves. *Maximum*—150 psig (10.3 bar)

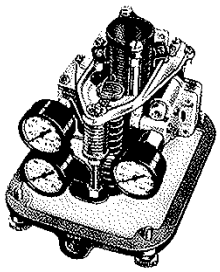
Operating Temperature Capabilities: From − 30 to + 175°F (− 34 to + 79°C)

Typical Construction Materials: *Actuator*—Cylinder and Piston, aluminum; Piston Rod and Extension, chrome-plated stainless steel; Cylinder Seal Bushings, brass; Seal Rings, nitrile; Yoke, cast iron or steel. *Positioner*—Base, Cover and Beam, die cast aluminum; Bellows, brass. *Snubber*—Cylinder, Reservoir, Piston and Piston Rings, cast iron; Piston Rod, chrome-plated stainless steel; O-Rings, nitrile

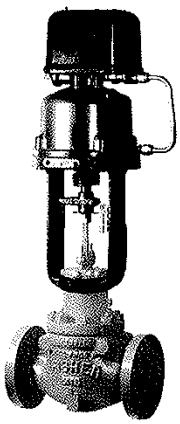
Yoke Mounting Boss Diameters: 3-9/16 or 5 in. (90.5 or 127 mm) depending on actuator size

Typical Accessories: *Bypass valve* (required with all handwheel constructions). *Type 2625* volume booster. *Type 304* stem positioner switch

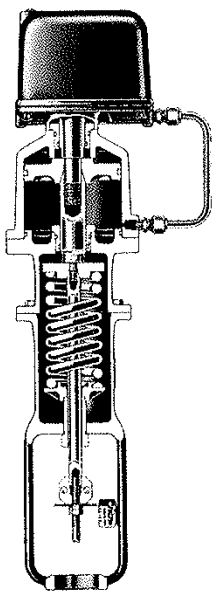
Bulletin Reference: 61.2:470



Type 3570 Positioner without Cover



Type 470-ES Control Valve (Type 470 on Design ES Valve Body Assembly)



Type 472

480 Series Actuators

The 480 Series actuators are general purpose constructions. They are used for either proportional or two-position control on a wide variety of butterfly and ball valves as well as on louvers, dampers, and rheostats. The 480 Series actuators are available in many types and sizes as shown below to accommodate an extensive variety of requirements. The integral 3570 Series positioners are field reversible without additional parts to provide either direct (increasing signal pressure extends stem) or reverse-acting proportional control.

Basic Configurations Available: *Common Characteristics*—Yokeless double-acting pneumatic piston actuator for bracket mounting with integral 3570 Series stem positioner and guided stem for reciprocating motion. *Basic Type 480*—Actuator with standard mounting flange, threaded piston rod connection, and up to 4-1/8 in. (105 mm) stem travel (depending on actuator size) for bracket mounting on louvers and dampers; or actuator with tapped piston rod connection and up to 4 in. (102 mm) stem travel (depending on actuator size) for integral mounting on Saunders valves. *Basic Type 487*—Rack-and-pinion equipped rotary actuator with flexible drive coupling and mounting plate to accommodate rheostat. This actuator is available only in size 30

Optional Configurations Available: The following optional configurations are available as modifications to the basic actuator configurations described above. One or more of these options may be used together to modify a basic actuator configuration to suit your need. *-1 Added to Basic Type Number*—Eliminates integral stem positioner from basic actuator configuration. This option is used for two-position control applications. *-4 Added to Basic Type Number*—Adds a hydraulic snubber to the basic actuator configuration. This option is used to minimize vertical instability of the actuator stem in certain severe applications. *-8 Added to Basic Type Number*—Removes standard mounting flange, replaces standard threaded piston rod connection used on basic actuator configuration with a clevis-type connection, and reduces maximum stem travel to 2-1/8 in. (54 mm). This option is used to adapt a basic actuator configuration (in size 20 only) for use on 1, 1-1/2, and some 3 in. ball valves. *-12 Added to Type Number*—Replaces standard mounting flange with universal mounting flange, replaces standard threaded piston rod connection used on basic actuator configuration with a clevis-type connection, and reduces maximum stem travel to 2-1/8 in. (54 mm). This actuator is available only in size 20. *-15 Added to Type Number*—Replaces standard mounting flange with universal mounting flange. This option is used to adapt a basic actuator configuration for use on a butterfly valve in actuator sizes 20, 30, 40, 60 and 80. *-16 Added to Type Number*—Replaces standard mounting flange with universal mounting flange and extends maximum stem travel to 8-1/8 in. (206 mm) in actuator sizes 40, 60, and 80

Actuator Sizes: Seven sizes with effective piston areas from 8-1/2 to 221-1/2 in.^{2} (55 to 1429 cm^2)

Maximum Stem Travels: From 1-3/4 to 8-1/8 in. (44 to 206 mm) depending on actuator size

Maximum Usable Thrusts: From 2227 to 33,000 lb (9900 to 146,790 N) depending on construction and cylinder operating pressure

Typical Positioner Signal Pressure Ranges: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Signal Pressure: 50 psig (3.4 bar)

Cylinder Operating Pressures: *Minimum*—35 psig (2.4 bar) for valves with low torque requirements or 50 psig (3.4 bar) for all other valves. *Maximum*—150 psig (10.3 bar)

Operating Temperature Capabilities: From − 30 to + 175°F (− 34 to + 79°C)

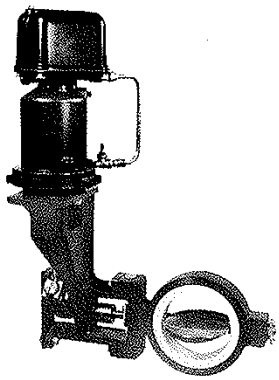
Typical Construction Materials: *Actuator*—Cylinder and Piston, aluminum; Piston Rod and Extension, chrome-plated stainless steel; Cylinder Seal Bushings, brass; Seal Rings, nitrile. *Additional Basic Type 487 Parts*—Flexible Drive Coupling, steel and nylon; Pinion Gear Shaft, stainless steel; Rack and Pinion Gears, Ball Bearing, and Mounting Plate, steel. *Positioner*—Base, Cover and Beam, die-

cast aluminum; Bellows, brass. *Snubber*—Cylinder, Reservoir, Piston and Piston Rings, cast iron; Piston Rod, chrome-plated stainless steel; O-Rings, nitrile

Mounting: Holes may be drilled into a mounting bracket as required to attach the actuator

Typical Accessories: *Type 2625* volume booster. *Type 4200* electronic stem position indicator. *Type 304* stem position switch

Bulletin Reference: 61.2:480



Type 480-15 on Butterfly Valve

490 Series Actuators

The 490 Series actuators are long-stroke constructions used for either proportional or two-position control on globe-style and angle-style valves having travel requirements greater than 8-1/8 inches (206 mm). The 490 Series are available in many types and sizes as shown below to accommodate an extensive variety of requirements. The integral 3570 Series positioners are field reversible to provide either direct (increasing signal pressure extends stem) or reverse-acting proportional control.

Basic Configuration: Type 490—Double-acting pneumatic piston actuator with yoke mounting and guided stem for reciprocating motion. Actuator has integral Type 3570P or 3570PC pneumatic stem positioner

Optional Configurations Available: The following optional configurations are available as modifications to the basic actuator configurations described above. One or both of these options may be used together to modify a basic actuator configuration to suit your needs. *-1 Added to Basic Type Number*—Eliminates integral stem positioner from basic actuator configuration. This option is used for two-position control applications. *-5 Added to Basic Type Number*—Adds a side-mounted handwheel to the basic actuator configuration. The handwheel can be used either as a travel stop in the up direction, or as a means to manually position the stem

Actuator Sizes: Six piston diameters with effective areas from 17-1/4 to 149 in.^{2} (111 to 961 cm^2)

Maximum Stem Travels: 9 to 24 in. (229 to 610 mm) in 1 in. (25 mm) increments

Maximum Usable Thrusts: *With Positioner*—From 2320 to 20,100 lb. (10,300 to 89,400 N) depending on construction and cylinder operating pressure. *Without Positioner*—From 4300 to 29,800 lb (19,100 to 133,000 N) depending on construction and cylinder operating pressure

Typical Signal Pressure Ranges: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Signal Pressure: 50 psig (3.4 bar)

Maximum Cylinder Operating Pressures: *With Positioner*—150 psig (10.3 bar). *Without Positioner*—For 5 through 12 in. (127 through 305 mm) diameter pistons, 250 psig (17.2 bar). For 14 in (356 mm) diameter pistons, 200 psig (13.8 bar)

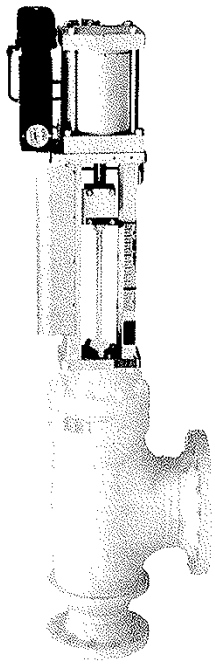
Operating Temperature Capabilities: From − 10 to 165°F (− 23 to + 74°C)

Typical Construction Materials: *Actuator*—5 through 12 in. (127 through 305 mm) Cylinder, chrome-plated steel; 14 in. (356 mm) Cylinder, chrome-plated steel or brass, Piston, steel; Piston Rod Assembly, chrome-plated steel; Yoke, steel. *Positioner*—Base, Cover, and Beam, die-cast aluminum; Bellows, brass. *Handwheel*—Cast iron

Yoke Mounting Boss Diameters: 5 or 7 in. (127 or 178 mm) depending on construction

Typical Accessories: *Bypass valve* (standard with all handwheel constructions). *Type 2625* volume booster. *Type 304* stem position switch.

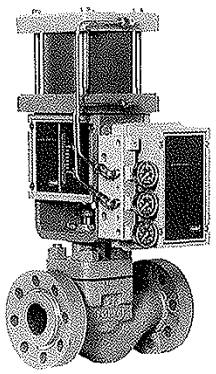
Bulletin Reference: 61.2:490



Type 490-FBT Control Valve (Type 490 Actuator on Design FBT Valve Body Assembly)

585 & 585R Actuators

The Types 585 and 585R piston actuators are compact, double acting pneumatic actuators that provide accurate throttling or on-off operation of sliding stem control valves. The Type 585 fully retracts the actuator stem for fail action upon loss of cylinder pressure. The Type 585R fully extends the actuator stem upon loss of cylinder pressure. No additional parts are required to convert one type to the other.



Type 585 Actuator, Type 3611JP Positioner, and Design CE Valve Body

Configurations Available: Double acting pneumatic actuator with yoke mounting. For on-off control, actuators are used with switching valves. For throttling control, either a Type 3611JP pneumatic or Type 3621JP electro-pneumatic positioner is utilized with the actuator.

Actuator Sizes: *Size 25*—25 in. sq (161 cm sq), *Size 50*—47 in. sq (303 cm sq)

Maximum Stem Travels: From 7/16 to 2 in. (11 to 51 mm) depending on actuator size.

Maximum Usable Thrust: From 180 to 1610 lb. (899 to 7162 N) depending on construction

Typical Positioner Signal Pressure Ranges: 3-15 or 6-30 psig (0.2-1.0 or 0.4-2.1 bar)

Maximum Position Signal Pressure: 150 psig (10.3 bar)

Operating Temperature Capabilities: From − 40 to 180°F (− 40 to 82°C)

Typical Construction Materials: *Actuator Yoke and Cylinder Cap*—cast iron; *Piston*—aluminum; *Cylinder*—steel; *Positioner Case*—aluminum; *Positioner Cover*—polyester plastic.

Yoke Mounting Boss Diameters: 2 1/8 to 2 13/16 in. depending on actuator size.

Typical Accessories: Top mounted handwheel, cylinder bypass.

Bulletin Reference: 61.2:585

1061 Actuators

The Type 1061 is a compact, piston-operated, rotary actuator used for either proportional or two-position control. The actuator linkage is completely enclosed, yet the valve body packing remains accessible for minor adjustments without removing any parts. This actuator generally mounts on Type 8550, or Design V100 rotary valves, or on splined-shaft butterfly valves.

Available Configuration: Double-acting, unguided-stem, pneumatic piston actuator with bracket and enclosed linkage for rotary-stem output of up to 90°

Actuator Sizes: Six sizes with effective piston areas from 16-1/2 to 130-1/2 in.^{2} (106 to 842 cm^2)

Maximum Rotation: 90° with optional 60° travel stops

Maximum Usable Torque: *Without Positioner*—From 2500 to 45,000 in. -lb (282 to 5084 N•m) depending upon actuator size

Typical Positioner Signal Pressure: 3 to 15 or 6 to 30 psig (0.2 to 1.0 or 0.4 to 2.0 bar)

Maximum Positioner Signal Pressure: 35 psig (2.4 bar)

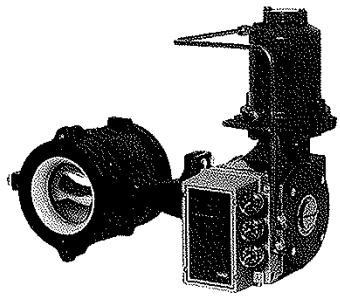
Cylinder Operating Pressure: *With Positioner*—Minimum of 20 and maximum of 110 psig (minimum of 1.4 and maximum of 7.6 bar). *Without Positioner*—150 psig (10.3 bar) maximum depending upon actuator size

Operating Temperature Capabilities: − 40 to + 180°F (− 40 to + 82°C)

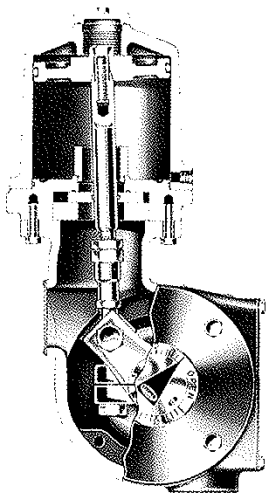
Construction Materials: *Actuator*—Cylinder and Piston, aluminum; Piston Rod, plated stainless steel; Cylinder Flange, aluminum; Sliding Seal, brass; Seal Support Cylinder, iron; Housing Assembly, aluminum; Mounting Yoke, cast iron

Typical Accessories: *Type 304* stem position switch. *Type 1076* manual handwheel. Series 3610 pneumatic or Series 3620 electro-pneumatic stem positioners. *Switching valve* for operating actuators without positioners. *Bypass valve* recommended with all handwheel constructions

Bulletin Reference: 61.2:1061



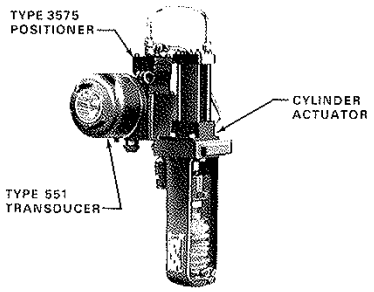
Type 1061-V100 Control Valve (Type 1061 Actuator on Design V100 Valve Body Assembly)



Type 1061

320 Series Actuators

The 320 Series are compact, fast-acting actuators. They are used for proportional control of valves requiring long travels, fast stroking speeds, or high thrusts or torques. The 320 Series actuators include an integrally mounted Type 3575 electrohydraulic stem positioner, which features a Type 551 electrohydraulic transducer. The positioner is field reversible without additional parts to provide either direct (increasing input signal extends stem) or reverse-acting control.



Type 320-V25 (Type 320 Actuator on Design V25 Ball Valve Body Assembly)

Available Configurations: *Common Characteristics*—Double-acting, electrohydraulic piston actuator with integral Type 3575 stem positioner, yoke mounting, and guided stem for reciprocating motion. An external hydraulic pumping unit is required. *Type 320*—These actuators can provide up to 8-1/8 in. (206 mm) stem travel and are used on rotary-shaft valves. *Type 321*—These actuators can provide up to 8-1/2 in. (216 mm) travel and are used on rotary-shaft valves such as Design V100, Type 8500, and splined-shaft butterfly valves. *Type 323*—These actuators can provide up to 3 in. (76 mm) travel and are used on sliding-stem valves

Actuator Sizes: Three sizes with effective piston areas from 5 to 19-5/8 in.^{2} (32 to 127 cm^2)

Maximum Stem Travels: *Type 320*—4-1/8 or 8-1/8 in. (105 or 206 mm) depending on actuator size. *Type 321*—4-1/2 or 8-1/2 in. (114 or 216 mm) depending on actuator size. *Type 323*—2 or 3 in. (51 or 76 mm) depending on actuator size

Maximum Usable Thrusts and Torques: *Types 320 and 323*—From 3430 to 10,300 lb (15,256 to 45,814 N) depending on construction and cylinder operating pressure. *Type 321*—From 6860 to 33,500 in.-lb (772 to 3785 N•m) depending on construction and cylinder operating pressure

Typical Input Signal Ranges: 1 to 9 Vdc, 1 to 5 mA dc, 4 to 20 mA dc or 10 to 50 mA dc

Maximum Cylinder Operating Pressure: 500, 750, or 1000 psig (34.5, 51.7, or 68.9 bar)

Operating Temperature Capabilities: From − 20 to + 140°F (− 29 to + 60°C) with special considerations for the hydraulic fluid

Electrical Classificaton: Type 551 electrohydraulic transducer is listed by UL and CSA as explosion proof in Class I, Group D, Division 1 hazardous locations

Typical Construction Materials: *Cylinder, Piston and Seals*—Steel and nitrile or steel and viton. *Yoke*—Cast iron. *Positioner Case*—Aluminum. *Positioner Bellows*—Stainless steel. *Transducer Case and Cover*—Aluminum. *Transducer Bellows*—Stainless steel.

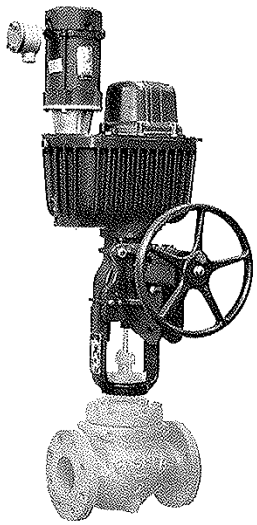
Yoke Mounting Boss Diameters: From 2-13/16 to 5 in. (71 to 127 mm) depending on actuator size

Typical Accessories: *Uni-directional or bi-directional volume booster* to increase stroking speed in either one or both directions; boosters available only on actuators having 3 in. (76 mm) or greater travel. *Lock-in-last-position valves or directional shutdown valves* to provide appropriate stem position in case of supply pressure failure. *Handwheel* (not available with size 40 Type 320)

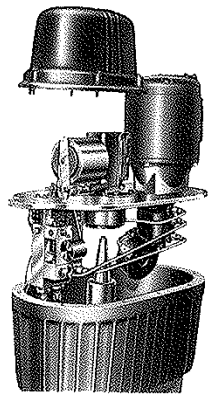
Bulletin Reference: 61.5:320

350 Series Actuators

The 350 Series are general-purpose actuators that are used on a wide variety of globe, angle, and rotary valves for either proportional or two-position control. These actuators include hydraulic pump and motor.



Type 350-ED Control Valve (Type 350 Actuator with Optional Handwheel on Design ED Valve Body Assembly)



Arrangement of Type 350 Components on Mounting Plate

Available Configurations: *Common Characteristics*—Double-acting, electrohydraulic piston actuator with integral hydraulic pump and motor. *Type 350*—Threaded stem connector for use with sliding-stem control valve bodies. *Type 352*—Threaded stem connector for use with sliding stem control valve bodies; actuator spring retracts actuator piston rod with loss of hydraulic pressure of power supply. *Type 353*—Threaded stem connector for use with sliding-stem control valve bodies; actuator spring extends actuator piston rod with loss of hydraulic pressure or power supply. *Type 354*—Splined shaft connection for rotary valves.

Actuator Sizes: Essentially two versions are available, a standard-thrust version—2000 lb (8896 N) maximum gross cylinder output thrust; and a high-thrust version—5000 lb (22,200 N) maximum gross cylinder output thrust

Maximum Stem Travels: *Types 350, 352, 353*—1-1/2 to 3 in. (38 to 76 mm). *Type 354*—90 degrees.

Maximum Usable Thrusts: *Types 350, 352, 353*—2000 or 5000 lb (8896 or 22,200 N) depending on construction. *Type 354*—7031 in.-lb (794 N•m)

Typical Input Signal Ranges: 1 to 5 mA dc, 4 to 20 mA dc, or 10 to 50 mA dc; split ranges are also available

Pump Motor Power Supply Requirements: 115/230 Vac, 60 Hz, single phase or 220/440, 50/60 Hz, three phase (special motors are also available)

Electrical Classification: Motor is available CSA listed as explosion proof for Class 1, Group D, Division 1 or 2 (An intrinsically safe version of the actuator is available)

Operating Temperature Capabilities: From − 40 to + 104°F (− 40 to + 40°C)

Typical Construction Materials: *Reservoir, Mounting Plate and Cover*—Aluminum. *Yoke*—Iron. *Piston Rod Assembly*—Chrome-plated steel. *Cylinder*—Steel. *Piston and Bushings*—Brass. *O-Rings and Rod Packing*—Nitrile. *Pilot Bellows*—Stainless steel

Yoke Mounting Boss Diameters: 2-13/16, 3-9/16, or 5 in. (71, 90, or 127 mm)

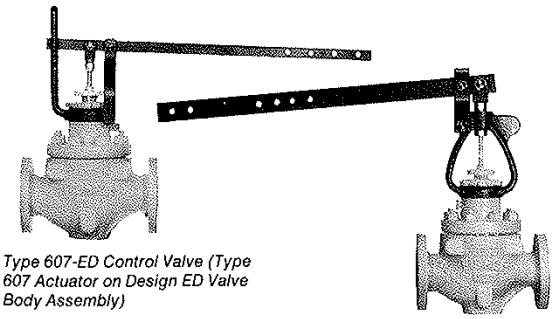
Typical Accessories: *Side-mounted handwheel* can be used to position the valve plug or disc manually; some handwheel varieties can be used as a travel stop in the up or down direction. *Cylinder bypass valve* equalizes pressure above and below the piston to allow handwheel operation. *Two lock-in-last- position valves* provide automatic locking of the stem in the last controlled position upon failure of the power supply to the pump motor or upon any malfunction that would cause loss of the pilot supply pressure

Bulletin Reference: 61.5:350

607 & 608 Lever Actuators

The Types 607 and 608 actuators are used to give a power source a mechanical advantage when operating a control valve. Typical control valves used are in the **easy-e®** or the Design GS valves. Power sources can be liquid level ball float sensors, combustion controls, electric motors, power pistons or similar devices.

The actuator can operate either as a first class lever in which the valve stem moves down with rising lever, or as a second class lever in which the valve stem rises with rising lever. Each construction is completely field-reversible with multiple adjustments to permit several mechanical-advantage variations.



Type 607-ED Control Valve (Type 607 Actuator on Design ED Valve Body Assembly)

Available Configurations: *Common Characteristics*—Lever actuator with yoke mounting and with sliding stem for reciprocating motion. *Type 607*—Medium-duty construction. Lever orientation on valve body assembly may be changed by loosening the yoke locknut and rotating the actuator. *Type 608*—Heavy-duty construction. Lever orientation on valve body assembly may be changed by loosening the yoke locknut and rotating the actuator.

Maximum Stem Travels: *Type 607*—3/4 in. (19 mm). *Type 608*—From 3/4 to 2 in. (19 to 51 mm) depending on construction.

Maximum Usable Thrusts: *Type 607*—From 425 to 1175 lb (1890 to 5230 N) depending on construction. *Type 608*—From 1050 to 2350 lb (4670 to 10,500 N) depending on construction

Typical Construction Materials: *Types 607 and 608*—Yoke, high-tensile iron; Lever and Lever Link, steel; Link Pins, stainless steel

Yoke Mounting Boss Diameters: *Type 607 or 608*—2-1/8 or 2-13/16 in (54 or 71 mm) depending on construction.

Bulletin Reference: 61.7:607

617 & 618 Float-Operated Lever Actuators

The Types 617 and 618 float-operated lever actuators are designed to control the level of liquids in open tanks, vats, reservoirs, etc., by controlling the flow into or from the vessel. Each type is field reversible so that it can be used either as a first-class lever (to control flow into a vessel) or as a second-class lever (to control flow from a vessel). Multiple adjustments permit several mechanical advantage variations.

Available Configurations: *Type 617*—Standard duty, reversible, float-operated lever actuator. *Type 618*—Heavy duty, reversible, float-operated lever actuator

Maximum Stem Travels: *Type 617*—3/4 in. (19 mm). *Type 618*—From 3/4 to 2 in. (19 to 51 mm) depending on construction

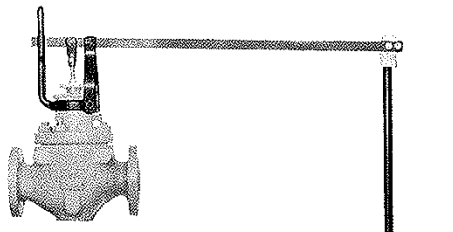
Maximum Usable Thrusts: *Type 617*—From 85 to 133 lb (378 to 592 N) depending on construction. *Type 618*—From 34 to 87 lb (151 to 387 N) depending on construction

Typical Construction Materials: *Yoke*—High-tensile iron. *Lever and Lever Link*—Steel. *Float*—Copper or stainless steel. *Link Pins*—Stainless steel. *Lever Segment*—Brass. *Clevis (Type 617 Only)*—Diecast zinc. *Guide Link (Type 618 Only)*—Brass

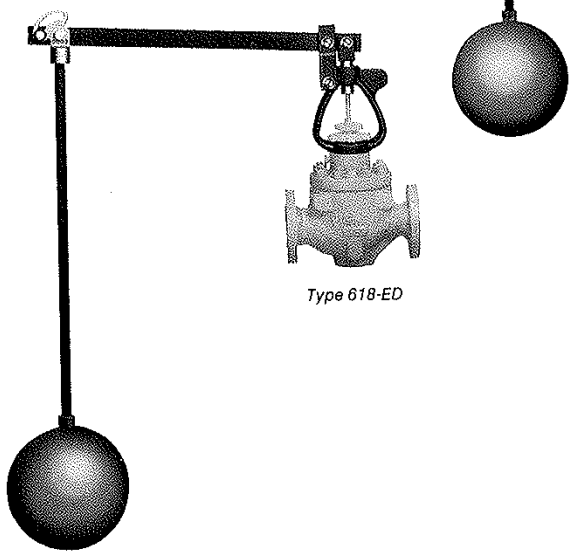
Yoke Mounting Boss Diameters: 2-1/8 or 2-13/16 in. (54 or 71 mm) depending on construction

Spherical Float Sizes: *Copper*—6, 8, or 10 in. (152, 203, or 254 mm) diameter. *Stainless Steel*—6, 7-3/4, or 9-3/4 in. (152, 197, or 248 mm) diameter

Bulletin Reference: 61.7:617



Type 617-ED Control Valve (Type 617 Actuator on Design ED Valve Body Assembly)



Type 618-ED

1008 Handwheel Actuators

The Type 1008 actuator is used in applications that require a throttling type of control valve that can be manually operated. This actuator can be used on nearly all standard globe-style or angle-style control valve body assemblies.

Available Configuration: Manual handwheel actuator for yoke mounting with guided stem for reciprocating motion

Actuator Sizes: Four sizes

Maximum Stem Travels: From 3/4 to 3 in. (19 to 76 mm) depending on actuator size

Maximum Usable Thrusts: From 1650 to 17,000 lb (7340 to 75,600 N) depending on actuator size

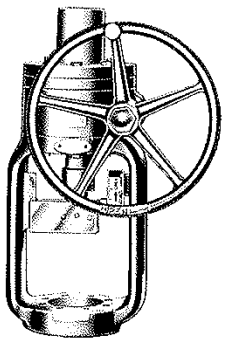
Maximum Handwheel Forces: From 39 to 140 lb (173 to 623 N) depending on actuator size

Typical Construction Materials: *Sizes 30, 40, and 50*—Handwheel, high-tensile iron; Yoke, ductile iron; Acme Power Nut, stainless steel; Acme Power Screw, aluminum bronze. *Size 80*—Handwheel and Yoke, high-tensile iron; Worm Gear, phosphor bronze; Worm Shaft and Stem Screw, steel

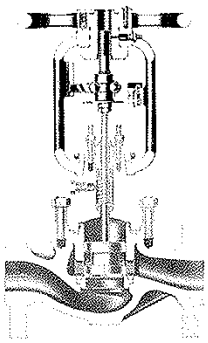
Yoke Mounting Boss Diameters: From 2-1/8 to 5 in. (54 to 127 mm) depending on actuator size

Typical Accessories: Tejax model A35 valve stem position indicator (on Sizes 30, 40, and 50 only)

Bulletin Reference: 61.8:1008



Type 1008, Size 80



Type 1008-ES (Type 1008 Actuator on Design ES Valve Body Assembly), Typical of Actuator Sizes 30, 40, and 50

1076 Handwheel Actuator

The 1076 actuator is a manual handwheel actuator available for use with rotary-shaft valve bodies such as the Design V100 **Vee-Ball®** valve.

The declutchable Type 1076 is used on power-actuated valves as a secondary operating means. The actuator is connected to the valve shaft only when the handwheel actuator is in use and the power actuator is not operating the valve.

Available Configuration: Actuator uses a worm and worm gear sector to transmit power from the handwheel or optional chainwheel to a splined shaft. Type 1076 is an auxiliary manual actuator engaged when the power actuator is not in use

Maximum Rotation: 90°

Maximum Usable Torques: From 515 to 30,000 in.-lb (58 to 3390 N•m) depending on construction

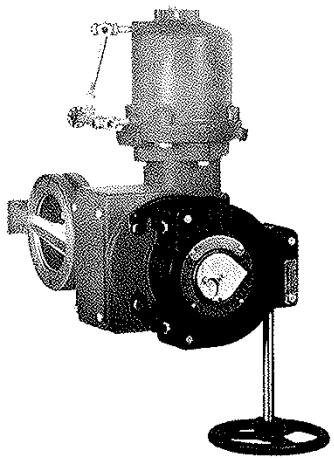
Maximum Handwheel Forces: From 29 to 132 lb (129 to 587 N) depending on construction

Shaft Diameter Compatibility: 1/2 through 2-1/2 in. (12.7 through 63.5 mm)

Typical Construction Materials: *Case, Cover, Handwheel and Worm Gear Sector*—Cast Iron. *Worm*—Steel. *Worm Gear Shaft*—17 -4PH stainless steel

Mounting: Actuator can be mounted to valve in any one of four possible orientations

Bulletin References: 61.8:1076



Type 1076 Actuator on ēdisc Series Valve with Type 1061 Actuator

1083 Handlever Actuators

The Type 1083 handlever actuator is used for manual-only operation of the Type 8551 **ēdisc**® rotary shaft valves. A spring secures the handlever in the notched quadrant plate, allowing the valve disc to be locked in any of l0 positions.

Valve Compatibility: Within torque output limitations listed below, the Type 1083 handlever actuator can be used with Type 8551 *ēdisc* valves having 1/2, 5/8, 3/4, or 1 in. (12.7, 15.9, 19.1, or 25.4 mm) diameter valve shafts

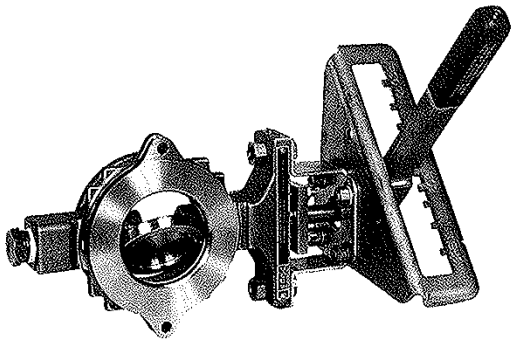
Maximum Rotation: 90°

Maximum Valve Torque Capabilities: *Valve Closed*—1000 in.-lb (113 N•m). *Valve Open*—350 in.-lb (49 N•m)

Valve Disc Positions: Disc locking positions are provided at every 10° increment between 0 and 90° of valve disc rotation; lever is aligned with disc edge for rapid determination of disc position

Construction Materials: *Handlever*—Zinc-plated iron. *Quadrant Plate and Yoke*—Zinc-plated steel. *Handlever Grip*—Vinyl

Bulletin Reference: 61.8:1083



Type 1083 Handlever on Type 8551 ēdisc Valve

304 Electrical Valve Position Switches

The Type 304 electrical switch is normally used as a valve position switch. As such, it is mounted on a control valve actuator to operate alarms, signal lights, relays, solenoid valves, or similar equipment at up to six predetermined points of valve travel. The Type 304 can also be adapted to operate in response to any linear or rotary motion that can turn the cam rod.

Maximum Cam Rod Rotation: 90° from point of activation of first switch to point of activation of last switch

Switch Type: Single pole, double throw

Switch Electrical Rating: *Service Ratings (Continuous Ratings for Resistive Loads)*—115/230/440 Vac at 15 A maximum, 6 or 12 Vdc at 15 A maximum, 24 Vdc at 6 A maximum, 110 Vdc at 0.5 A maximum, or 220 Vdc at 0.25 A maximum. *Maximum Inrush Current*—30A for normally-closed contacts or 25A for normally-open contacts. *Horsepower Ratings*—3/4 hp (552 W) at 125 Vac or 1-1/2 hp (1103 W) at 250 Vac

Number of Individual Switches: 1, 2, 3, 4, 5, or 6

Operating Temperature Capabilities: From − 40 to + 180°F (− 40 to + 82°C)

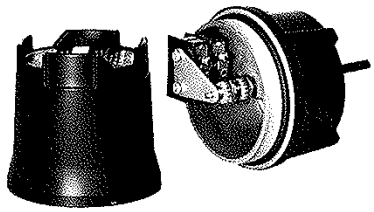
Electrical Classification: CSA listed as explosion proof in Class I, Groups C and D, Division 1 locations and has a watertight enclosure (Enclosure 4)

Construction Materials: *Base and Cover*—Aluminum. *Cams and Cam Rod*—Stainless steel. *Operating Arm and Cam Gears*—Cadmium-plated steel. *O-Rings*—Nitrile

Mounting: Parts are provided for mounting Type 304 on Fisher actuators

Additional Option: Terminal strip

Bulletin Reference: 13.3:304 or 62.3:304

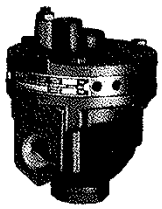


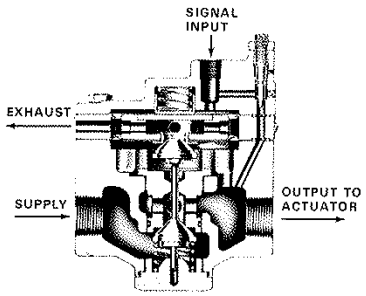
2625 High-Capacity Volume-Booster Air Relay

The Type 2625 is a high-capacity volume-booster relay with adjustable bypass. It is normally used on control valve actuators to speed up the proportional operation of a control valve in response to sudden pressure changes from a pneumatic-output valve stem positioner, such as a Type 3582.

The bypass feature in the Type 2625 allows the actuator to respond directly to small or slow positioner output changes produced by usual process undulations, yet it allows the relay to respond with high-volume output pressure for rapid actuator stroking when confronted with positioner output changes that exceed the adjustable deadband limits.

Because of the deadband characteristic resulting from the bypass feature, the Type 2625 should not be used to boost pneumatic controller outputs.





Available Configuration: Volume-booster relay with adjustable bypass, which has a double-acting valve plug construction

Maximum Input Signal Pressure: 150 psig (10.3 bar)

Maximum Supply Pressure: Must be the same as the maximum input signal of the controlled device up to a limit of 150 psig (10.3 bar)

Minimum Deadband Width: 1 psi (0.7 bar) or 5% of output span, whichever is greater

Supply and Output Connection Sizes: 3/4 in. NPT female

Operating Temperature Capabilities: From − 40 to + 300°F (− 40 to + 149°C) depending on construction materials

Typical Construction Materials: *Body*—Aluminum. *Cage*—Brass. *Diaphragm*—Nitrile on nylon. *O-Rings*—Nitrile. *Valve Assemblies*—Aluminum and nitrile or aluminum, stainless steel, and Viton*

Bulletin Reference: 62.3:2625

*Trademark of Du Pont Co.

3583 & 3583C Pneumatic Linear-Motion Transmitters

The Types 3583 and 3583C transmit linear motion information and are used in conjunction with additional indicating and/or recording instruments. They are normally mounted on sliding-stem-type control valve actuators, and convert linear stem motion to a pneumatic output pressure which is proportional to the valve stem position.

The action of these transmitters may be easily changed without additional parts to obtain either increasing (direct acting) or decreasing (reverse acting) output pressure with downward stem motion.

Available Configurations: *Type 3583*—Pneumatic linear-motion transmitter with output and supply pressure gauges (either 0 to 30 or 0 to 60 psig gauges, as specified). *Type 3583C*—Pneumatic linear-motion transmitter with automotive tire valves instead of pressure gauges

Acceptable Stem Movement: Full output available with stem movements up to 4-1/8 in. (105 mm)

Output Signal: 3 to 15, 5 to 25, or 6 to 30 psig (0.2 to 1.0, 0.3 to 1.7, or 0.4 to 2.0 bar)

Supply Pressure Requirements: *Minimum*—5 psig (0.3 bar). *Maximum*—35 psig (2.4 bar)

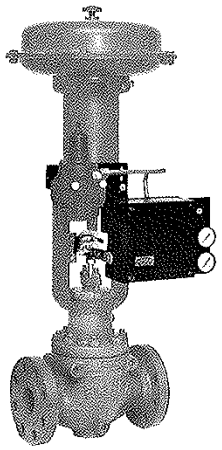
Supply and Output Connection Sizes: 1/4 in. NPT female

Operating Temperature Capabilities: From − 40 to + 250°F (− 40 to + 121°C) depending on construction

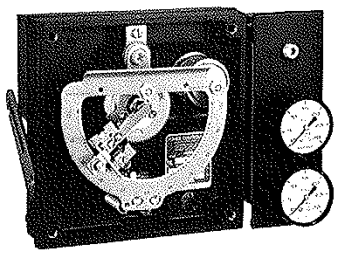
Typical Construction Materials: *Case, Cover and Relay Body*—Aluminum. *Nozzle and Flapper*—Stainless steel. *Bellows*—Phosphor bronze. *O-Rings*—Nitrile or Viton*. *Relay Diaphragms*—Nitrile or polyacrylic Dacron*

Mounting: Mounting plate is provided for convenient mounting of Type 3583 or Type 3583C to many actuators

Bulletin Reference: 62.3:3583



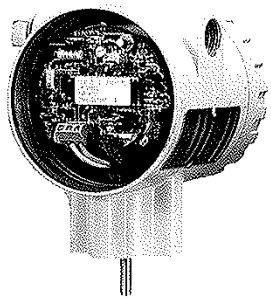
Type 3583 Mounted on a Control Valve



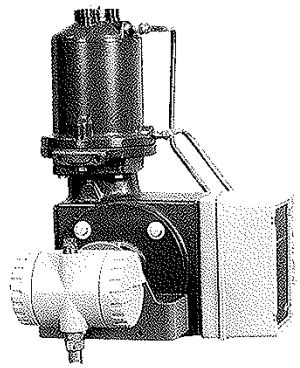
Type 3583 with Cover Off

4200 Series Electronic Position Transmitters

The 4200 Series electronic position transmitters sense the position of rotary or sliding stem valves, vents, dampers or other devices. Available variations include a transmitter (4 to 20 milliampere output) with integral high and low electrical position switches, a transmitter only, or an electrical position switch only.



4200 Series Transmitter



4200 Series Transmitter on a Control Valve

Input Signal Source: Standard single potentiometer, or optional dual potentiometer for transmitter and position switch circuit inputs.

Output Signal: *Range*—4 to 20 mA dc transmitter output. *Load Impedance*—0 to 650 ohms with a 24 volt dc nominal supply. *Output Current Limit*—30 mA dc. *Switches*—ON/OFF condition of high/low position switch relays (SPDT).

Recommended Power Supply: 24 volts dc nominal

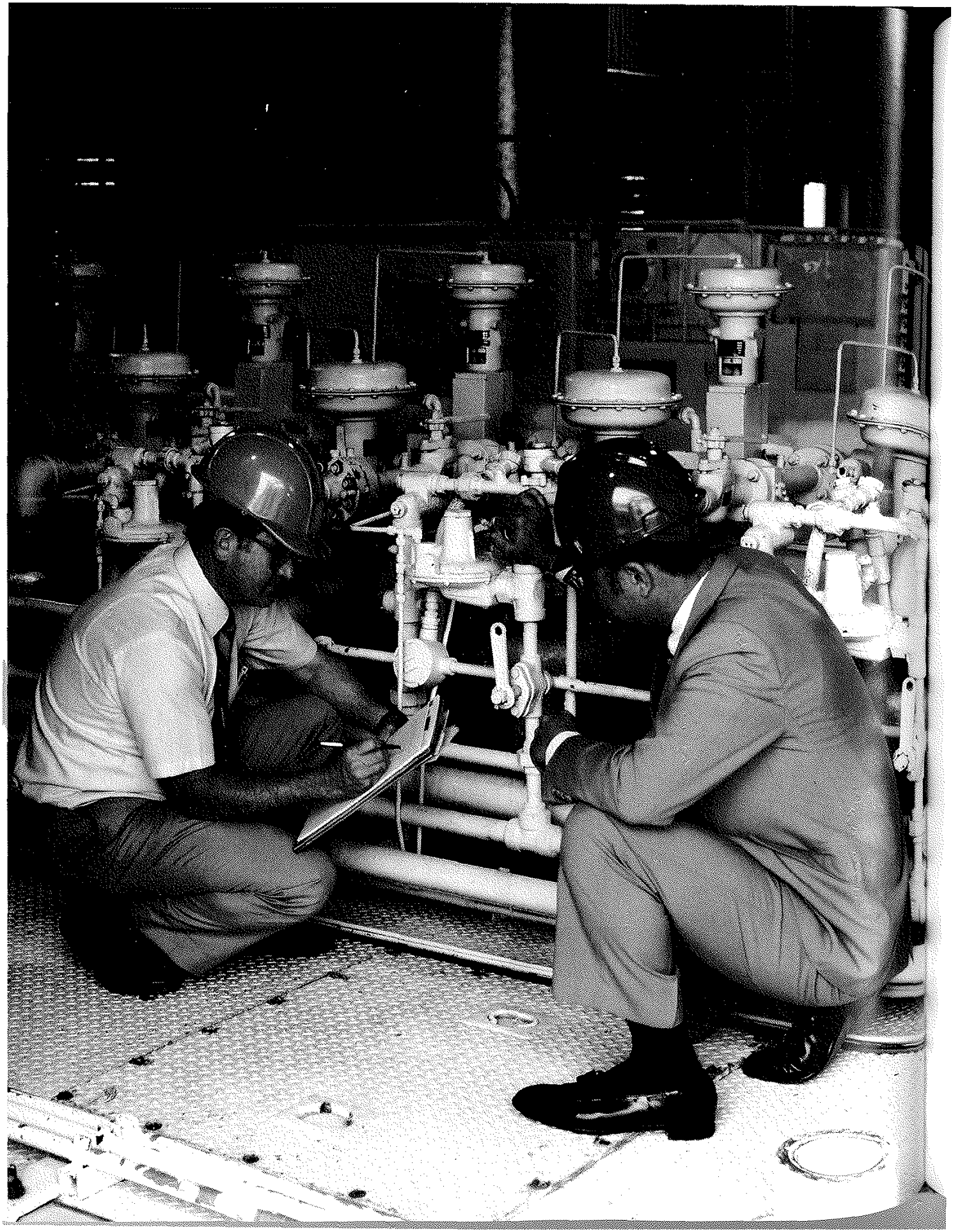
Reference Accuracy: ± 1% of output span. Includes combined effects of hysteresis, linearity, and deadband. *Repeatability*—± 0.25% of span

Typical Construction Materials: *Housing and Covers*—aluminum alloy; *O-Rings*—nitrile; *Mounting Hardware*—steel.

Mounting: Mounting plate provided for convenient mounting to many actuators.

Bulletin Reference: 62.3:4200

*Trademark of DuPont Co.



Contents

Introduction

Instrument engineers agree that the simpler a control system is, the better it is—as long as it provides adequate control. And in general, regulators* are simpler than the alternative of a control valve with its external power sources and transmitting and controlling instruments. A regulator is a very simple control device in which all of the energy to operate it is derived from the controlled system. Consider using a regulator first whenever you have a requirement for

- Pressure control
- Level control
- Flow control

If your process requires the control of some other variable, refer to section 6, Control Valves, and the appropriate instrumentation sections(s).

Also note that, even in instances where you need pressure, level or flow control, use of a regulator may still be inappropriate. Both regulators and control valve/instrument packages have their advantages and limitations. The following table lists selected characteristics of each. These and other considerations peculiar to your specific control problem need to be carefully studied to determine which method of control is the better choice.

All regulators, whether they are being used for pressure, level or flow control, fit into one of the following two basic categories:

1) Direct-operated
2) Pilot-operated

Characteristically, direct-operated regulators are adequate for narrow-range control, and where the allowable change in outlet pressure can be 10 to 20 percent of the outlet pressure setting.

*While the word "regulator" is used in this introduction, the individual selection guides and product descriptions use the descriptive product name (i.e., pump governors, relief valves, etc.)

Regulator vs. Control Valve/Instrument

SELECTED REGULATOR CHARACTERISTICS	SELECTED CONTROL VALVE/ INSTRUMENT CHARACTERISTICS
Purchase price, installation and maintenance costs are normally lower	Wide variety of construction materials and accessories available
Requires no additional power sources for basic operation	Transmitting and controlling instruments are separate and may be remote mounted
Less complex, and often lighter and more compact	Specific construction has broad application flexibility
Controller, which provides fixed-band proportional control only, is built in	Separate controller allows for adjustable-band proportional control with reset and/or rate options for excellent control response

Pilot-operated regulators are preferred for broad-range control, or where the allowable change in outlet pressure is required to be less than 10 percent of the outlet pressure setting. They are also commonly used when remote set point adjustment is required for a regulator application.

For your convenience, each regulator in the following pressure, level or flow regulator selection guides is identified as being either direct-operated or pilot-operated.

Pressure Reducing Regulators

Description

A pressure reducing regulator maintains a desired reduced outlet pressure while providing the required fluid flow to satisfy a variable downstream demand. The value at which the reduced pressure is maintained is the outlet pressure setting of the regulator.

Direct-Operated Regulator

As shown in the accompanying figures, a direct-operated pressure-reducing regulator senses the downstream pressure through either an internal pressure tap 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 Regulator

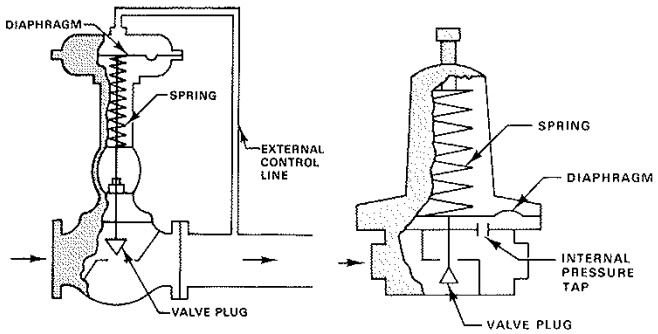
The addition of a pilot to a regulator provides a two-path control system. The main valve diaphragm responds quickly to downstream pressure changes, causing an immediate correction in the main valve plug position. The pilot diaphragm responds simultaneously, diverting some of the reduced inlet pressure to the other side of the main valve diaphragm to control the final positioning of the main valve plug.

Selection

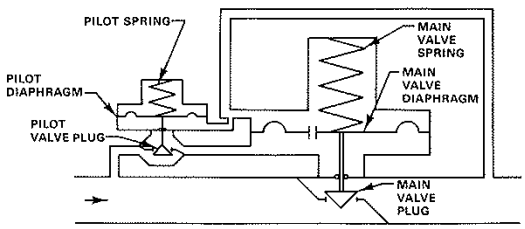
Familiarize yourself with the following application considerations as they apply to your control requirements.

- Outlet pressure setting and maximum allowable pressure change from setting
- Minimum, normal, and maximum inlet pressures
- Minimum controlled flow, normal flow, and maximum required flow
- Name, temperature, and specific gravity of controlled fluid
- Inlet and outlet pipe sizes
- Installation
- Environmental considerations, such as noise level, venting, corrosion, temperature extremes, etc.
- Special capabilities, such as automatic emergency shutoff, internal relief, gauges, test connections, etc.

The following three selection tables will guide you to product descriptions that describe pressure reducing regulators. To help you make your final selection, contact your Fisher sales office or sales representative who will assist you in selecting the type and size of pressure regulator that will best suit your need.



Direct-Operated Pressure Reducing Regulators



Pilot-Operated Pressure Reducing Regulator

Liquid Pressure Reducing Regulators

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
		Psig	Bar			
14 inch wc through 1 psig	35 through 69 mbar	250	17.2	1/2 through 2	655-GS	7-39
		400	27.6	1 through 6	1098-EGR(2)	7-46
		500(3)	34.5(3)	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED or 655-EK	7-39
					796R-EDR(4) or 796R-EKR(4)	7-40
				1 through 6	796-ED(4) or 796-EK(4)	7-40
2 psig	0.1 bar	250	17.2	1/2 through 2	655-GS	7-39
		300	20.7	1/8 through 1	95L	7-25
		400	27.6	1 through 6	1098-EGR(2)	7-46
		500(3)	34.5(3)	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED or 655-EK	7-39
					796-EDR(4) or 796R-EKR(4)	7-40
				1 through 6	796-ED(4) or 796-EK(4)	7-40
5 through 10 psig	0.3 through 0.7 bar	250	17.2	1/2 through 2	655-GS	7-39
		300	20.7	1/8 through 1	95L	7-25
				1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				1 through 6	1098-EGR(2)	7-46

1. These regulators are direct-operated except where noted.
2. Pilot-operated regulator.
3. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
4. Pressure-loaded regulator.

—Continued—

Liquid Pressure Reducing Regulators (Continued)

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (INCH)	TYPE NUMBER[1]	SEE PAGE
		Psig	Bar			
5 through 10 psig	0.3 through 0.7 bar	500[3]	34.5[3]	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED or 655-EK	7-39
					796R-EDR[4] or 796R-EKR[4]	7-40
				1 through 6	796-ED[4] or 796-EK[4]	7-40
15 psig	1.0 bar	250	17.2	1/2 through 2	655-GS	7-39
		300	20.7	1/8 through 1	95L	7-25
				1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				1 through 6	1098-EGR[2]	7-46
		500[3]	34.5[3]	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED or 655-EK	7-39
					796-EDR[4] or 796R-EKR[4]	7-40
				1 through 6	796-ED[4] or 796-EK[4]	7-40
20 psig	1.4 bar	250	17.2	1/2 through 2	655-GS	7-39
		300	20.7	1/8 through 1	95L	7-25
				1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				1 through 6	1098-EGR[2]	7-46
		500[3]	34.5[3]	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED or 655-EK	7-39
					796-EDR[4] or 796R-EKR[4]	7-40
				1 through 6	796-ED[4] or 796-EK[4]	7-40
50 through 75 psig	3.4 through 5.2 bar	250	17.2	1/2 through 2	655-GS	7-39
		300	20.7	1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				1 through 6	1098-EGR[2]	7-46
		600[3]	41.4[3]	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED or 655-EK	7-39
					796-EDR[4] or 796R-EKR[4]	7-40
				1 through 6	796-ED[4] or 796-EK[4]	7-40
100 psig	6.9 bar	250	17.2	1/2 through 2	655-GS	7-39
		300	20.7	1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				1 through 6	1098-EGR[2]	7-46
		600[3]	41.4[3]	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED or 655-EK	7-39
					796-EDR[4] or 796R-EKR[4]	7-40
				1 through 6	796-ED[4] or 796-EK[4]	7-40
150 psig	10.3 bar	250	17.2	1/2 through 2	655-GS	7-39
		300	20.7	1/8 through 2	95H	7-25
		700[3]	48.3[3]	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED or 655-EK	7-39
					796-EDR[4] or 796R-EKR[4]	7-40
				1 through 6	796-ED[4] or 796-EK[4]	7-40

1. These regulators are direct-operated except where noted.
2. Pilot-operated regulator.
3. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
4. Pressure-loaded regulator.

Steam Pressure Reducing Regulators

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (IN.)	TYPE NUMBER(1)	SEE PAGE	TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (IN.)	TYPE NUMBER(1)	SEE PAGE
Psig	Bar	Psig	Bar				Psig	Bar	Psig	Bar			
1	0.07	150	10.3	1/2 through 2	655-GS	7-39	50 through 100	3.4 through 6.9	125(2)	8.6(2)	1 through 4	92B(3)	7-34
		500(2)	34.5(2)	1 through 4	655-ED	7-39			150	10.3	1/2 through 2	655-GS	7-39
2	0.1	150	10.3	1/2 through 2	655-GS	7-39			250(2)	17.2(2)	1/2 through 1	92C(3)	7-34
		250(2)	17.2(2)	1 through 4	92S	7-33					1 through 4	92S(3)	7-34
		300	20.7	1/8 through 1	95L	7-25			300	20.7	1/8 through 2	95H	7-25
		500(2)	34.5(2)	1 through 4	655-ED	7-39					1/2 through 1	92C(4)	7-34
5 through 20	0.3 through 1.4	125(2)	8.6(2)	1 through 4	92B(3)	7-33			600(2)	41.4(2)	1 through 4	655-ED	7-39
		150	10.3	1/2 through 2	655-GS	7-39	150	10.3	125(2)	8.6(2)	1 through 4	92B(3)	7-34
		250(2)	17.2(2)	1/2 through 1	92C(3)	7-33			150	10.3	1/2 through 2	655-GS	7-39
				1 through 4	92S(3)	7-33			250(2)	17.2(2)	1/2 through 1	92C(3)	7-34
		300	20.7	1/8 through 1	95L	7-25					1 through 4	92S(3)	7-34
				1/8 through 2	95H	7-25			300	20.7	1/8 through 2	95H	7-25
				1/2 through 1	92C(4)	7-33					1/2 through 1	92C(4)	7-34
		500(2)	34.5(2)	1 through 4	655-ED	7-39			750(2)	51.7(2)	1 through 4	655-ED	7-39

1. These regulators are direct-operated except where noted.
2. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
3. Pilot-operated regulator.
4. Can be pressure-loaded and/or pilot-operated regulator depending on construction.

Gas Pressure Reducing Regulators

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (IN.)	TYPE NUMBER(1)	SEE PAGE
		Psig	Bar			
Atmosphere		5	0.3	2 through 4	66 Series	7-24
		20	1.4	2	133Z	7-26
		500(2)	34.5(2)	1 through 4	796-EDR(3) or 796-EKR(3)	7-40
				1 through 6	796-ED(3) or 796-EK(3)	7-40
5 in. wc	12 mbar	125	8.6	3/4 through 1	S400 Series	7-34
7 in. wc	17 mbar	10	0.7	2 through 4	66 Series	7-24
		60	4.1	2	133 Series	7-26
				1-1/2 or 2	166 Series	7-26
		100	6.9	8 through 12	298C-KB(4)	7-36
		125	8.6	3/4 through 1	S250 Series(5)	7-32
				3/4 through 1	S400 Series	7-34
				3/4 through 1-1/2	S100 Series(5)	7-31
				1-1/4 through 2	S300 Series	7-33
				1-1/2 or 2	S200 Series(5)	7-32
		150	10.3	3/4 through 1-1/4	Y600 Series(5)	7-40
				1-1/2 or 2	730B Series	7-28
		200	13.8	8 or 10	298C-KB(4)	7-36
		250	17.2	1/4 or 1/4 x 3/8	912 Series	7-29
				1/4 x 1/2 through 1/2 x 3/4	R922	7-31
		400	27.6	3/4	R722	7-30
				2	99 Series(4)	7-35
				1 through 6	1098-EGR(4)	7-37
		500(2)	34.5(2)	1 through 4	616-EDR, 616-EKR, or C16-ETR	7-38
					796R-EDR(3) or 796R-EKR(3)	7-40
				1 through 6	796-ED(3) or 796-EK(3)	7-40
				1/4	1305C or 1306C	7-29

1. These regulators are direct-operated except where noted.
2. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
3. Pressure-loaded regulator.
4. Pilot-operated regulator.
5. Certain regulators within this series have either high-pressure or low-pressure shutoff or both. If this integral shutoff is necessary for your control problem, refer to the "Pressure Shutoff Regulators" selection guide.

—Continued—

Gas Pressure Reducing Regulators (Continued)

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (IN.)	TYPE NUMBER[1]	SEE PAGE
		Psig	Bar			
11 in. wc	27 mbar	10	0.7	2 through 4	66 Series	7-24
		60	4.1	2	133 Series	7-26
				1-1/2 or 2	166 Series	7-26
		100	6.9	8 through 12	298C-KB[4]	7-36
		125	8.6	3/4 through 1	S250 Series[5]	7-32
				3/4 through 1	S400 Series	7-34
				3/4 through 1-1/2	S100 Series[5]	7-31
				1-1/4 through 2	S300 Series	7-33
				1-1/2 or 2	S200 Series[5]	7-32
		150	10.3	3/4 through 1-1/4	Y600 Series[5]	7-40
				1-1/2 or 2	730B Series	7-28
		200	13.8	8 or 10	298C-KB[4]	7-36
		250	17.2	1/4 or 1/4 x 3/8	912 Series	7-29
				1/4 x 1/2 through 1/2 x 3/4	R922	7-31
				1/2 through 2	655-GS	7-39
				8	298C-KB[4]	7-36
		400	27.6	3/4	R722	7-30
				2	99 Series[4]	7-35
				1 through 6	1098-EGR[4]	7-37
		500[2]	34.5[2]	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR[3] or 796R-EKR[3]	7-40
				1 through 6	796-ED[3] or 796-EK[3]	7-40
				1/4	1305C or 1306C	7-29
2 psig	0.1 bar	10	0.7	2 through 4	66 Series	7-24
		60	4.1	2	133 Series	7-26
				1-1/2 or 2	166 Series	7-26
		100	6.9	8 through 12	298C-KB[4]	7-36
		125	8.6	3/4 or 1	S250 Series[5]	7-32
				3/4 through 1	S400 Series	7-34
				3/4 through 1-1/2	S100 Series[5]	7-31
				1-1/4 through 2	S300 Series	7-33
				1-1/2 or 2	S200 Series[5]	7-32
				3/4 x 1 or 1	S251C[4]	7-38
		150	10.3	3/4 through 1-1/4	Y600 Series[5]	7-40
				1-1/2 or 2	730B Series	7-28
		200	13.8	8 or 10	298C-KB[4]	7-36
		250	17.2	1/4 or 1/4 x 3/8	912 Series	7-29
				1/4 x 1/2 through 1/2 x 3/4	R922	7-31
				1/2 through 2	655-GS	7-39
				8	298C-KB[4] or 298T-KB[4]	7-36
		300	20.7	1/8 through 1	95L	7-25
		400	27.6	3/4	R722	7-30
				2	99 Series[4]	7-35
				1 through 6	1098-EGR[4]	7-37
		500[2]	34.5[2]	1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR[3] or 796R-EKR[3]	7-40
				1 through 6	796-ED[3] or 796-EK[3]	7-40
				1/4	1305C or 1306C	7-29

1. These regulators are direct-operated except where noted.
2. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
3. Pressure-loaded regulator.
4. Pilot-operated regulator.
5. Certain regulators within this series have either high-pressure or low-pressure shutoff or both. If this integral shutoff is necessary for your control problem, refer to the "Pressure Shutoff Regulators" selection guide.

—Continued—

Gas Pressure Reducing Regulators (Continued)

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (IN.)	TYPE NUMBER(1)	SEE PAGE
		Psig	Bar			
5 psig	0.3 bar	60	4.1	2	133 Series	7-26
				1-1/2 or 2	166 Series	7-26
		100	6.9	8 through 12	298C-KB(4)	7-36
		125	8.6	1-1/4 through 2	S300 Series	7-33
				1-1/2 or 2	S200 Series(5)	7-32
				3/4 x 1 or 1	S251C(4)	7-38
				3/4 x 1 through 2	S301F(4)	7-38
		150	10.3	3/4 through 1-1/4	Y600 Series(5)	7-40
				1-1/2 or 2	730B Series	7-28
		200	13.8	8 or 10	298C-KB(4)	7-36
		250	17.2	1/4 or 1/4 x 3/8	912 Series	7-29
				1/4 x 1/2 through 1/2 x 3/4	R922H	7-31
				1/2 through 2	655-GS	7-39
				8	298C-KB(4)	7-36
				1/2	64 Series	7-23
		300	20.7	1/8 through 1	95L	7-25
				1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				3/4	R722H	7-30
				2	99 Series(4)	7-35
				1 through 6	1098-EGR(4)	7-37
		500(2)	34.5(2)	1/4	1305C or 1306C	7-29
				1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR(3) or 796R-EKR(3)	7-40
				1 through 6	796-ED(3) or 796-EK(3)	7-40
		750	52	2 through 4	399-161(4)	7-37
		1500	103	1 or 2	630 Series	7-27
10 psig	0.7 bar	60	4.1	2	133 Series	7-26
				1-1/2 or 2	166 Series	7-26
		100	6.9	8 through 12	298C-KB(4)	7-36
		125	8.6	1-1/2 or 2	S200 Series(5)	7-32
				3/4 x 1 or 1	S251C(4)	7-38
		150	10.3	1-1/2 or 2	730B Series	7-28
		200	13.8	8 or 10	298C-KB(4)	7-36
		250	17.2	1/4 x 1/2 through 1/2 x 3/4	R922H	7-31
				1/2 through 2	655-GS	7-39
				8	298C-KB(4)	7-36
				1/2	64 Series	7-23
		300	20.7	1/8 through 1	95L	7-25
				1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				3/4	R722H	7-30
				2	99 Series(4)	7-35
				1 through 6	1098-EGR(4)	7-37
		500(2)	34.5(2)	1/4	1305C or 1306C	7-29
				1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR(3) or 796R-EKR(3)	7-40
				1 through 6	796-ED(3) or 796-EK(3)	7-40

1. These regulators are direct-operated except where noted.
2. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
3. Pressure-loaded regulator.
4. Pilot-operated regulator.
5. Certain regulators within this series have either high-pressure or low-pressure shutoff or both. If this integral shutoff is necessary for your control problem, refer to the "Pressure Shutoff Regulators" selection guide.

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Gas Pressure Reducing Regulators (Continued)

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (IN.)	TYPE NUMBER[1]	SEE PAGE
		Psig	Bar			
10 psig	0.7 bar	750	52	2 through 4	399-161[4]	7-37
		1000	69.0	3/4 or 1	627 Series	7-27
		1440	99.3	1 through 4 x 6	310 Series[4]	7-36
		1500	103	1 or 2	630 Series	7-27
		2000	138	1/4	1301F	7-29
15 psig	1.0 bar	100	6.9	8 through 12	298C-KB[4]	7-36
		125	8.6	3/4 x 1 or 1	S251C[4]	7-38
		200	13.8	8 or 10	298C-KB[4]	7-36
		250	17.2	1/4 x 1/2 through 1/2 x 3/4	R922H	7-31
				1/2 through 2	655-GS	7-39
				8	298C-KB[4]	7-36
				1/2	64 Series	7-23
		300	20.7	1/8 through 1	95L	7-25
				1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				2	99 Series[4]	7-35
				1 through 6	1098-EGR[4]	7-37
		500[2]	34.5[2]	1/4	1305C or 1306C	7-29
				1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR[3] or 796R-EKR[3]	7-40
				1 through 6	796-ED[3] or 796-EK[3]	7-40
		750	52	2 through 4	399-161[4]	7-37
		1000	69.0	3/4 or 1	627 Series	7-27
		1440	99.3	1 through 4 x 6	310 Series[4]	7-36
		1500	103	1 or 2	630 Series	7-27
		2000	138	1/4	1301F	7-29
20 psig	1.4 bar	100	6.9	8 through 12	298C-KB[4]	7-36
		125	8.6	3/4 x 1 or 1	S251C[4]	7-38
		200	13.8	8 or 10	298C-KB[4]	7-36
		250	17.2	1/2 through 2	655-GS	7-39
				8	298C-KB[4]	7-36
				1/2	64 Series	7-23
		300	20.7	1/8 through 1	95L	7-25
				1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				2	99 Series[4]	7-35
				1 through 6	1098-EGR[4]	7-37
		500[2]	34.5[2]	1/4	1305C or 1306C	7-29
				1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR[3] or 796R-EKR[3]	7-40
				1 through 6	796-ED[3] or 796-EK[3]	7-40
		750	52	2 through 4	399-161[4]	7-37
		1000	69.0	3/4 or 1	627 Series	7-27
		1440	99.3	1 through 4 x 6	310 Series[4]	7-36
		1500	103	1 or 2	630 Series	7-27
		2000	138	1/4	1301F	7-29

1. These regulators are direct-operated except where noted.
2. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
3. Pressure-loaded regulator.
4. Pilot-operated regulator.
5. Certain regulators within this series have either high-pressure or low-pressure shutoff or both. If this integral shutoff is necessary for your control problem, refer to the "Pressure Shutoff Regulators" selection guide.

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Gas Pressure Reducing Regulators (Continued)

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (IN.)	TYPE NUMBER(1)	SEE PAGE
		Psig	Bar			
50 psig	3.4 bar	100	6.9	8 through 12	298C-KB(4)	7-36
		200	13.8	8 or 10	298C-KB(4)	7-36
		250	17.2	1/2 through 2	655-GS	7-39
				8	298C-KB(4)	7-36
				1/2	64 Series	7-23
		300	20.7	1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				2	99 Series(4)	7-35
				1 through 6	1098-EGR(4)	7-37
		600(2)	41.4(2)	1/4	1305C or 1306C	7-29
				1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR(3) or 796R-EKR(3)	7-40
				1 through 6	796-ED(3) or 796-EK(3)	7-40
		750	52	2 through 4	399-161(4)	7-37
		1000	69.0	3/4 or 1	627 Series	7-27
				2	99 Series	7-35
		1440	99.3	1 through 4 x 6	310 Series(4)	7-36
		1500	103	1 or 2	630 Series	7-27
		2000	138	1/4	1301F	7-29
75 psig	5.2 bar	100	6.9	8 through 12	298C-KB(4)	7-36
		200	13.8	8 or 10	298C-KB(4)	7-36
		250	17.2	1/2 through 2	655-GS	7-39
				8	298C-KB(4)	7-36
				1/2	64 Series	7-23
		300	20.7	1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				2	99 Series(4)	7-35
				1 through 6	1098-EGR(4)	7-37
		600(2)	41.4(2)	1/4	1305C or 1306C	7-29
				1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR(3) or 796R-EKR(3)	7-40
				1 through 6	796-ED(3) or 796-EK(3)	7-40
		750	52	2 through 4	399-161(4)	7-37
		1000	69.0	3/4 or 1	627 Series	7-27
				2	99 Series(4)	7-35
		1440	99.3	1 through 4 x 6	310 Series(4)	7-36
		1500	103	1 or 2	630 Series	7-27
		4000	276	1/4	1301F	7-29

1. These regulators are direct-operated except where noted.
2. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
3. Pressure-loaded regulator.
4. Pilot-operated regulator.
5. Certain regulators within this series have either high-pressure or low-pressure shutoff or both. If this integral shutoff is necessary for your control problem, refer to the "Pressure Shutoff Regulators" selection guide.

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Gas Pressure Reducing Regulators (Continued)

TYPICAL OUTLET PRESSURE SETTING		MAXIMUM INLET PRESSURE		STANDARD SIZE (IN.)	TYPE NUMBER(1)	SEE PAGE
		Psig	Bar			
100 psig	6.9 bar	250	17.2	1/2 through 2	655-GS	7-39
				8	298C-KB(4)	7-36
				1/2	64 Series	7-23
		300	20.7	1/8 through 2	95H	7-25
		400	27.6	1/4	67 Series	7-24
				2	99 Series(4)	7-35
				1 through 6	1098-EGR(4)	7-37
		600(2)	41.4(2)	1/4	1305C or 1306C	7-29
				1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR(3) or 796R-EKR(3)	7-40
				1 through 6	796-ED(3) or 796-EK(3)	7-40
		750	52	2 through 4	399-161(4)	7-37
		1000	69.0	3/4 or 1	627 Series	7-27
				2	99 Series	7-35
		1440	99.3	1 through 4 x 6	310 Series(4)	7-36
		1500	103	1 or 2	630 Series	7-27
		4000	276	1/4	1301F	7-29
150 psig	10.3 bar	250	17.2	1/2 through 2	655-GS	7-39
				1/2	64 Series	7-23
		300	20.7	1/8 through 2	95H	7-25
		400	27.6	1 through 6	1098H-EGR(4)	7-37
		700(2)	48.3(2)	1/4	1305C or 1306C	7-29
				1 through 4	616-EDR, 616-EKR, or 616-ETR	7-38
					655-ED, 655-EK, or 655-ET	7-39
					796R-EDR(3) or 796R-EKR(3)	7-40
				1 through 6	796-ED(3) or 796-EK(3)	7-40
		750	52	2 through 4	399-161(4)	7-37
		1000	69.0	3/4 or 1	627 Series	7-27
		1440	99.3	1 through 4 x 6	310 Series(4)	7-36
		1500	103	1 or 2	630 Series	7-27
		4000	276	1/4	1301F	7-29
200 psig	13.8 bar	250	17.2	1/2	64 Series	7-23
		750	52	2 through 4	399-161(4)	7-37
		1440	99.3	1 through 6	310 Series(4)	7-36
		1500	103	1 or 2	630 Series	7-27
		4000	276	1/4	1305C, 1305D, 1306C, or 1306D	7-29
		6000	414	1/4	1301F or 1301G	7-29
300 psig	20.7 bar	750	52	2 through 4	399-161(4)	7-37
		1440	99.3	1 through 6	310 Series(4)	7-36
		1500	103	1 or 2	630 Series	7-27
		4000	276	1/4	1305D or 1306D	7-29
		6000	414	1/4	1301G	7-29
400 or 500 psig	27.6 or 34.5 bar	1440	99.3	1 through 6	310 Series(4)	7-36
		1500	103	1 or 2	630 Series	7-27
		4000	276	1/4	1305D or 1306D	7-29
		6000	414	1/4	1301G	7-29
600 psig	41.4 bar	1440	99.3	1 through 6	310 Series(4)	7-36

1. These regulators are direct-operated except where noted.
2. Some of the regulators listed in the "Type Number" column may allow higher inlet pressures.
3. Pressure-loaded regulator.
4. Pilot-operated regulator.
5. Certain regulators within this series have either high-pressure or low-pressure shutoff or both. If this integral shutoff is necessary for your control problem, refer to the "Pressure Shutoff Regulators" selection guide.

Differential Pressure Reducing Regulators

Description

A differential pressure reducing regulator maintains a pressure difference between two locations in the pressure system. The value at which the pressure difference is maintained is the differential pressure setting of the regulator.

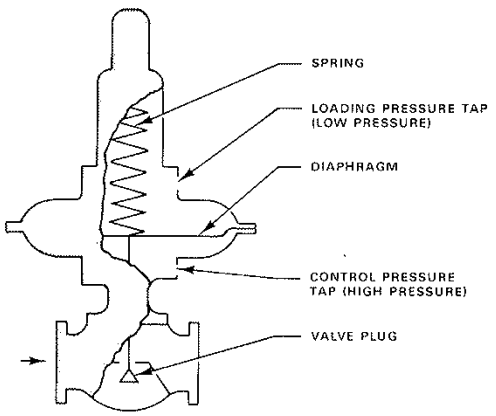
As shown in the accompanying figure, a differential pressure reducing regulator has two pressure taps. Output pressure from a remote mounted instrument or pressure loader is applied through an external pressure tap to the top of the main diaphragm. The outlet or control pressure is applied to the bottom side of the diaphragm through an external pressure tap. In some differential pressure reducing regulators, this control pressure is applied to the bottom side of the diaphragm through an internal pressure tap. The differential pressure is applied to a spring-and-diaphragm mechanism which moves the valve plug to change the size of the flow path through the regulator.

Selection

Familiarize yourself with the following application considerations as they apply to your control requirements.

- Differential pressure setting and maximum allowable pressure change from setting
- Minimum, normal, and maximum inlet and outlet pressures
- Minimum controlled flow, normal flow, maximum required flow
- Name, temperature and specific gravity of the fluid flowing through the regulator
- Name and temperature of fluid that supplies the differential control pressure to the regulator
- Inlet and outlet pipe sizes
- Installation
- Environmental considerations, such as noise level, corrosion, temperature extremes, etc.
- Special capabilities such as remote set point adjustment, gauges, test connections, etc.

The following selection table will guide you to product descriptions that describe differential pressure reducing regulators. To help you make your final selection, contact your Fisher sales office or sales representative, who will assist you in selecting the type and size of differential pressure reducing regulator that will best suit your need.



Differential Pressure Reducing Regulator

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Differential Pressure Reducing Regulators

SERVICE	DIFFERENTIAL CONTROL PRESSURE		MAXIMUM INLET PRESSURE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
	Psig	Bar	Psig	Bar			
Liquid or gas	2 to 30	0.1 to 2.0	300	20.7	1/8 through 1	95LD	7-49
	0.1 to 150	0.007 to 10.3	1500	103	1 through 4	647-EDR or 647-EKR	7-50
	5 to 150	0.3 to 10.3	300	20.7	1/8 through 2	95HD	7-49
	0 to 200	0 to 13.8	1500	103	1 through 4	795R-EDR or 795R-EKR	7-51
					1 through 6	795-ED or 795-EK	
Steam	2 to 30	0.1 to 2.0	300	20.7	1/8 through 1	95LD	7-49
	5 to 150	0.3 to 10.3	300	20.7	1/8 through 2	95HD	7-49

1. All of these regulators are direct-operated. Many other regulators listed in the liquid, steam, or gas pressure reducing selection guide tables can be adapted for differential pressure reducing applications.

Pressure Reducing and Differential Pressure Reducing Pump Governors

Pressure Reducing Pump Governor Description

A pressure reducing pump governor is used either to maintain a constant discharge pressure from a pump or as a direct operated regulator to maintain a desired reduced outlet pressure.

When used as a pump governor, the value at which the pump discharge pressure is maintained is the setting of the pump governor. Fluid, such as steam, flows through the pump governor to a turbine, which drives a pump. As shown in the accompanying figure, the governor senses pump discharge pressure through an external control line. This discharge pressure is applied to a spring-and-piston mechanism, which moves the valve plug to change the size of the flow path through the pump governor.

When used as a direct operated pressure regulator, the value at which the reduced pressure is maintained is the outlet pressure setting. As shown in the following figure, the pump governor senses downstream pressure through an external control line. This downstream pressure is applied to the spring-and-piston mechanism, which moves the valve plug to change the size of the flow path through the pump governor.

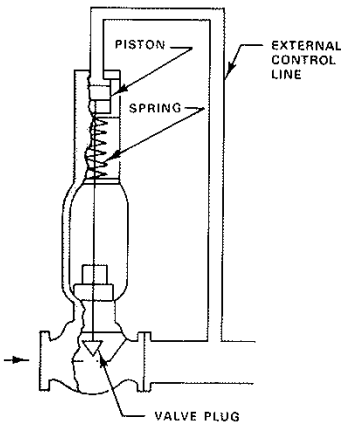
Differential Pressure Reducing Pump Governor Description

A differential pressure reducing pump governor maintains a constant pressure differential between two locations in the pressure system. The value at which the pressure difference is maintained is the differential pressure setting of the pump governor. As shown in the accompanying figure, the governor has two pressure taps. A higher pressure is applied to the top side of the diaphragm and a lower pressure to the bottom side of the diaphragm. The differential pressure is applied to a spring-and-diaphragm mechanism, which moves the valve plug to change the size of the flow path through the pump governor.

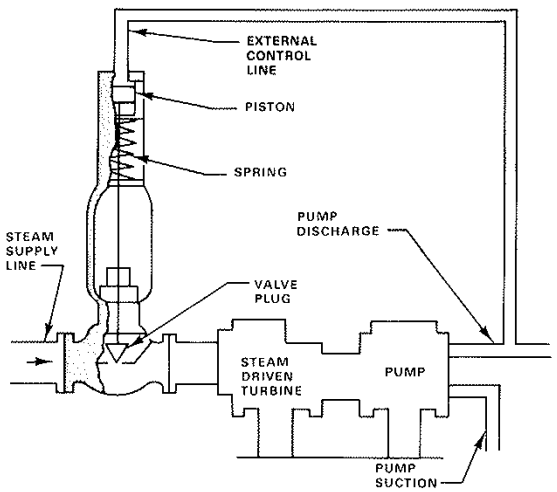
Selection

Familiarize yourself with the following application considerations as they apply to your control requirements.

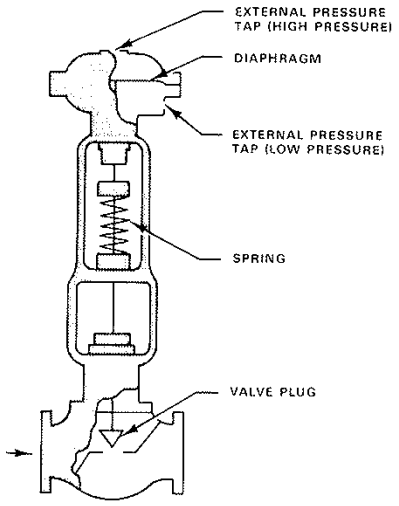
- Outlet pressure setting or differential pressure setting, and maximum allowable pressure change from this setting
- Minimum, normal, and maximum inlet and outlet pressures
- Name, temperature, and specific gravity of the fluid flowing through the pump governor
- Name and temperature of each fluid that supplies control pressure or differential control pressures to the pump governor
- Inlet and outlet pipe sizes



Pressure Reducing Pump Governor



Pump Governor Regulating Pump Discharge Pressure



Differential Pressure Reducing Pump Governor

- Installation
- Environmental considerations, such as noise level, corrosion, temperature extremes, etc.
- Special capabilities such as gauges, test connections, etc.

Two selection tables are shown; one for pressure reducing pump governors and one for differential pressure reducing pump governors. These tables will guide you to product descriptions that describe the pump governors. To help you make your final selection, contact your Fisher sales office or sales representative, who will assist you in selecting the type and size of pump governor that will best suit your need.

Pressure Reducing Pump Governors

SERVICE	CONTROL PRESSURE		MAXIMUM INLET PRESSURE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
	Psig	Bar	Psig	Bar			
Liquid or gas	95 to 500	6.6 to 34.5	1500	103	1 through 4	1B-ED or 1B-EK	7-54
	500 to 4600	34.5 to 317	1500	103	1 through 4	603-ED or 603-EK	7-55
Steam	95 to 500	6.6 to 34.5	1160	80.0	1 through 4	1B-ED	7-54
	500 to 4600	34.5 to 317	1160	80.0	1 through 4	603-ED	7-55

1. All of these pump governors are direct-operated.

Differential Pressure Reducing Pump Governors

SERVICE	DIFFERENTIAL CONTROL PRESSURE		MAXIMUM INLET PRESSURE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
	Psig	Bar	Psig	Bar			
Liquid or gas	5 to 100	0.3 to 6.9	1500	103	1 through 4	644-ED	7-56
	14 to 155	1.0 to 10.7	1500	103	1 through 4	645-ED	7-56
Steam	5 to 100	0.3 to 6.9	1160	80.0	1 through 4	644-ED	7-56
	14 to 155	1.0 to 10.7	1160	80.0	1 through 4	645-ED	7-56

1. All of these pump governors are direct-operated.

Pressure Relief Valves

Description

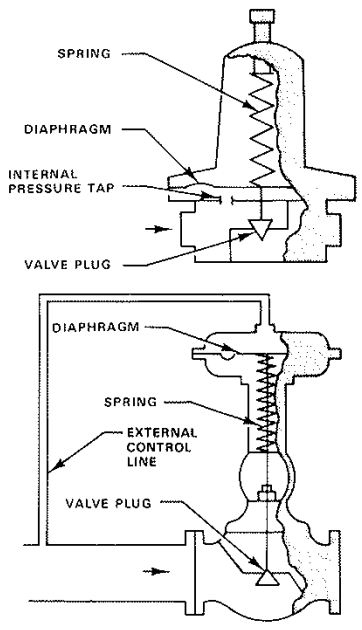
A pressure relief valve is used to limit pressure buildup (i.e., prevent overpressure) at its location in a pressure system. The relief valve opens to prevent a rise of internal pressure in excess of a specified value. This relief valve may be an active part of the system, such as is used for upstream pressure regulation, or it may provide only emergency relief to atmosphere. The value at which the relief valve begins relieving pressure is the relief pressure setting.

Direct-Operated Relief Valve

As shown in the accompanying figures, a direct-operated pressure relief valve senses the upstream pressure to be limited through either an internal pressure tap or an external control line. This upstream pressure opposes a spring, which moves the diaphragm and valve plug to change the size of the flow path through the valve.

Pilot-Operated Relief Valve

The addition of a pilot to a relief valve permits diversion of upstream pressure so that it also loads the main valve on the side of the main valve spring. A large enough increase in upstream pressure moves the pilot valve plug to stop the diverted pressure from entering the main valve. Loading pressure aiding main valve shutoff escapes through the pressure venting tap. This permits upstream pressure unbalance to open the main valve.



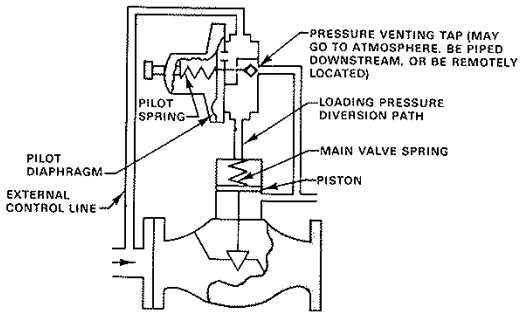
Direct-Operated Pressure Relief Valves

Selection

Familiarize yourself with the following application considerations as they apply to your control requirements.

- Inlet pressure relief setting and maximum allowable pressure buildup over the relief setting
- Normal and maximum inlet pressure
- Minimum, normal, and maximum relief flow rates
- Name, temperature, and specific gravity of controlled fluid
- Inlet and outlet pipe sizes
- Installation
- Environmental considerations such as noise level, venting, corrosion, temperature extremes, etc.
- Special capabilities, such as gauges, test connections, etc.

The following three selection tables will guide you to product descriptions that describe pressure relief valves. To help you make your final selection, contact your Fisher sales office or sales representative who will assist you in selecting the type and size of pressure relief valve that will best suit your need.



Pilot-Operated Pressure Relief Valve

Liquid Pressure Relief Valves

TYPICAL RELIEF (INLET) PRESSURE SETTING		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
1 psig	0.07 bar	2	1807	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
5 psig	0.3 bar	1/4 through 1	98L	7-42
		1/4 through 2	98H	7-42
		2	1807	7-48
			1808(2)	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
		2 through 6	1098-63EGR(2)	7-37
12 or 25 psig	0.8 or 1.7 bar	1/4 through 1	98L	7-42
		1/4 through 2	98H	7-42
		2	1807	7-48
			1808(2)	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
		2 through 6	63EG(2)	7-41
			1098-63EGR(2)	7-37
60 psig	4.1 bar	1/4 through 2	98H	7-42
		2	1807	7-48
			1808(2)	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
		2 through 6	63EG(2)	7-41
			1098-63EGR(2)	7-37

1. These relief valves are direct-operated except where noted.
2. Pilot-operated relief valve.

- Continued -

Liquid Pressure Relief Valves

TYPICAL RELIEF (INLET) PRESSURE SETTING		STANDARD SIZE (INCH)	TYPE NUMBER[1]	SEE PAGE
100 or 125 psig	6.9 or 8.6 bar	1/4 through 2	98H	7-42
		2	1807	7-48
			1808[2]	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	414-6305[2] or 414-6305[2]	7-45
			616-ED, 616-EK, or 616-ET	7-38
		2 through 6	63EG[2]	7-41
250 or 300 psig	17.2 or 20.7 bar	1/4 through 1	98HH	7-42
		1 through 6	414-6305[2] or 414-6305B[2]	7-45
		2 through 6	63EG[2]	7-41
375 psig	25.9 bar	1/4 through 1	98HH	7-42
		1 through 6	414-6305[2] or 414-6305B[2]	7-45
1200 psig	82.7 bar	1 through 6	414-6305[2] or 414-6305B[2]	7-45

1. These relief valves are direct-operated except where noted.
2. Pilot-operated relief valve.

Steam Pressure Relief Valves[1]

TYPICAL RELIEF (INLET) PRESSURE SETTING		STANDARD SIZE (INCH)	TYPE NUMBER[2]	SEE PAGE
5, 12, or 25 psig	0.3, 0.8, or 1.7 bar	1/4 through 1	98L	7-42
		1 through 4	655R-EDR	7-39
		1/4 through 2	98H	7-42
60, 100, or 125 psig	4.1, 6.9, or 8.6 bar	1 through 4	655R-EDR	7-39
		1/4 through 2	98H	7-42
250, 300, or 375 psig	17.2, 20.7, or 25.9 bar	1/4 through 1	98HH	7-42

1. These devices are throttling relief valves, not safety relief valves as described in the ASME Boiler and Pressure Vessel Code. For various definitions of pressure relief devices, see ANSI B95.1-1972.
2. All of these relief valves are direct-operated.

Gas Pressure Relief Valves[1]

TYPICAL RELIEF (INLET) PRESSURE SETTING		STANDARD SIZE (INCH)	TYPE NUMBER[1]	SEE PAGE
7 inch wc	17 mbar	1/4	289U	7-43
		3/4 through 2	Y611 or Y612 Series	7-40
		2	289H	7-43
			289P-6355[2]	7-44
			1807	7-48
		2 through 4	66R or 66RR[2]	7-42
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
14 inch wc	35 mbar	1/4	289U	7-43
		3/4 or 1	289L	7-43
		3/4 through 2	Y611 or Y612 Series	7-40
		2	289H	7-43
			289P-6355[2]	7-44
			1807	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		2 through 4	66R or 66RR[2]	7-42
		1 through 6	616-ED, 616-EK, or 655R-ETR	7-38

1. These relief valves are direct-operated except where noted.
2. Pilot-operated relief valve.

- Continued -

Gas Pressure Relief Valves[1] (Continued)

TYPICAL RELIEF (INLET) PRESSURE SETTING		STANDARD SIZE (INCH)	TYPE NUMBER[1]	SEE PAGE
1 psig	69 mbar	1/4	289U	7-43
		3/4 or 1	289L	7-43
		3/4 through 2	Y611 or Y612 Series	7-40
		2	289H	7-43
			289P-6355[2]	7-44
			1807	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		2 through 4	66R or 66RR[2]	7-42
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
5 psig	0.3 bar	1/4	289A or 289B	7-43
		1/4 through 1	98L	7-42
		1/4 through 2	98H	7-42
		1 or 2	289H	7-43
			630R	7-46
		3/4 through 2	Y611 or Y612 Series	7-40
			1805 Series	7-47
		2	289P-6355[2]	7-44
			1807	7-48
			1808[2]	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		2 through 4	66R or 66RR[2]	7-42
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
		2 through 6	1098-63EGR[2]	7-37
10 psig	0.69 bar	2	289P-6355[2]	7-44
12 psig	0.8 bar	1/4	289A	7-43
		1	289H	7-43
			289P-167AR[2]	7-44
		1/4 through 1	98L	7-42
		1/4 through 2	98H	7-42
		3/4 through 2	1805 Series	7-47
		1 or 2	630R	7-46
		2	1805P-167AR[2]	7-47
			1807	7-48
			1808[2]	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
		2 through 6	63EG[2]	7-41
			1098-63EGR[2]	7-37
25 psig	1.7 bar	3/4 or 1	H200 Series	7-48
		1	289H	7-43
			289P-167AR[2]	7-44
		1/4 through 1	98L	7-42
		1/4 through 2	98H	7-42
		3/4 through 2	1805 Series	7-47
		1 or 2	630R	7-46
		2	1805P-167AR[2]	7-47
			1807	7-48
			1808[2]	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
		2 through 4	399-6355[2], 399-6358[2]	7-45
		2 through 6	63EG[2]	7-41
			1098-63EGR[2]	7-37

1. These relief valves are direct-operated except where noted.
2. Pilot-operated relief valve.

- Continued -

Gas Pressure Relief Valves[1] (Continued)

TYPICAL RELIEF (INLET) PRESSURE SETTING		STANDARD SIZE (INCH)	TYPE NUMBER[1]	SEE PAGE
50 psig	3.4 bar	1/4	H800	7-49
60 psig	4.1 bar	3/4 or 1	H200 Series	7-48
		1	289H	7-43
			289P-167AR[2]	7-44
		1/4 through 2	98H	7-42
		3/4 through 2	1805 Series	7-47
		1 or 2	630R	7-46
		2	1805P-167AR[2]	7-44
			1807	7-48
			1808[2]	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	616-ED, 616-EK, or 616-ET	7-38
		2 through 4	399-6355[2], 399-6358[2]	7-45
		2 through 6	63EG[2]	7-41
			1098-63EGR[2]	7-37
100 psig	6.9 bar	3/4 or 1	H200 Series	7-48
		1	289P-167AR[2]	7-44
		1/4 through 2	98H	7-42
		3/4 through 2	1805 Series	7-47
		1 or 2	630R	7-46
		2	1805P-167AR[2]	7-47
			1807	7-48
			1808[2]	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	414-6305[2] or 414-6305B[2]	7-45
			616-ED, 616-EK, or 616-ET	7-38
		2 through 4	399-6365[2], 399-6358[2]	7-45
		2 through 6	63EG[2]	7-41
125 psig	8.6 bar	3/4 or 1	H200 Series	7-48
		1/4 through 2	98H	7-42
		3/4 through 2	1805 Series	7-47
		1 or 2	630R	7-46
		2	1807	7-48
			1808[2]	7-48
		1 through 4	655R-EDR, 655R-EKR, or 655R-ETR	7-39
		1 through 6	414-6305[2] or 414-6305B[2]	7-45
			616-ED, 616-EK, or 616-ET	7-38
		2 through 4	399-6365[2], 399-6358[2]	7-45
		2 through 6	63EG[2]	7-41
250 psig	17.2 bar	1/4 through 1	98HH	7-42
		3/4 or 1	H200 Series	7-48
		1 or 2	630R	7-46
		1 through 6	414-6305[2] or 414-6305B[2]	7-45
		2 through 4	399-6365[2], 399-6358[2]	7-45
		2 through 6	63EG[2]	7-41
300 psig	20.7 bar	1/4 through 1	98HH	7-42
		3/4 or 1	H200 Series	7-48
		1 through 6	414-6305[2] or 414-6305B[2]	7-45
		2 through 4	399-6365[2], 399-6358[2]	7-45
		2 through 6	63EG[2]	7-41
375 psig	25.9 bar	1/4 through 1	98HH	7-42
		1 through 6	414-6305[2] or 414-6305B[2]	7-45
1200 psig	82.7 bar	1 through 6	414-6305[2] or 414-6305B[2]	7-45

1. These relief valves are direct-operated except where noted.
2. Pilot-operated relief valve.

Differential Pressure Relief Valves

Description

A differential pressure relief valve maintains a pressure differential between two locations in the pressure system by limiting the pressure buildup upstream of the relief valve. The value at which the relief valve begins relieving pressure is the differential pressure setting.

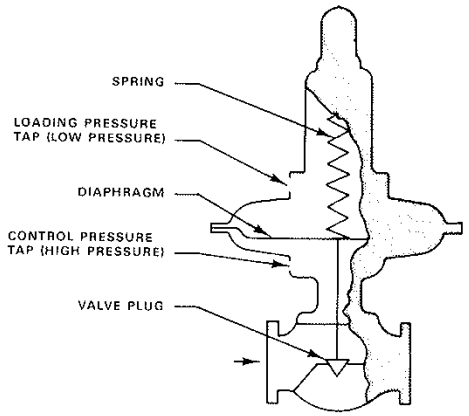
As shown in the accompanying figure, a differential pressure relief valve has two pressure taps. Loading pressure from a remote mounted instrument or pressure loader is applied through an external pressure tap to the top of the main diaphragm. The upstream or control pressure is applied to the bottom side of the diaphragm through an external pressure tap. In some differential pressure relief valves, this control pressure is applied to the bottom side of the diaphragm through an internal pressure tap. The differential pressure is applied to a spring-and-diaphragm mechanism, which moves the valve plug to change the size of the flow path through the relief valve.

Selection

Familiarize yourself with the following application considerations as they apply to your control requirements.

- Differential pressure setting and maximum allowable pressure change from setting
- Normal and maximum inlet pressure
- Minimum controlled flow, normal flow, maximum required flow
- Name, temperature, and specific gravity of the fluid flowing through the differential relief valve
- Name and temperature of fluid that supplies the differential control pressure to the relief valve
- Inlet and outlet pipe sizes
- Installation
- Environmental considerations, such as noise level, corrosion, temperature extremes, etc.
- Special capabilities such as remote set point adjustment, gauges, test connections, etc.

The following selection table will guide you to product descriptions that describe differential pressure relief valves. To help you make your final selection, contact your Fisher sales office or sales representative, who will assist you in selecting the type and size of differential pressure relief valve that will best suit your need.



Differential Pressure Relief Valve

Differential Pressure Relief Valves

SERVICE	DIFFERENTIAL RELIEF CONTROL PRESSURE		MAXIMUM RELIEF (INLET) PRESSURE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
	Psig	Bar	Psig	Bar			
Liquid or gas	2 to 38	0.1 to 2.6	150	10.3	1/4 through 1	98LD	7-50
	0.06 to 130	0.004 to 9.0	200	13.8	1 through 6	647-ED or 647-EK	7-50
	5 to 200	0.3 to 13.8	400	27.6	1/4 through 2	98HD	7-50
	150 to 375	10.3 to 25.9	400	27.6	1/4 through 1	98HHD	7-50
Steam	2 to 38	0.1 to 2.6	150	10.3	1/4 through 1	98LD	7-50
	5 to 200	0.3 to 13.8	400	27.6	1/4 through 2	98HD	7-50
	150 to 375	10.3 to 25.9	400	27.6	1/4 through 1	98HHD	7-50

1. All of these relief valves are direct-operated.

Pressure Relief and Differential Pressure Relief Pump Governors

Pressure Relief Pump Governor Description

A pressure relief pump governor may be used to relieve pressure or to limit pressure buildup (i.e., prevent overpressure) at its location in the pressure system. The value at which the pump governor begins relieving pressure is the relief pressure setting.

As shown by the accompanying figure, the pressure to be limited is sensed through an external control line. This pressure is applied to a spring-and-piston mechanism, which moves the valve plug to change the size of the flow path through the pressure relief pump governor.

Differential Pressure Relief Pump Governor Description

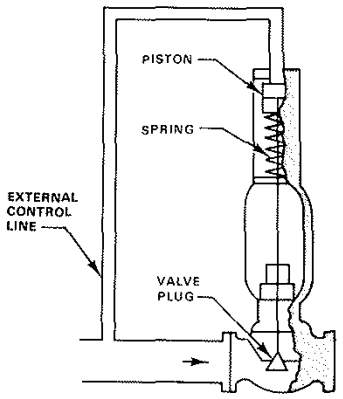
A differential pressure relief pump governor maintains a pressure difference between two locations in the pressure system. The value at which the pressure difference is maintained is the differential pressure setting.

As shown in the accompanying figure, the pump governor has two pressure taps. A higher pressure is applied to the top side of the diaphragm and a lower pressure to the bottom side of the diaphragm. This sensed differential pressure is applied to the spring-and-diaphragm mechanism, which moves the valve plug to change the size of the flow path through the pump governor.

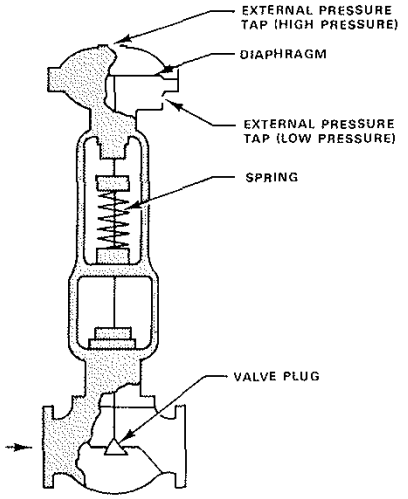
Selection

Familiarize yourself with the following application considerations as they apply to your control requirements.

- Inlet pressure relief setting or differential pressure relief setting, and maximum allowable pressure buildup over the relief setting
- Normal and maximum inlet pressures
- Normal flow and maximum required flow
- Name and temperature of fluid flowing through the pump governor
- Name and temperature of fluid that supplies differential control pressure to the pump governor
- Inlet and outlet pipe sizes
- Installation
- Environmental considerations, such as noise level, corrosion, temperature extremes, etc.
- Special capabilities such as gauges, test connections, etc.



Pressure Relief Pump Governor



Differential Pressure Relief Pump Governor

Two selection tables covering pump governors are listed; one for pressure relief applications and one for differential pressure relief applications. These tables will guide you to product descriptions that describe the pump governors. To help you make your final selection, contact your Fisher sales office or sales representative, who will assist you in selecting the type and size of pump governor that will best suit your need.

Pressure Relief Pump Governors

SERVICE	TYPICAL RELIEF (INLET) PRESSURE SETTING		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
	Psig	Bar			
Liquid, gas or steam	100, 125, 250, 300, 375 or 500	6.9, 8.6, 17.2, 20.7, 25.9 or 34.5	1 through 4	1B-EDR or 1B-EKR	7-54
	500 or 1500	34.5 or 103	1 through 4	603-EDR or 603-EKR	7-55

1. All of these pump governors are direct-operated.

Differential Pressure Relief Pump Governors

SERVICE	DIFFERENTIAL RELIEF CONTROL PRESSURE		MAXIMUM RELIEF (INLET) PRESSURE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
	Psig	Bar	Psig	Bar			
Liquid, gas, or steam	5 to 100	0.3 to 6.9	600	41.4	1 through 4	644-EDR	7-56
	14 to 155	0.96 to 10.7	1000	69.0	1 through 4	645-EDR	7-56

1. All of these pump governors are direct-operated.

Pressure Shutoff Regulators

A pressure shutoff regulator shuts off the fluid flow through it whenever the sensed control pressure violates a set limit. Depending upon the capability of the regulator selected, it may be able to shut off in response to a low pressure condition only, a high pressure condition only, or both.

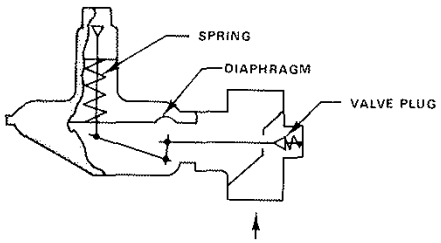
The accompanying figure shows a low pressure shutoff regulator. A pressure shutoff regulator may sense the control pressure with either an internal or external pressure tap, which may be directly upstream or downstream from the regulator, or at some other remote location. This sensed control pressure is applied to the spring-and-diaphragm mechanism. The spring and diaphragm act to allow an unbalance force within the regulator to move the valve plug to the closed position, which shuts off the fluid flow through the regulator. Normally, this shutoff force is supplied by a compressed spring. Once this force has been automatically triggered by the sensing element, it normally continues to hold the valve plug in the closed position until it can be manually reset.

Selection

Familiarize yourself with the following application considerations as they apply to your control requirements.

- Control pressure setting for shutoff and maximum control pressure
- Minimum, normal, and maximum inlet pressures
- Normal flow and maximum required flow
- Name, temperature, and specific gravity of the fluid flowing through the regulator
- Inlet and outlet pipe sizes
- Installation
- Environmental considerations such as corrosion, temperature extremes, etc.
- Special capabilities such as gauges, test connections, etc.

Two selection tables are shown; one for regulators with pressure shutoff capabilities only, and one for regulators with both pressure reducing and pressure shutoff capabilities. Additional information for pressure reducing regulators is shown in the "Pressure Reducing Regulators" selection guide. These tables will guide you to product descriptions that describe pressure shutoff regulators. To help you make your final selection, contact your Fisher sales office or sales representative, who will assist you in selecting the correct pressure shutoff regulator that will best suit your need.



Low Pressure Safety Shutoff Regulator

Pressure Shutoff Regulators

TYPE OF SHUTOFF	MAXIMUM INLET PRESSURE		LOW PRESSURE SHUTOFF RANGE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
	Psig	Bar					
Low pressure	1	.07	3 to 5 inch wc	7.5 to 12 mbar	3/4 through 1-1/4	Y510	7-51

1. All of these regulators are direct-operated.

Pressure Reducing Regulators with Integral Shutoff

TYPE OF SHUTOFF	MAXIMUM INLET PRESSURE		OUTLET PRESSURE RANGE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
	Psig	Bar					
Low pressure	50	3.4	5.5 to 16 inch wc	14 to 40 mbar	3/4 through 1-1/2	S104 or S106	7-31
	60	4.1	4.5 to 20 inch wc	11 to 50 mbar	3/4 or 1	S256, S257, S258, or S259	7-31
	100	6.9	3.5 inch wc to 3.25 psig	8.7 to 224 mbar	1-1/2 or 2	S204 or S206	7-32
	150	10.3	7 inch wc to 7 psig	17 or 483 mbar	3/4 through 1-1/4	Y600-6, Y600-7, Y600-8, or Y600-9	7-40

1. All of these regulators are direct-operated.

Pressure Switching Valves

Description

A three-way pressure switching valve diverts its inlet pressure from one to the other of its two outlet ports whenever the sensed switching pressure violates a set limit. Depending upon the capability of the valve selected, it may be able to switch in response to a low pressure only, a high pressure only, or both.

As shown in the accompanying figure, a three-way pressure switching valve normally senses a switching pressure from a remote location with an external pressure tap. This switching pressure is applied to the spring-and-diaphragm mechanism, which moves the valve plug to switch the flow path through the valve from one outlet port to the other outlet port.

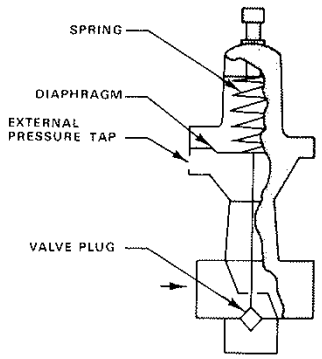
Ordinarily, this type of valve switches pressure back and forth between its two outlets automatically; they do not normally require manual resetting. However, some types have a manual reset option.

Selection

Familiarize yourself with the following application considerations as they apply to your pressure switching requirements.

- Switching pressure settings
- Minimum, normal, and maximum inlet pressures
- Name and temperature of the fluid flowing through the valve
- Name and temperature of the sensed switching pressure fluid
- Inlet and outlet pipe sizes
- Installation
- Environmental considerations such as corrosion, temperature extremes, etc.
- Special capabilities such as manual reset, gauges, test connections, etc.

The following selection table will guide you to product descriptions that describe pressure switching valves. To help you make your final selection, contact your Fisher sales office or sales representative, who will assist you in selecting the correct switching valve that will best suit your need.



3-Way Pressure Switching Valve

Pressure Switching Valves

SWITCHING PRESSURE RANGE		MAXIMUM INLET PRESSURE		STANDARD SIZE (INCH)	TYPE NUMBER(1)	SEE PAGE
Psig	Bar	Psig	Bar			
2 to 60	0.1 to 4.1	150	10.3	1/4	168 Series	7-53
3 to 100	0.2 to 6.9	250	17.2	1/4 or 1/2	164A	7-52
5 to 100	0.2 to 6.9	250	17.2	1/4	167A	7-52
35 to 150	2.4 to 10.3	150	10.3	1/4	168H Series	7-53
3 to 200	0.2 to 13.8	250	17.2	1/4 or 1/2	164(2)	7-52
Snap-acting body assembly only		150	10.3	1/4	68 Series	7-53

1. Direct-operated 3-way switching valves except where noted.
2. Direct-operated 2-way on/off switching valve.

Vacuum Service Equipment

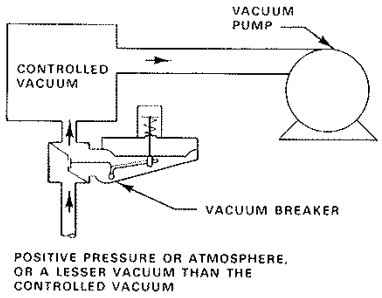
Description

Direct-operated devices such as vacuum breakers and vacuum regulators may be used to control vacuum.

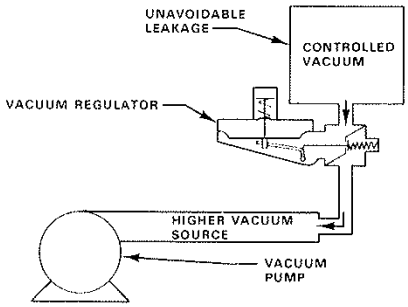
A vacuum breaker prevents a vacuum from exceeding a specified value. During operation, a vacuum breaker remains closed until an increase in vacuum (decrease in absolute pressure) exceeds the spring setting and causes the vacuum breaker to open. Depending on control line connection, some types may be used as either a vacuum breaker or a relief valve.

A vacuum regulator maintains a constant vacuum in the inlet system to the regulator with a higher vacuum connected to the outlet. During operation, a vacuum regulator remains closed until a vacuum decrease (an increase in absolute pressure) exceeds the spring setting and causes the vacuum regulator to open.

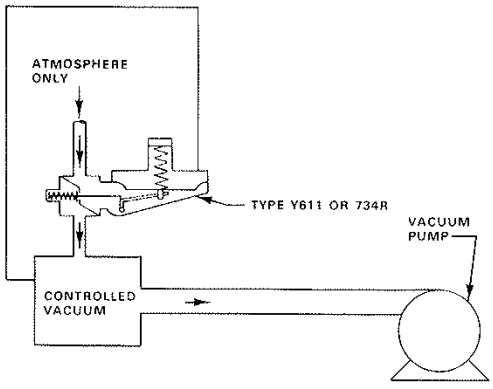
The following figures illustrate this equipment connected in pressure systems.



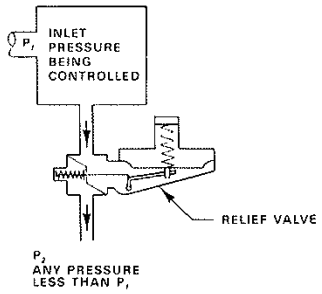
Typical Vacuum Breaker Piping Configuration



Typical Vacuum Regulator Piping Configuration



Relief Valves Used as Vacuum Breakers



Typical Relief Valve Piping Configuration

Selection

Familiarize yourself with the following application considerations as they apply to your vacuum control requirements.

- Name and temperature of controlled fluid
- Controlled vacuum setting and maximum allowable change from setting
- Required flow capacity
- Inlet and outlet pipe sizes
- Installation
- Environmental considerations such as corrosion, temperature extremes, shock and vibration, etc.
- Special capabilities such as gauges, test connections, etc.

The following selection table will guide you to product descriptions that describe devices for vacuum service. To help you make your final selection, contact your Fisher sales office or sales representative, who will assist you in selecting the type and size of device that will best suit your need.

Vacuum Service Equipment

SPRING RANGE		STANDARD SIZE (INCH)	TYPE NUMBER	SEE PAGE
Vacuum Breaker				
0 psig to 6 inch wc vac.	0 to 15 mbar vac.	2, 3, or 4	66 Series	7-24
1 inch wc vac. to 6.1 inch Hg vac.	2.5 mbar vac. to 206 mbar vac.	1-1/2 or 2	Y610	7-40
3 inch wc vac. to 6.1 inch Hg vac.	7.5 mbar vac. to 206 mbar vac.	1-1/2 or 2	734A	7-28
0 psig to 9.6 inch Hg vac.	0 to 325 mbar vac.	3/4 through 1-1/14	Y610	7-40
2 inch wc vac. to 14 inch Hg vac.	5.0 mbar vac. to 474 mbar vac.	1-1/2 or 2	734R	7-28
2.5 inch wc vac. to 14.25 inch Hg vac.	6.2 mbar vac. to 482 mbar vac.	3/4 through 1-1/14	Y611	7-40
3 inch wc vac. to 14.25 inch Hg vac.	7.5 mbar vac. to 482 mbar vac.	1-1/2 or 2	Y611	7-40
Vacuum Regulator				
0 psig to 6 inch wc vac.	0 to 15 mbar vac.	2, 3, or 4	66 Series	7-24
1 inch wc vac. to 6.1 inch Hg vac.	2.5 mbar vac. to 206 mbar vac.	1-1/2 or 2	Y612	7-40
3 inch wc vac. to 6.1 inch Hg vac.	7.5 mbar vac. to 206 mbar vac.	1-1/2 or 2	734V	7-28
0 psig to 26 inch Hg vac.	0 to 0.88 bar vac.	3/4 through 1-1/4	Y612	7-40
Relief Valve				
2 inch wc to 7 psig	5.0 to 483 mbar	1-1/2 or 2	734R	7-28
2.5 inch wc to 7 psig	6.2 to 483 mbar	3/4 through 1-1/4	Y611	7-40
3 inch wc to 7 psig	7.5 to 483 mbar	1-1/2 or 2	Y611	7-40

Level Regulators

Description

Level regulators are used to maintain liquid level within a tank. A complete level regulator is composed of a ball float as a sensing element, an actuator, and a valve body. A level regulator may be an integral unit; it may be assembled from a ball float actuator and a valve; or assembled from a ball float sensor, a level actuator, and a valve.

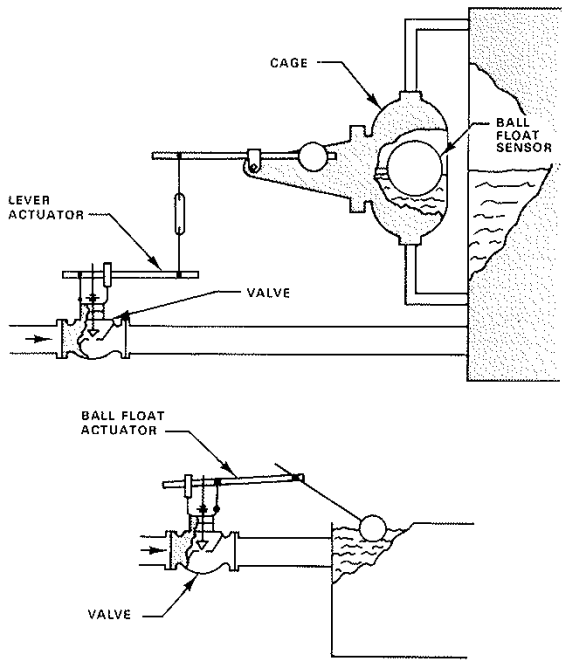
The accompanying figures show several level regulators. Different combinations of level regulators are available using various ball float sensors, lever or ball float actuators, and valve bodies.

Selection

Familiarize yourself with the following application considerations as they apply to your control requirements.

- Minimum, normal, and maximum inlet pressures
- Normal flow and maximum required flow
- Name, temperature, and specific gravity of flowing fluid
- Inlet and outlet pipe sizes
- Open or closed tank
- Environmental considerations, such as corrosion, temperature extremes, etc.

The following selection table will guide you to product descriptions that describe level regulators. To help you make your final selection, contact your Fisher sales office or sales representative, who will assist you in selecting the type and size of level regulator that will best suit your need.



Level Regulators

Level Regulators

APPLICATION		TYPE NUMBER	STANDARD SIZE (INCH)	MAXIMUM INLET PRESSURE		SEE PAGE
				Psig	Bar	
Open Tank		171F Level Regulator	1/2 through 2	150	10.3	7-57
		617 Ball Float Actuator 618 Ball Float Actuator	These ball float actuators may be used with most 1 through 4 inch globe valves. Most commonly used with **easy-e®** and Design GS valve bodies.			6-39
Closed Tank	Externally or Internally Mounted	171L Lever Valve	1/2 through 2	150	10.3	7-57
		607 Lever Actuator or 608 Lever Actuator	These lever actuators may be used with most 1 through 4 inch globe valves. Most commonly used with **easy-e** and Design GS valve bodies.			6-39

Accessory Equipment for Regulators

Regulators may be used in conjunction with many different types of accessories, such as filters, strainers, gauges, etc. The accessories and their usage are listed in the following table.

To help you make your final selection on any of these accessories, contact your Fisher sales office or sales representative who will assist you in selecting the appropriate accessory equipment for your needs.

Accessory Equipment for Regulators

ACCESSORY	USE	TYPE NUMBER	SEE PAGE
Electrically-operated rotary drive unit	For remote set point adjustment of pilot-operated pressure regulators	661	7-54
Filters	To remove moisture, dust, rust or other fine substances from air or gas lines just upstream from instrument air or other small volume pressure regulators	254 Series	10-2
		361	10-3
		P590 Series	10-3
Manually operated valves	For throttling or shutoff use in control or other small-diameter lines	111	7-53
Noise abatement equipment	To eliminate excessive fluid noise resulting from gas or vapor flow in pilot-operated regulators or relief valves	6010, 6012 Whisper Trim® cages	8-3 8-2
Pressure gauges	For indication of vacuum or positive pressures	J500 Series, J510 Series	7-53
Strainers	To remove dirt, scale or other solid substances from the flow stream just upstream from all pressure regulators	260 Series	10-2

64 Series Pressure Reducing Regulators

The 64 Series are direct-operated regulators typically used to deliver constant reduced pressure to pilot-operated controllers and other pneumatic instrumentation.

Normal Service: Gaseous fluids

Available Configurations: *Type 64*—Standard. *Type 64R*—Same as Type 64 except with internal relief. *Type 64B*—Same as Type 64 except for NH_3 service

Body Sizes and End Connection Styles: 1/2 in. NPT screwed

Body Side Connection: (For outlet pressure gauge) 1/4 in. NPT screwed

Maximum Inlet Pressure: 250 psig (17.2 bar)

Outlet Pressure Range: *Types 64 and 64R*—3 to 200 psig (0.2 to 13.8 bar) in 7 ranges. *Type 64B*—3 to 100 psig (0.2 to 6.9 bar) in 5 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

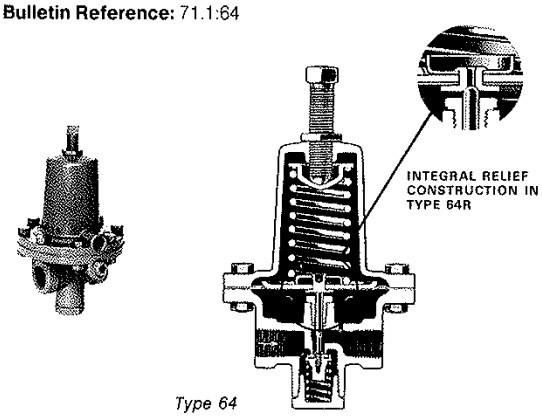
Outlet Pressure Registration: Internal

Typical Construction Materials: *Body and Spring Case*—Die-cast aluminum. *Major Metal Internal Parts*—Brass, aluminum or SST. *Diaphragm*—Nitrile. *Valve Disc*—Nitrile

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position. Regulator may also be panel mounted

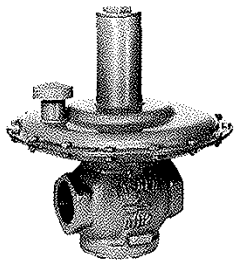
Bulletin Reference: 71.1:64



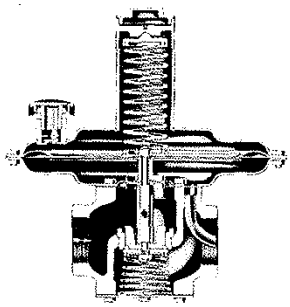
Type 64

66 Series Pressure Reducing Regulators

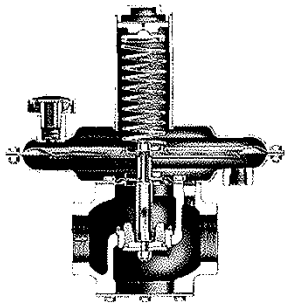
The 66 Series direct-operated regulators are widely used in burner control, tank blanketing and other applications where precise control of low-pressure industrial gases is needed. These regulators provide sensitivity and accuracy over a broad range of downstream demand applications. Variations of 66 Series regulators may be used for monitoring applications and as vacuum regulators and vacuum breakers.



Type 66 or 66Z



Type 66Z with Pitot Tube



Type 66 with External Pressure Tap for Downstream Control Line

Normal Service: Gaseous fluids

Available Configurations: See table below

Body Sizes and End Connection Styles: 2 in. NPT screwed. 2, 3, and 4 in. Classes 125 and 150 flanged

Maximum Inlet Pressure: See table below

Outlet Pressure Range: See table below

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning adjusting screw

Outlet Pressure Registration: Either internal pilot tube registration or external pressure tap for control line, depending on regulator construction

Control Line Connection: Where used, this connection is 3/4 in. NPT female

Typical Construction Materials: *Body*—Cast iron or steel. *Spring Case and Lower Casing*—Steel. *Major Metal Internal Parts*—Steel and either brass or stainless steel. *Diaphragm and O-Ring*—Nitrile or fluoroelastomer

Normal Operating Temperature: −20 to +350°F (−18 to +177°C) depending on construction

Installation: Normally installed in a horizontal pipeline with the spring case vertical above the body

Bulletin Reference: 71.1:66

TYPE NUMBER	MAXIMUM INLET PRESSURE		OUTLET PRESSURE RANGE	
	Psig	Bar	In. wc	mbar
66	10	0.7	2 to 28[1]	5 to 70[1]
66Z	5	0.3	1 vac. to +2	2.5 vac. to +5
66 Series vacuum breaker or regulator	No more than 1 psi change from spring setting	No more than 69 mbar change from spring setting	6 vac. to +1.5[2]	15 vac. to +3.7[2]

1. In 7 ranges.
2. In 4 ranges.

67 Series Pressure Reducing Regulators

The 67 Series are small-volume, direct-operated regulators used to provide constant reduced pressure to spray guns, air chucks, torches, pneumatic instrumentation and other equipment.

Normal Service: Gases or liquids

Available Configurations: See table below

Body Sizes and End Connection Styles: 1/4 in. NPT screwed

Maximum Inlet Pressure: *67H, 67HR, 67SS and 67SSR*—400 psig (27.6 bar) *All other types*—250 psig (17.2 bar)

Outlet Pressure Range: Four ranges between 3-100 psig (0.21-5.5 bar)

Outlet Pressure Adjustment: See configuration table for configurations with adjustable spring range. Adjustment is made by turning adjusting screw or handwheel.

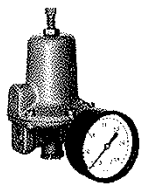
Outlet Pressure Registration: Internal

Typical Construction Materials: *Body and Spring Case*—Aluminum, zinc, brass, steel, or stainless steel. *Major Metal Internal Parts*—Aluminum, brass, steel or stainless steel. *Diaphragm and Valve Plug*—Nitrile. *Filter*—Cellulose or stainless steel

Normal Operating Temperature: −20 to +180°F (−29 to +82°C) with standard materials

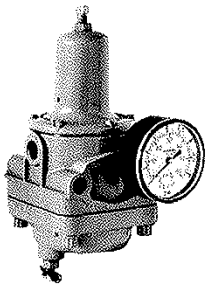
Installation: May be mounted in any position. Regulator may also be panel mounted

Bulletin Reference: 71.1:67

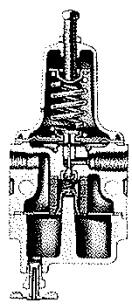


Typical of 67 Series with Pressure Gauge and Squarehead Adjusting Screw

Typical of 67 Series with Handwheel and Spring Case for Panel Mounting



Typical of 67 Series with Filter and Dual Scale Pressure Gauge



Typical 67 Series with Filter and Internal Relief

Available 67 Series

CONSTRUCTION FEATURE		TYPE NUMBER									
		67	67AF	67AFR	67AFS	67AFSR	67H	67HR	67R	67SS	67SSR
Standard	Aluminum body & spring case	X	X	X					X		
	Brass body & spring case						X	X			
	Stainless steel body & spring case				X	X				X	X
	Filter		X	X	X	X					
	Internal relief			X		X		X	X		X
	NACE-qualified materials	X	X	X	X	X			X		
Optional	Aluminum/alloy 400 (UNS N04400) inlet screen	X	X	X			X	X	X		
	Steel/stainless steel inlet screen				X	X				X	X
	Pressure gauge in side outlet	X	X	X	X	X	X	X	X	X	X
	Tire valve in side outlet	X							X		
	Type H800 relief valve in end outlet connection for outlet pressure settings of 35 psig (2.4 bar) or less	X	X	X	X	X	X	X	X	X	X
	■ Plain or ■ chrome-plated handwheel adjusting screw	X	X	X			X	X	X		
	Spring case with handwheel adjusting screw	X	X	X			X	X	X		
	TFE diaphragm protector for liquid ammonia service	X									
	Extra-thick diaphragm						X				
	Adjusting screw safety wiring		X	X							
	Spring case for mounting Type 661 remote control drive unit (can't be ordered with handwheel or 1/4-inch 18 NPT vent tapping)	X	X	X					X		

95 Series Pressure Reducing Regulators

The Types 95L and 95H are direct-operated, general-purpose regulators suitable for controlling many kinds of fluids. A soft seating surface is available on the regulator valve plug to provide tight shutoff up to 150°F (66°C), while the metal seating surfaces used at higher temperatures are carefully machine lapped to ensure shutoff. The main differences in the two types are in the outlet pressure ranges.

Normal Service: Liquids, steam or gaseous fluids

Body Sizes and End Connection Styles: *Type 95L*—1/8 through 1 in. NPT screwed. *Type 95H*—1/8 through 2 in. NPT screwed

Maximum Inlet Pressure: *Cast Iron bodies*—250 psig (17.2 bar). *Steel or Stainless Steel Bodies*—300 psig (20.7 bar)

Outlet Pressure Range: *Type 95L*—2 to 30 psig (0.1 to 2.0 bar) in 3 ranges. *Type 95H*—5 to 150 psig (0.3 to 0.5 bar) in 7 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning adjusting screw

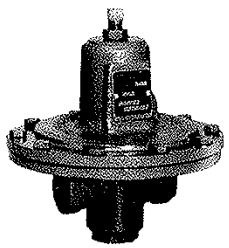
Outlet Pressure Registration: Internal

Typical Construction Materials: *Body and Spring Case*—Cast iron, steel or stainless steel. *Major Metal Internal Parts*—Brass or stainless steel. *Valve Plug Seating Surfaces and Diaphragm*—Neoprene or stainless steel

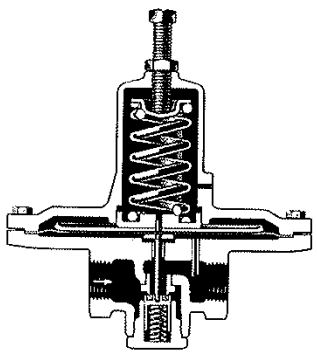
Normal Operating Temperature: *With Neoprene Diaphragm and Valve Plug Seat*— − 20 to + 150°F (− 29 to + 66°C). *With Stainless Steel Diaphragm and Valve Plug Seat*—Cryogenic to + 450°F (232°C) for stainless steel body; − 20 to + 450°F (− 29 to + 232°C) for steel body; − 20 to + 410°F (− 29 to + 210°C) for cast iron body

Installation: May be mounted in any position

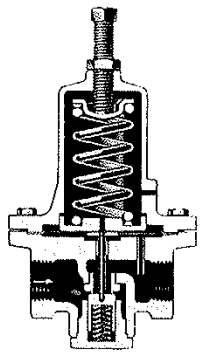
Bulletin Reference: 71.1:95



Typical 95L



Type 95L with Neoprene Diaphragm and Valve Plug Seat



Type 95H with Stainless Steel Diaphragm and Valve Plug Seat

133 Series Pressure Reducing Regulators

The 133 Series are direct-operated regulators used for industrial and commercial applications supplying gas to furnaces, burners, and other appliances. These regulators use a balancing diaphragm and an outlet pressure boosting principle to provide sensitivity and accuracy over a broad range of downstream demand applications. The 133 Series regulators are also suitable for pressure monitoring applications.

Normal Service: Gaseous fluids

Available Configurations: See table below

Body Sizes and End Connection Styles: 2 in. NPT screwed and 2 in. Class 125 flanged

Maximum Inlet Pressure: See table below

Outlet Pressure Range: See table below

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Outlet Pressure Registration: External pressure tap for control line

Control Line Connection: 3/4 in. NPT female

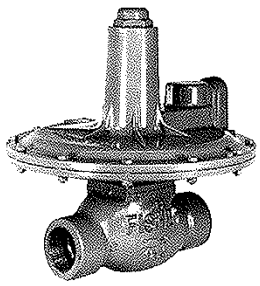
Typical Construction Materials: *Body*—Cast iron. *Spring Case and Lower Casing*—Aluminum. *Major Metal Internal Parts*—Aluminum and stainless steel. *Diaphragm*—Nitrile/Nylon. *Valve Disc*—Nitrile

Normal Operating Temperature: −20 to +150°F (−29 to +66°C) with standard materials

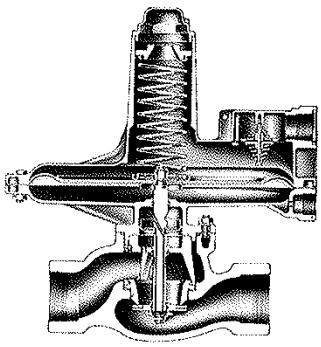
Installation: Normal installation is in a horizontal pipeline with spring case vertical above the body

Bulletin Reference: 71.1:133

TYPE NUMBER	MAXIMUM INLET PRESSURE		OUTLET PRESSURE RANGE	
	Psig	Bar		
133L	60	4.1	2 in. wc to 2 psig (6 ranges)	5.0 to 138 mbar (6 ranges)
133H	60	4.1	1.5 to 10 psig (3 ranges)	0.1 to 0.7 bar (3 ranges)
133Z	20	1.4	1 in. wc vac. to +4 in. wc (2 ranges)	2.5 mbar vac. to +10 mbar (2 ranges)



133 Series



Type 133L

166 Series Pressure Reducing Regulators

The 166 Series are direct-operated regulators used as the final control element in large industrial and commercial installations. These regulators use an outlet pressure boosting principle to provide sensitivity and accuracy over a broad range of downstream demand applications. The 166 Series regulators are also suitable for pressure monitoring applications.

Normal Service: Gaseous fluids

Available Configurations: See table below

Body Sizes and End Connection Styles: See table below

Maximum Inlet Pressure: See table below

Outlet Pressure Range: See table below

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning adjusting screw

Outlet Pressure Registration: External pressure tap for control line

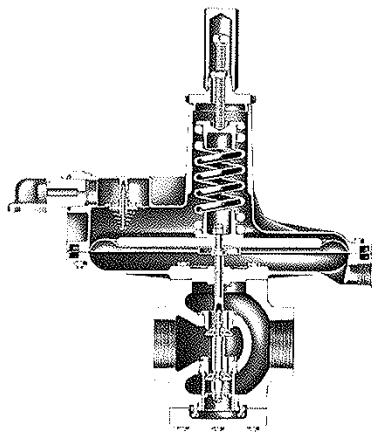
Control Line Connection: 3/4 in. NPT female

Typical Construction Materials: *Body*—Cast iron or steel. *Spring Case*—Steel or aluminum. *Major Metal Internal Parts*—Aluminum and either brass or stainless steel for Type 166-4; Aluminum and stainless steel for all other types. *Diaphragm and Valve Disc*—Nitrile

Normal Operating Temperature: −20 to +150°F (−29 to +66°C) with standard materials

Installation: Normal installation is in a horizontal pipeline with spring case vertical above the body

Bulletin Reference: 71.1:166



Type 166-6

TYPE NUMBER	BODY SIZES AND END CONNECTIONS	OUTLET PRESSURE RANGE		MAXIMUM INLET PRESSURE	
				Psig	Bar
166-4	2 inch NPT screwed; 2 inch Class 125, 150, 250, or 300 flanged	2 to 5 psig (1 range)	138 to 345 mbar (1 range)	60	4.1
166-5(1)	1-1/2 or 2 inch NPT screwed; 2 inch Class 125, 150, 250, or 300 flanged	4 inch wc to 2 psig (5 ranges)	10 to 138 mbar (5 ranges)		
166-6(1)	1-1/2 or 2 inch NPT screwed; 2 inch Class 125, 150, 250, or 300 flanged	2 to 10 psig (2 ranges)	0.1 to 0.7 bar (2 ranges)		

1. Maximum inlet pressure is 125 psig (8.6 bar) when using a smaller seat ring.

627 Series Pressure Reducing Regulators

The 627 Series are direct-operated pressure reducing regulators for low and high pressure systems. These regulators can be used with natural gas, air, or a variety of other gases.

Available Constructions: The *Type 627* is equipped with a pitot tube for greater regulated capacities. The *Type 627R* combines the Type 627 with an internal relief and an open throat. The *Type 627M* is the Type 627 with an additional stem seal between the body outlet pressure and diaphragm case; pressure is measured under the diaphragm through the downstream control line connection. The Type *627MR* is a Type 627M with an additional internal relief.

Body Sizes and End Connection Styles: 3/4 through 2 in. NPT screwed; 1 or 2 in. ANSI Class 600 raised face flanged.

Maximum Inlet Pressure: Up to 2000 psig (138 bar) depending on regulator construction

Outlet Pressure Range: From 10 to 150 psig (0.69 to 10.3 bar) in 4 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning adjusting screw.

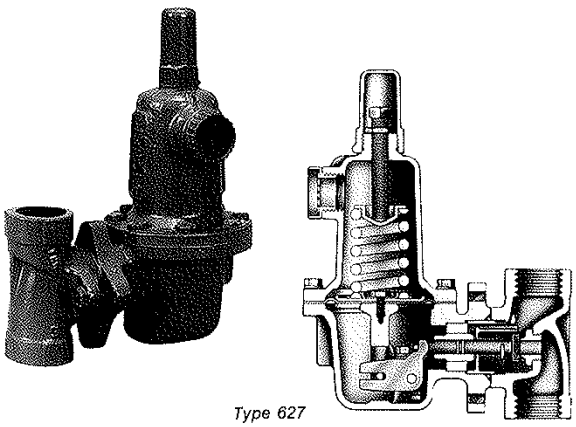
Outlet Pressure Registration: *Type 627 and 627R*—internal. *Type 627M and 627MR*—external through control line connection in the diaphragm case.

Typical Construction Materials: *Body*—Ductile iron or steel. *Spring Case and Diaphragm Case*—Steel, ductile iron, or die cast aluminum. *Seat Ring*—Aluminum or stainless steel. *O-rings and Diaphragm*—Nitrile

Normal Operating Temperature: From − 20 to 180°F (− 29 to 82°C)

Installation: Body may be installed in any of four positions. Spring case vent may be rotated to any of four positions.

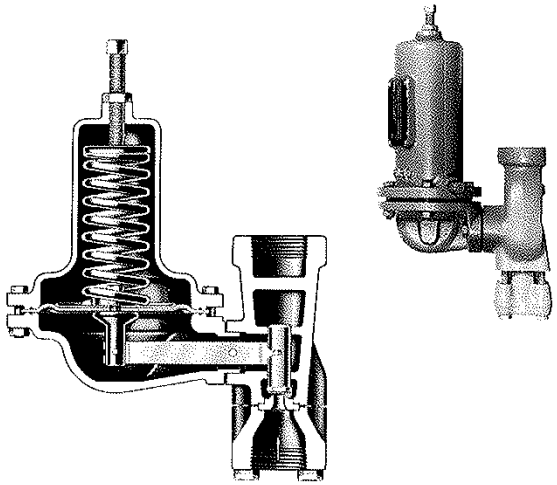
Bulletin Reference: 71.1:627



Type 627

630 Big Joe® Pressure Reducing Regulator

The Type 630 **Big Joe** direct-operated regulator is used primarily for farm taps and first-stage reduction of gas pressure on high pressure transmission lines. This regulator is very durable and is built to take rugged use. Variations of the Type 630 may be pressure loaded to provide closer control.



Normal Service: Gaseous fluids

Available Configurations: Low pressure and high pressure versions of Type 630

Body Sizes and End Connection Styles: 1 or 2 in. NPT screwed

Maximum Inlet Pressure: Up to 1500 psig (103 bar), depending on regulator construction

Outlet Pressure Setting: *Low Pressure*—30 to 40 psig (0.2 to 2.8 bar) in 4 ranges. *High Pressure*—27 to 500 psig (1.9 to 34.5 bar) in 6 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning adjusting screw

Outlet Pressure Registration: Internal

Typical Construction Materials: *Body, Spring Case and Lower Casing*—Cast iron or steel. *Inlet Adaptor*—Steel. *Major Metal Internal Parts*—Steel, zinc and either brass or stainless steel. *Diaphragm*—Neoprene. *Valve Disc*—Nitrile or nylon

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position

Bulletin Reference: 71.1:630

730B Series Pressure Reducing Regulators

The 730B Series are direct-operated regulators typically used on commercial and industrial installations to supply gas to ovens, large furnaces, and boilers. Many configurations are available that provide a blocked throat, different vents and vent orientations, or a separate relief valve.

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 1-1/2 or 2 in. NPT screwed and 2 in. Class 150 or 300 flanged

Maximum Inlet Pressure: Up to 150 psig (10.3 bar) depending on regulator construction

Outlet Pressure Range: 2.25 in. wc to 10 psig (0.006 to 0.7 bar)

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

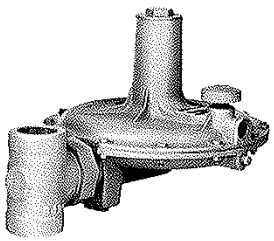
Outlet Pressure Registration: Internal pitot tube registration or external pressure tap for control line

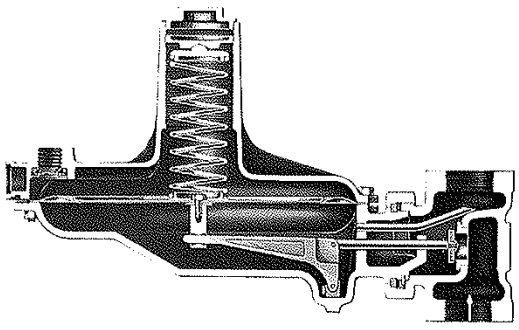
Typical Construction Materials: *Body and Lower Casing*—Cast iron, stainless steel, and steel. *Spring Case*—Aluminum, cast iron or stainless steel. *Major Metal Internal Parts*—Brass, iron, stainless steel, or steel. *Diaphragm and Valve Disc*—Nitrile

Normal Operating Temperature: −20 to +150°F (−29 to +66°C) with standard materials

Installation: Normally installed in a horizontal pipeline with spring case vertical above lower casing

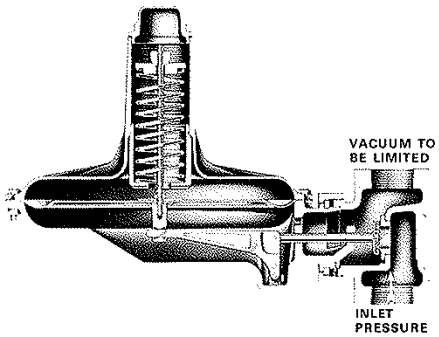
Bulletin Reference: 71.1:730B



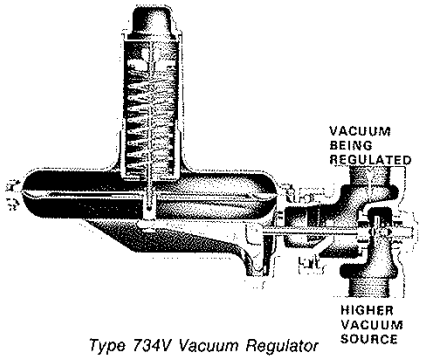


734 Series Equipment for Vacuum Service

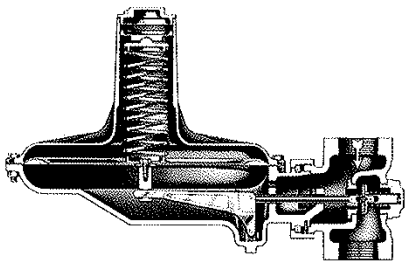
The 734 Series are direct-operated devices used as (1) vacuum breakers to prevent a vacuum from exceeding a specified value, (2) vacuum regulators to maintain a constant vacuum in the inlet system, and (3) relief valves to maintain a constant inlet pressure with the outlet to atmosphere, or any pressure system which is at a lower pressure than the inlet.



Type 734A Vacuum Breaker



Type 734V Vacuum Regulator



Type 734R Vacuum Breaker or Relief Valve

Normal Service: Gaseous fluids

Available Configurations: Type 734A vacuum breaker. Type 734V vacuum regulator. Type 734R vacuum breaker or relief valve

Body Sizes and End Connection Styles: 1-1/2 or 2 in. NPT screwed

Pressure Range: *Types 734A and 734V*—3 in. wc vac. to 6 in. Hg vac. (7.5 mbar vac. to 203 mbar vac.) in 2 ranges. *Type 734R*—2 in. wc vac. to 14 in. Hg vac. (50 mbar vac. to 474 mbar vac.) in 6 ranges when used as a vacuum breaker; 2 in. wc to 7 psig (5.0 to 483 mbar) in 8 ranges when used as a relief valve

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: Internal for all types except for Type 734R when used as a vacuum breaker. In this case, the 734R requires a control line connecting the vacuum source to the spring case

Typical Construction Materials: *Body and Lower Casing*—Cast iron or steel. *Spring Case*—Aluminum or steel. *Major Metal Internal Parts*—Brass and steel. *Diaphragm*—Nitrile. *Valve Disc*—Nitrile or neoprene

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: Normally installed with spring case vertical above the lower casing. If installed in any other position, the weight of the parts will affect the spring setting

Bulletin Reference: 71.1:734

912 Series Pressure Reducing Regulators

All 912 Series direct-operated regulators have an internal relief valve. The lever mechanism provides accurate and sensitive control for low gas requirements.

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 1/4 in. NPT screwed inlet and 1/4 or 3/8 in. NPT screwed outlet

Maximum Inlet Pressure: 250 psig (17.2 bar)

Outlet Pressure Range: 3 in. wc to 5 psig (0.007 to 0.3 bar) in 8 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

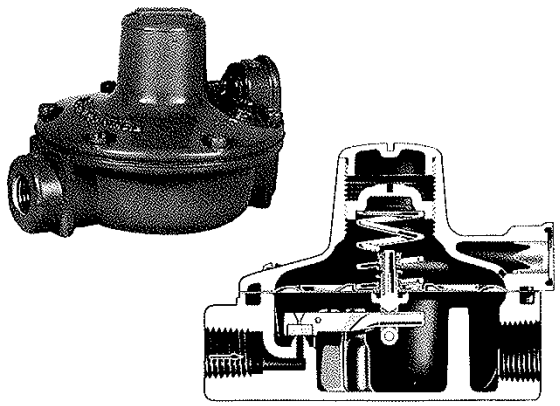
Outlet Pressure Registration: Internal

Typical Construction Materials: *Body and Spring Case*—Die cast zinc. *Major Metal Internal Parts*—Brass and zinc. *Valve Disc*—Nitrile. *Diaphragm*—Natural rubber

Normal Operating Temperature: − 20 to + 160°F (− 29 to + 71°C) with standard materials

Installation: Must be installed so spring case vent is down. Has two tapped holes in body for mounting.

Bulletin Reference: 71.1:912



1301 Series Pressure Reducing Regulators

The Types 1301F and 1301G are direct-operated regulators used where high inlet pressures of up to 6000 psig (414 bar) are transformed to reduced outlet pressures. The main differences in the two types are in the outlet pressure ranges.

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 1/4 in. NPT screwed

Maximum Inlet Pressure: 6000 psig (414 bar)

Outlet Pressure Range: *Type 1301F*—10 to 225 psig (0.7 to 15.5 bar) in 3 ranges. *Type 1301G*—200 to 500 psig (13.8 to 34.5 bar) in 1 range

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

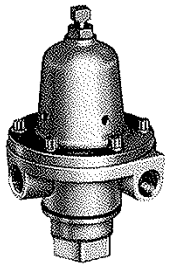
Outlet Pressure Registration: Internal

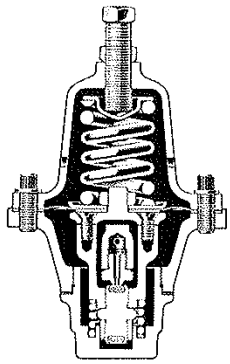
Typical Construction Materials: *Body, Bottom Cap and Spring Case*—Brass or steel. *Major Metal Internal Parts*—Brass and stainless steel. *Diaphragm*—Stainless steel. *Valve Disc*—Nylon

Normal Operating Temperature: − 20 to + 180°F (− 29 to + 82°C) with standard materials

Installation: May be installed in any position

Bulletin Reference: 71.1:1301





1305 & 1306 Series Pressure Reducing Regulators

The 1305 and 1306 Series are direct-operated regulators used where their output pressure is the supply medium to pilot-operated regulators or any other source where small flow is required and there is a need to prevent formation of condensate and freeze-up.

Normal Service: Gaseous fluids

Available Configurations: *Types 1305C and 1305D*—These types are the same except for outlet pressure ranges. They are installed in a high pressure, warm gas flow line. Heat from the line is transmitted to the reduced pressure gas, thereby raising the temperature to help prevent the formation of condensate. *Types 1306C and 1306D*—These types are identical except for outlet pressure ranges. They are installed through a coupling. This construction enables the use of an independent heating medium to flow through the coupling and supply heat to the point of gas pressure reduction

Body Sizes and End Connection Styles: *Types 1305C and 1305D*—Inlet 1 in. NPT male; Outlet 1/4 in. NPT female. *Types 1306C and 1306D*—Inlet and Outlet, 1/4 in. NPT female; coupling 2 in. NPT female

Maximum Inlet Pressure: 4000 psig (276 bar). 6000 psig (414 bar) for coupling of 1306 Series regulators

Outlet Pressure Range: *Types 1305C and 1306C*—10 to 225 psig (0.7 to 15.5 bar) in 3 ranges. *Types 1305D and 1306D*—200 to 500 psig (13.8 to 34.5 bar) in 1 range

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

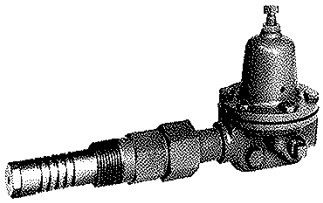
Outlet Pressure Registration: Internal

Typical Construction Materials: *Lower Casing and Spring Case*—Brass. *Inlet Adaptor*—Stainless steel. *Coupling for 1306 Series*—Steel. *Major Metal Internal Parts*—Steel and stainless steel. *Diaphragm*—Stainless steel. *Valve Disc*—Nylon

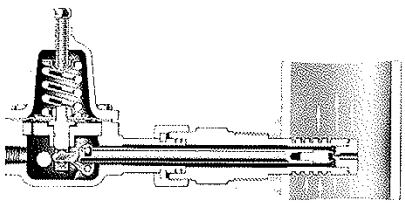
Normal Operating Temperature: − 20 to + 200°F (− 29 to + 93°C) with standard materials

Installation: May be installed in any position

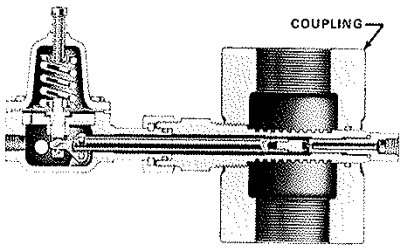
Bulletin Reference: 71.1:1305



1305 Series



1305 Series



1306 Series

R722 & R722H Pressure Reducing Regulators

The Types R722 and R722H are direct-operated service regulators used for transforming line pressure, up to 400 psig (27.6 bar), to reduced pressure in either pounds per square inch pressure or inches of water column.

Normal Service: Gaseous fluids

Available Configuration: Type R722 for psig to in. wc reducing service. Type R722H for psig to psig reducing service. The R722 Series regulators have internal relief

Body Sizes and End Connection Styles: 3/4 in. NPT screwed end connections. 3/4 in. NPT female vent with screen

Maximum Inlet Pressure: Up to 400 psig (27.6 bar), depending on regulator construction

Outlet Pressure Range: 2.6 in. wc to 10 psig (0.006 to 0.7 bar) in 8 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning adjusting screw

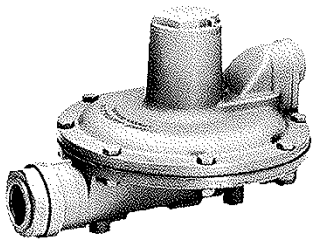
Outlet Pressure Registration: Internal

Typical Construction Materials: *Body*—Die-cast zinc. *Spring Case*—Die-cast aluminum. *Inlet Adaptor*—Brass and aluminum. *Major Metal Internal Parts*—Steel and brass. *Diaphragm and Valve Disc*—Nitrile

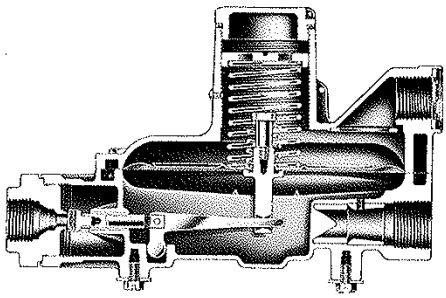
Normal Operating Temperature: − 20 to + 160°F (− 29 to + 71°C) with standard materials

Installation: Must be installed so spring case vent is down

Bulletin Reference: 71.1:R722



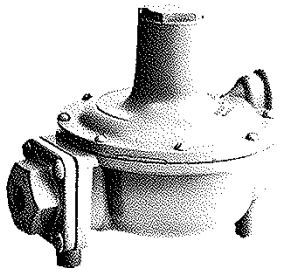
Type R722



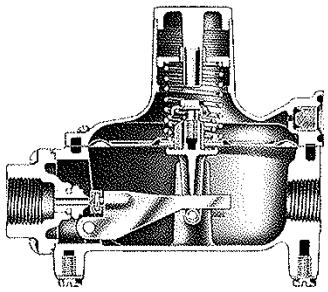
Type R722H

R922 & R922H Pressure Reducing Regulators

The Types R922 and R922H are direct-operated regulators used where small gas flow is required. These regulators have a lever mechanism that provides accurate and sensitive control.



Type R922



Type R922

Normal Service: Gaseous fluids

Available Configurations: Types R922 and R922H. Type R922 has internal relief

Body Sizes and End Connection Styles: 1/4 or 1/2 in. NPT screwed inlet. 1/2 or 3/4 in. NPT screwed outlet. 3/4 in. NPT screened vent

Maximum Inlet Pressure: 250 psig (17.2 bar)

Outlet Pressure Range: 1.5 in. wc to 19 psig (0.004 to 1.3 bar) in 10 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Outlet Pressure Registration: Internal

Typical Construction Materials: *Body and Spring Case*—Die-cast aluminum. *Major Metal Internal Parts*—Aluminum, brass and zinc. *Valve Disc*—Nitrile. *Diaphragm*—Natural rubber

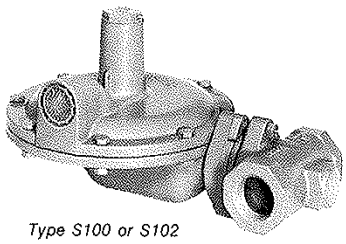
Normal Operating Temperature: − 20 to + 160°F (− 29 to + 71°C) with standard materials

Installation: Must be installed so spring case vent is down. Body has two tapped mounting pads

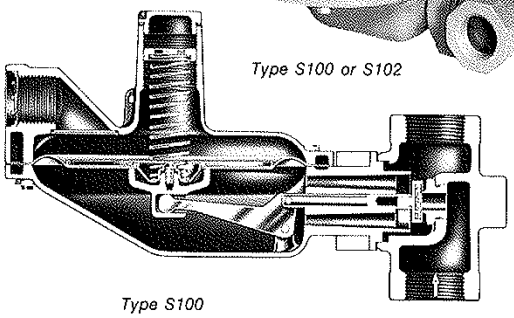
Bulletin Reference: 71.1:R922

S100 Series Pressure Reducing Regulators

The S100 Series direct-operated regulators are used primarily in supplying gas to residential and limited commercial applications (such as small laundries). S100 Series regulators are offered in seven different types and may be used on natural, manufactured, or liquefied petroleum gases.



Type S100 or S102



Type S100

Normal Service: Gaseous fluids

Available Configurations: See table below

Body Sizes and End Connection Styles: 3/4 through 1-1/2 in. NPT screwed. The inlet and outlet may be in different sizes

Maximum Inlet Pressure: Up to 125 psig (8.6 bar) depending on regulator construction

Outlet Pressure Range: See table below

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Outlet Pressure Registration: Internal

Typical Construction Materials: *Body*—Cast iron. *Spring Case and Lower Casing*—Die-cast aluminum. *Major Metal Internal Parts*—Steel, stainless steel and aluminum. *Diaphragm and Valve Disc*—Nitrile

Normal Operating Temperature: − 20 to + 160°F (− 29 to + 71°C) with standard materials

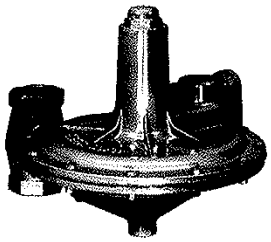
Installation: Normally installed in a horizontal pipe with the spring case vertical above the lower casing. If installed in any other position, the weight of the parts will affect the spring setting.

Bulletin Reference: 71.1:S100

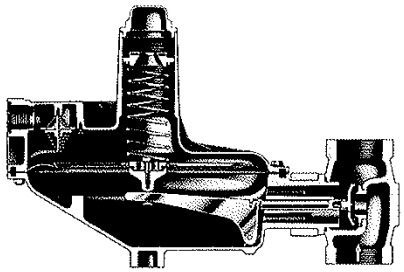
TYPE NUMBER	OUTLET PRESSURE RANGE		LOW PRESSURE SHUTOFF	HIGH PRESSURE SHUTOFF
Without Internal Relief				
S100	3.5 in. wc to 2.5 psig in 6 ranges	8.7 to 172 mbar in 6 ranges	No	No
S104	5.5 to 16 in. wc in 4 ranges	14 to 40 mbar in 4 ranges	Yes	No
With Internal Relief				
S102	3.5 in. wc to 2.5 psig in 6 ranges	8.7 to 172 mbar in 6 ranges	No	No
S106	5.5 to 16 in. wc in 4 ranges	14 to 40 mbar in 4 ranges	Yes	No

S200 Series Pressure Reducing Regulators

The S200 Series are direct-operated regulators for use in industrial or commercial installations where gas consumption varies greatly and where snap-acting solenoid valves cause instantaneous load changes. Under shock load conditions, these regulators are well known for their response and stability of operation.



Typical S200 Series



Type S201

TYPE NUMBER	OUTLET PRESSURE RANGE		LOW PRESSURE SHUTOFF
Without Internal Relief			
S201	2 to 30 in. wc (5 ranges)	5.0 to 75 mbar (5 ranges)	No
S201H	1 to 5 psig (3 ranges)	0.07 to 0.3 bar (3 ranges)	No
S201K	2 to 10 psig (2 ranges)	0.1 to 0.7 bar (2 ranges)	No
S204	3.5 in. wc to 3.25 psig (7 ranges)	8.7 to 224 mbar (7 ranges)	Yes
S211	2 in. wc to 10 psig (10 ranges)	5.0 mbar to 0.69 bar (10 ranges)	No
With Internal Relief			
S202	2 in. wc to 3.25 psig (7 ranges)	5.0 to 224 mbar (7 ranges)	No
S203[1]	2 in. wc to 3.25 psig (7 ranges)	5.0 to 224 mbar (7 ranges)	No
S206	3.5 in. wc to 3.25 psig (7 ranges)	8.7 to 224 mbar (7 ranges)	Yes

1. The Type S203 relief/monitor regulator minimizes hazardous venting of large quantities of gas to atmosphere by limiting required relief capacity without restricting total regulator capacity.

Normal Service: Gaseous fluids

Available Configurations: See table below. In addition to the types listed, certain regulators are available with a downstream control line, pressure test connection, and either pressure loading or combination spring and pressure loading. Pressure loading provides closer control and better capacity characteristics

Body Sizes and End Connection Styles: 1-1/2 or 2 in. NPT screwed and 2 in. Class 125 flanged. Some configurations are also available with 2 in. Class 250 flanged

Maximum Inlet Pressure: Up to 150 psig (10 bar), depending on regulator construction

Outlet Pressure Range: See table below

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Outlet Pressure Registration: Internal pressure registration is most common, but external pressure tap for control line is available for some regulator configurations

Typical Construction Materials: *Body*—Cast iron or steel. *Spring Case and Lower Casing*—Die-cast aluminum or cast iron. *Major Metal Internal Parts*—Steel and aluminum. *Diaphragm and Valve Disc*—Nitrile

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: Normally installed in a horizontal pipeline with spring case vertical above lower casing

Bulletin Reference: 71.1:S200

S250 Series Pressure Reducing Regulators

The S250 Series are direct-operated pressure reducing regulators that match the natural gas requirements of major household services. The S250 Series regulators are provided in two body styles—angle or meter bar—providing a choice of meter hookup.

Normal Service: Gaseous fluids

Available Configurations: See table below

Body Sizes and End Connection Styles: See table below

Maximum Inlet Pressure: See table below

Outlet Pressure Range: See table below

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

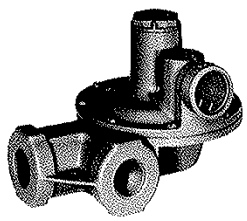
Outlet Pressure Registration: Internal

Typical Construction Materials: *Body and Spring Case*—Aluminum. *Major Metal Internal Parts*—Aluminum and steel. *Diaphragm and Valve Disc*—Nitrile

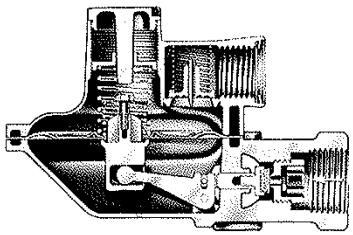
Normal Operating Temperature: − 20 to + 160°F (− 29 to + 71°C) with standard materials

Installation: Normally these regulators are installed on meters with the vent down

Bulletin Reference: 71.1:S250



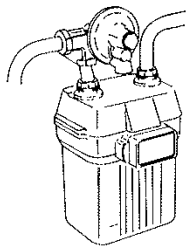
Typical of Angle Style S250 Series



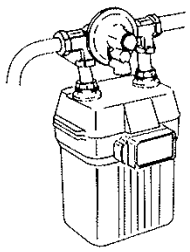
Type S252

TYPE NUMBER	BODY STYLE	MAXIMUM INLET PRESSURE(1)		OUTLET PRESSURE RANGE		LOW PRESSURE SHUTOFF
		Psig	Bar			
Without Internal Relief						
S251	Angle	125	8.6	3.5 in. wc to 2.5 psig (6 ranges)	8.7 to 172 mbar (6 ranges)	No
S253	Meter Bar					
S258	Angle	60	4.1	4.5 to 20 in. wc (5 ranges)	11 to 50 mbar (5 ranges)	Yes
S259	Meter Bar					
With Internal Relief						
S252	Angle	125	8.6	3.5 in. wc to 2.5 psig (6 ranges)	8.7 to 172 mbar (6 ranges)	No
S254	Meter Bar					
S256	Angle	60	4.1	4.5 to 20 in. wc (5 ranges)	11 to 50 mbar (5 ranges)	Yes
S257	Meter Bar					

1. Maximum inlet pressure depends on regulator construction.



Angle Style Body Top Mounted on Meter



Meter Bar Installation

S300 Series Pressure Reducing Regulators

The S300 Series are direct-operated regulators intended primarily for service in commercial, institutional and industrial installations such as shopping centers, schools, bakeries, and boilers.

Normal Service: Gaseous fluids

Available Configurations: See table below. In addition to the types listed, certain regulators are available with a downstream control line and pressure test connection

Body Sizes and End Connection Styles: 1-1/4 through 2 in. NPT screwed; Class 125 flanged for 2 in. bodies only

Maximum Inlet Pressure: Up to 125 psig (8.6 bar), depending on regulator construction

Outlet Pressure Range: See table below

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

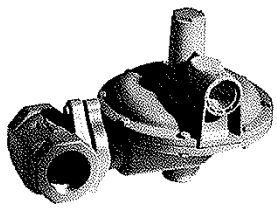
Outlet Pressure Registration: Either internal pressure tap or external pressure tap for control line are available, depending on application and regulator configuration

Typical Construction Materials: *Body*—Cast iron. *Spring Case and Lower Casing*—Aluminum. *Major Metal Internal Parts*—Steel and aluminum. *Diaphragm and Valve Disc*—Nitrile

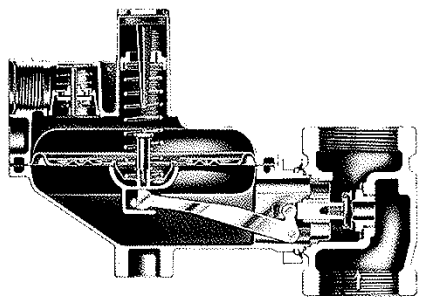
Normal Operating Temperatures: −20 to +160°F (−29 to +71°C) with standard materials

Installation: May be installed in any position

Bulletin Reference: 71.1:S300



Typical S300 Series



Type S302

TYPE NUMBER	OUTLET PRESSURE RANGE	
Without Internal Relief		
S301	3.5 to 28 in. wc (4 ranges)	8.7 to 70 mbar (4 ranges)
S301H	1 to 8 psig (4 ranges)	0.07 to 0.6 bar (4 ranges)
With Internal Relief		
S302	3.5 to 28 in. wc (4 ranges)	8.7 to 70 mbar (4 ranges)
S303(1)	4 to 28 in. wc (4 ranges)	10 to 70 mbar (4 ranges)
S302H	1 to 3 psig (2 ranges)	69 to 207 mbar (2 ranges)
S303H(1)	1 to 2.25 psig (2 ranges)	60 to 155 mbar (2 ranges)

1. These relief/monitor regulators minimize hazardous venting of large quantities of gas to atmosphere by limiting relief capacity without restricting total regulator capacity.

S400 Series Pressure Reducing Regulators

The S400 Series direct-operated regulators are intended for pressure-reducing control in a variety of residential, commercial, and industrial applications. The Type S402 regulator has high capacity, factory adjustable internal relief to help minimize overpressurization of the downstream system.

Normal Service: Gaseous fluids

Available Configurations: *Type S401*—Without internal relief. *Type S402*—With internal relief

Body Sizes and End Connection Styles: 3/4 x 3/4, 3/4 x 1, 1 x 1-inch NPT screwed

Maximum Inlet Pressure: 20, 60 or 125 psig (1.4, 4.1 or 8.6 Bar) depending upon orifice size utilized

Outlet Pressure Range: 4.5 in. wc to 2.5 psig (11.2 to 172 mbar) in 4 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

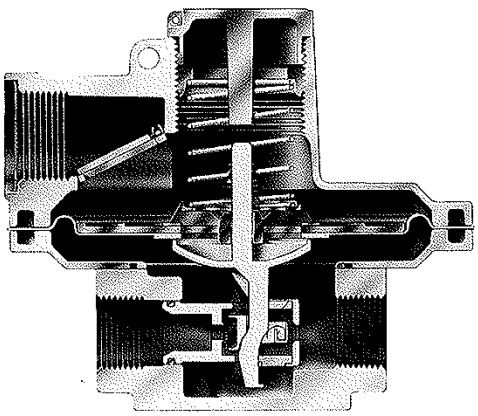
Outlet Pressure Registration: Internal

Typical Construction Materials: *Body*—Cast iron. *O-ring*—Nitrile. *Closing Cap*—ABS thermoplastic. *Adjusting Screw*—Delrin. *Spring Case*—Aluminum. *Vent Flapper Assembly*—Delrin and stainless steel. *Cam Stem*—Delrin. *Diaphragm Head*—Delrin. *Diaphragm*—Dacron fabric reinforced nitrile. *Orifice Tube Assembly*—Delrin/nylon/nitrile/stainless steel. *Control Spring, Relief Valve Spring, Relief Valve Spring Seat and Vent Screen*—Stainless steel. *Other Metal Parts*—Plated steel.

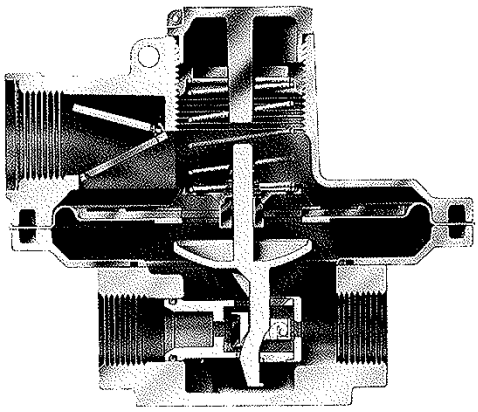
Normal Operating Temperature: − 20° to 160°F (− 29° to 71°C)

Installation: May be installed in any position in which the spring case vent points downward

Bulletin Reference: 71.1:S400



Type S402 with Internal Relief Valve Closed



Type S402 with Internal Relief Valve Open

92 Series Pressure Reducing Regulator

The 92 Series pressure reducing regulators are used for steam or hot air service. They are available as pilot-operated regulators or without a pilot for use as a pressure-loaded regulator. The pilot-operated regulator uses inlet pressure to operate the pilot. The pressure-loaded regulator uses a loading pressure, supplied from a separate loading regulator, to allow remote adjustment of the regulator.

Body Sizes and End Connection Styles: See table below

Maximum Inlet Pressure: Up to 300 psig (20.7 bar) depending on regulator construction

Outlet Pressure Range: See table below

Maximum Diaphragm Differential Pressure: For pressure-loaded regulator, maximum diaphragm differential pressure is 150 psig (10.3 bar)

Maximum Diaphragm Casing Pressure: For pressure-loaded regulator, up to 300 psig (20.7 bar) depending on regulator construction

Outlet Pressure Registration: Pilot connection for external control line on pilot-operated regulator and internal pitot tube for both pilot-operated and pressure-loaded regulators

Outlet Pressure Adjustment: For pilot-operated regulator, outlet pressure setting may be adjusted throughout the spring range by turning the screw on the pilot. For pressure-loaded regulator, outlet pressure setting may be adjusted by varying the loading pressure

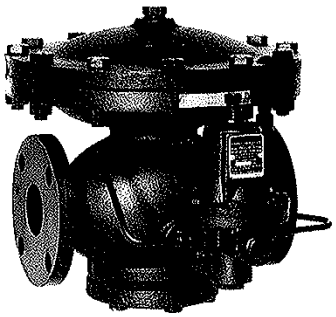
Control Line Connection: 1/4 in. NPT female

Typical Construction Materials: *Main Valve*—Body and Diaphragm Flange are cast iron or steel. Major Metal Internal Parts are stainless steel or brass. *Pilot*—Body and Spring Case are cast iron or steel. Major Metal Internal Parts are steel, stainless steel, or brass

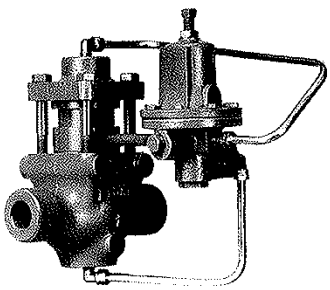
Maximum Operating Temperature: 406°F (208°C) for cast iron construction. 500°F (260°C) for steel construction

Installation: May be installed in any position except in vertical pipelines where condensate could affect performance

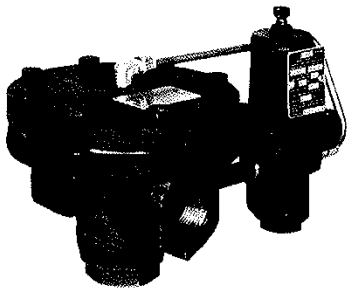
Bulletin References: 71.2:92B, 71.2:72C, 71.2:92S



Type 92B



Type 92S



Type 92C

TYPE NUMBER	BODY SIZES AND END CONNECTIONS	OUTLET PRESSURE RANGE	
		Low-Pressure Pilot	High-Pressure Pilot
92B	1, 1-1/2 or 2 inch NPT screwed; 1 to 4 inch Class 125 or 250 flanged.	2 to 25 psig (3 ranges) 0.14 to 1.7 bar (3 ranges)	15 to 150 psig (3 ranges) 1.05 to 10 bar (3 ranges)
92S	1, 1-1/2 or 2 inch NPT screwed. 1 to 4 inch Class 125B, 250B, 150, 300 or 600 flanged. 6 x 4 inch Class 300 or 600 flanged.	2 to 25 psig (3 ranges) 0.14 to 1.7 bar (3 ranges)	10 to 150 psig (3 ranges) 0.69 to 10 bar (3 ranges)
92C	1/2, 3/4 or 1 inch NPT screwed	---	5 to 150 psig (2 ranges) 0.3 to 10 bar (2 ranges)

99 Series Pressure Reducing Regulators

The versatile 99 Series pilot-operated regulators are used in a wide variety of applications such as natural gas distribution systems; industrial boiler, furnace, oven, mixer, and plant air service; and large commercial/institutional establishments such as shopping centers and schools.

A 99 Series regulator has a low pressure, a high pressure, or an extra high pressure pilot integrally mounted to the actuator casing. Many different combinations of body materials, spring ranges, and valve seat constructions are available.

The steel-body screwed-end Type 99 regulator for inlet pressures to 1000 psig (69 bar) has an integral extra high pressure pilot and additionally uses a Type 1301F pilot and a Type H110 pop relief valve. The complete product description for the Type 1301F pilot regulator is shown in this section of the catalog. Use the Type Number Index for a convenient reference.

Normal Service: Gaseous fluids

Main Valve Body Sizes and End Connection Styles: 2 in. NPT screwed or Class 125, 150, 250, or 300 flanged, except 2 in. NPT screwed only for 1000 psig (69 bar) max inlet regulator

Maximum Inlet Pressure: Up to 1000 psig (69 bar) depending on construction

Outlet Pressure Range: 0 to 100 psig (0 to 6.9 bar) in 9 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the pilot adjusting screw

Outlet Pressure Registration: External pressure tap for control line

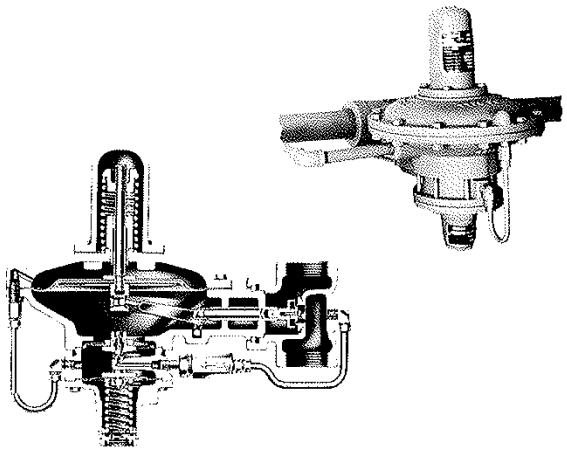
Control Line Connection: 1/2 in. NPT female

Typical Construction Materials: *Main Valve*—Body is cast iron, brass or steel; Actuator Casing is cast iron; Major Metal Internal Parts are steel and either brass or stainless steel; Diaphragm and Valve Disc are nitrile or fluoroelastomer. *Pilot*—Body and Spring Case are cast iron; Major Metal Internal Parts are cast iron, steel, aluminum, stainless steel, and brass; Diaphragms are nitrile, neoprene, or fluoroelastomer

Normal Operating Temperature: − 20 to + 350°F (− 29 to + 177°C) depending on construction

Installation: May be installed in any position

Bulletin Reference: 71.2:99



298 Series Pressure Reducing Regulators

The 298 Series regulators are pilot-operated and are used to provide sensitivity, accuracy, and high capacity for pressure reducing applications. Depending on actuator construction and pilot spring range, these regulators may be used for high, intermediate or low pressure service in gas distribution systems. These regulators do not have any gas bleed to atmosphere.

Two different actuators, Types 298C and 298H may be combined with various valve bodies and pilots to construct the pilot-operated regulators. See table below for typical actuator/valve body combinations.

The Type 298C is a heavy-duty actuator with a large diaphragm area and cast steel casings. This actuator can be used for outlet pressures up to 100 psig (6.9 bar) and is normally used to operate large valves. The Type 298H actuator is typically used for controlling outlet or downstream pressure up to 300 psig (20.7 bar).

The Design KB valve body used is a large capacity double-ported valve with a side hand-hole plate for easy inspection of internal parts. The complete product descriptions for the valve body listed in the table are in the "Control Valves" section of the catalog. Use the Type Number Index for a convenient reference.

Normal Service: Gaseous fluids

Maximum Valve Body Inlet Pressure: *Design KB*—8 in. body, up to 250 psig (17.2 bar); 10 in. body, up to 200 psig (13.8 bar); 12 in. body, up to 100 psig (6.9 bar)

Maximum Pilot Inlet (Supply) Pressure: Up to 600 psig (41.4 bar), depending upon pilot construction

Outlet Pressure Range: See table below

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw in the pilot

Outlet Pressure Registration: External pressure tap for control line

Control Line Connection: 1/2 in. NPT female

Typical Construction Materials: *Actuator*—Spring Case is cast iron for all types except Type 298C which is steel. Lower Diaphragm Casing is steel for all types except 298H, which is cast iron. Diaphragm is nitrile/fabric or neoprene/fabric, depending upon actuator construction. Major Metal Internal Parts are cast iron, steel, and either brass or stainless steel. *Pilot*—Body is cast iron. Spring Case is cast iron. Diaphragms are nitrile/fabric or neoprene/fabric. Major Metal Internal Parts are cast iron, steel, aluminum and either brass or stainless steel

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: Normally installed in a horizontal pipeline with the actuator vertical above the valve body

Bulletin Reference: 71.2:298

ACTUATOR TYPE NUMBER	VALVE BODY DESIGN	VALVE BODY SIZE (IN.)	PILOT TYPE NUMBER	OUTLET PRESSURE RANGE	
				Psig	Bar
298C	KB	8-12	61L 61LD 61LE	0.25 to 20 (5 ranges)	0.02 to 1.4 (5 ranges)
			61H	10 to 65 (1 range)	0.7 to 4.5 (1 range)
			61HP	15 to 300 (3 ranges)	1.0 to 20.7 (3 ranges)
298H	EK	1-6	61H	10 to 65 (1 range)	0.7 to 4.5 (1 range)
			61HP	15 to 300 (3 ranges)	1.0 to 20.7 (3 ranges)

310-32 Pressure Reducing Regulator

The Type 310-32 is a high pressure, pilot-operated gas regulator used where high capacity and accurate control are essential for pressures up to 1440 psig (99.3 bar). The Type 310 body is combined with the Type 32 pilot to form the pilot-operated regulator. The two stage pilot accepts full inlet pressure.

Normal Service: Gaseous liquids

Body Sizes and End Connection Styles: 1 in. NPT screwed. 2, 3, and 4 in. Classes 250, 300, and 600 flanged. 4 x 6 in. (inlet x outlet) Classes 300 and 600 flanged

Maximum Inlet Pressure: Up to 1440 psig (99.3 bar) depending on regulator construction

Outlet Pressure Range: 10 to 600 psig (0.7 to 41.4 bar) in 4 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw in the pilot

Outlet Pressure Registration: External pressure tap for control line

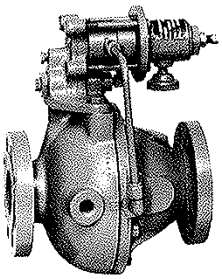
Control Line Connection: 1/2 in. NPT female

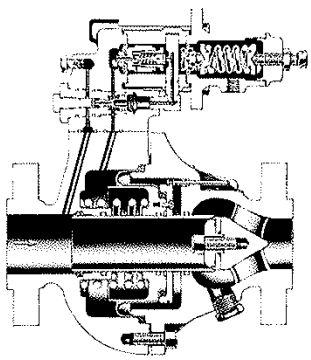
Construction Materials: *Main Valve*—Body is cast iron or steel. Major Metal Internal Parts are steel and stainless steel. Diaphragm is nitrile/fabric. Valve Seat is TFE. *Pilot*—Body and Spring Case are steel. Major Metal Internal Parts are steel and stainless steel. Diaphragm and Valve Disc are nitrile

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) for standard materials

Installaton: Normally installed in a horizontal pipeline with the pilot above the body

Bulletin Reference: 71.2:310





399 EASY JOE™ Pressure Reducing Regulator

The Type 399 EASY JOE regulator for air and gas service features top-entry trim for fast and easy in-line maintenance in such applications as district pressure regulation. Offers high capacity design with Whisper Trim® cage technology for quieter operation and less flow turbulence. The Type 399 is furnished with the Type 161 pilot, which is available in high-strength, corrosion-resistant stainless steel or economical aluminum.

Normal Service: Air or gas compatible with construction materials

Main Valve Body Sizes and End Connection Styles: 2 in. NPT screwed; 2, 3, 4 and 6 in. Class 125B, 250B, 150, 300 and 600 flanged

Maximum Inlet Pressure: Up to 750 psig (52 bar) depending upon size and construction

Outlet Pressure Ranges: 5 to 15 psig (0.34 to 1.0 bar), 10 to 125 psig (0.69 to 8.6 bar), and 120 to 300 psig (8.5 to 21 bar)

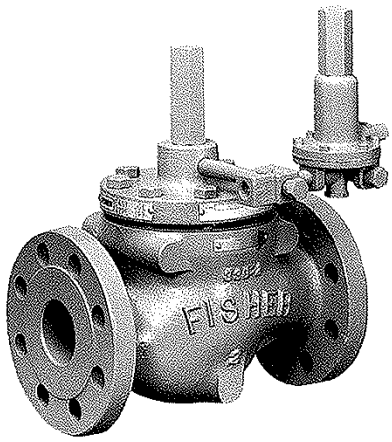
Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw in the pilot

Pressure Registration: External through downstream control line

Pilot Supply and Downstream Control Line Connections: 1/4 in. NPT female

Typical Construction Materials: *Main Valve Body and Bonnet*—Cast iron or steel. *Cage*—Heat-treated stainless steel. *Diaphragm*—Fabric-reinforced nitrile rubber. *Diaphragm Support and Cage Retainer*—Hard-anodized aluminum. *O-Ring Seals*—Nitrile rubber. *Other major parts*—Steel and stainless steel. *Type 161 Pilot*—Body, spring case and closing cap in stainless steel or aluminum. Valve plug assembly combines nitrile rubber and stainless steel. Diaphragm is neoprene rubber. Other major components in steel and stainless steel.

Bulletin Reference: 71.2:399-161



Type 399

1098-EGR Pressure Reducing Regulator

The Type 1098-EGR regulator is pilot-operated and is used to provide sensitivity, accuracy, and high capacity on gas and some liquid applications.

Depending on pilot construction and spring range, this regulator may be used for either intermediate or low pressure distribution service. It consists of a Type 1098 diaphragm actuator and spring-to-close Design EGR main valve with quick-change trim.

Normal Service: Gaseous fluids or liquids compatible with construction materials

Main Valve Body Sizes and End Connection Styles: 1 and 2 in. NPT screwed or socket weld. 1 through 6 in. buttwelding. 2 through 6 in. Classes 125B, 150, 250B, 300, and 600 flanged

Maximum Inlet Pressure: Up to 400 psig (28 bar) depending on construction

Outlet Pressure Range: *With Type 6351 Pilot*—3 to 100 psig (0.2 to 6.9 bar) in 3 ranges. *With Type 6352 Pilot*—2 in. wc to 10 psig (0.005 to 0.7 bar) in 2 ranges. *With Type 6353 Pilot*—3 to 125 psig (0.2 to 8.6 bar) in 2 ranges

Outlet Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw in the pilot

Outlet Pressure Registration: External pressure tap for control line

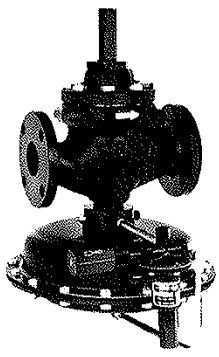
Control Line Connection: 1/2 in. NPT female

Typical Construction Materials: *Main Valve*—Body is cast iron or steel. Cage is cast iron or stainless steel. Other Major Metal Internal Parts are steel and stainless steel. Diaphragm, O-Rings, and Soft Seating Parts are nitrile or fluoroelastomer. Piston Ring is TFE. *Actuator*—Bonnet and Casings are steel. Major Metal Internal Parts are cast iron and stainless steel. Diaphragms and O-Rings are nitrile or fluoroelastomer. *Type 6351 Pilot*—Body and Spring Case are aluminum. Major Metal Internal Parts are aluminum or stainless steel. Diaphragm and Valve Plug seat are nitrile or fluoroelastomer. *Type 6352 or 6353 Pilot*—Body and Spring Case are aluminum, brass, steel, or stainless steel. Major Metal Internal Parts are steel, stainless steel, or aluminum. Diaphragm is natural rubber (Type 6352) or nitrile (Type 6353). Valve Plug Disc is nitrile or fluoroelastomer

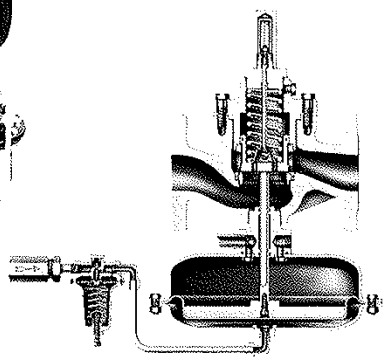
Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard elastomers, 0 to + 180°F (− 18 to + 82°C) with high-temperature elastomers on water service, or 0 to + 300°F (− 18 to + 149°C) with high-temperature elastomers on other fluids

Installation: Normally installed in a horizontal pipeline with the actuator vertical below the main valve, but may be installed in any position

Bulletin Reference: 71.2:1098-EGR



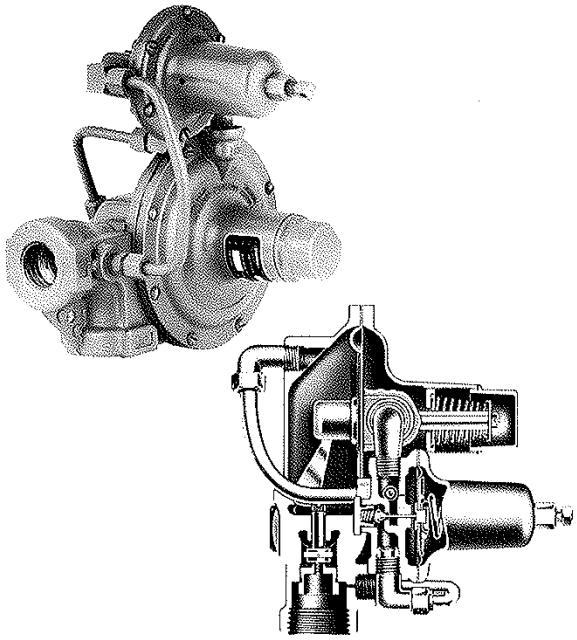
Type 1098-EGR-6352



Type 1098-EGR-6351

S251C Pressure Reducing Regulator

The Type S251C angle-bodied, pilot-operated service regulator is ideal for applications involving pressure-factor measurement (fixed-factor billing).



Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 3/4 x 1 in. (inlet x outlet) or 1 in. NPT screwed

Maximum Inlet Pressure: Up to 125 psig (8.6 bar) depending upon regulator construction

Outlet Pressure Range: 2 to 20 psig (0.1 to 1.4 bar) in 1 range

Outlet Pressure Adjustment: May be adjusted by turning the adjusting screw in the pilot

Outlet Pressure Registration: Internal through main regulator body

Construction Materials: *Main Valve*—Body and Diaphragm Cases are aluminum. Major Metal Internal parts are steel, plated steel, zinc, or aluminum. Diaphragm is nitrile-coated fabric. Valve Disc is nitrile. *Pilot*—Body and spring case are aluminum. Major Metal Internal parts are brass, aluminum, or stainless steel. Diaphragm is nitrile-coated fabric. Valve Plug Seat is nitrile

Normal Operating Temperature: − 20 to + 170°F (− 29 to + 77°C) with standard materials

Installation: Normally installed with pilot above the body

Bulletin Reference: 71.2:S251C

S301F Pressure Reducing Regulator

The Type S30F is an accurate, pilot-operated service regulator, ideal for applications involving pressure-factor measurement (fixed-factor billing).

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 3/4 x 1 in. (inlet x outlet), 1-1/4, 1-1/2, or 2 in. NPT screwed or 2 in. Class 125 flanged

Maximum Inlet Pressure: Up to 125 psig (8.6 bar) depending upon regulator construction

Outlet Pressure Range: 2 to 20 psig (0.1 to 1.4 bar) in 1 range

Outlet Pressure Adjustment: May be adjusted by turning the adjusting screw in the pilot

Outlet Pressure Registration: External pressure tap for control line

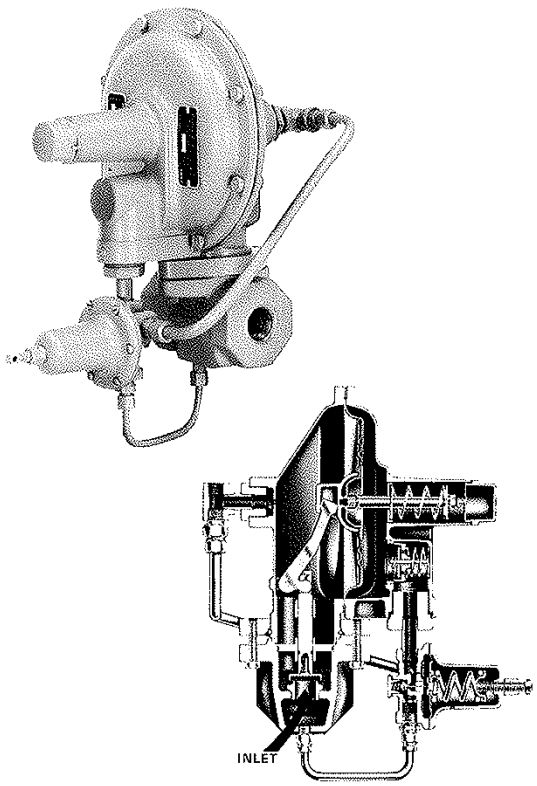
Control Line Connection: 1/4 in. NPT female

Construction Materials: *Main Valve*—Body is cast iron. Diaphragm Cases are aluminum. Major Metal Internal parts are steel, plated steel, or aluminum. Diaphragm is nitrile-coated fabric. Valve Disc is nitrile. *Pilot*—Body and spring case are aluminum. Major Metal Internal parts are brass, aluminum, or stainless steel. Diaphragm is nitrile-coated fabric. Valve Plug Seat is nitrile

Normal Operating Temperature: − 20 to + 170°F (− 29 to + 77°C)

Installation: Normally installed with spring case and diaphragm cases vertical above the body so that pilot spring case vent opening is facing downward

Bulletin Reference: 71.2:S301F



616-E Series Regulators

The Type 616 actuator, in combination with various valve bodies, provides sensitive control for either pressure reducing or pressure relief applications. See the table below for typical actuator/valve body combinations.

The Type 616 actuator is a compact, pressure-actuated, spring-and-diaphragm actuator.

The valve bodies are normally used to construct these regulators are members of the versatile **easy-e®** family of industrial control valves. The complete product descriptions for

the valve bodies listed in the table are in the "Control Valves" section of the catalog. Use the Type Number Index for a convenient reference to them.

Normal Service: Liquids and gaseous fluids

Pressure Range: See table below

Pressure Adjustment: May be adjusted through each spring range by turning the adjusting screw

Pressure Registration: External pressure tap for control line

Control Line Connection: 1/2 in. NPT female

Maximum Diaphragm Pressure: Up to 200 psig (13.8 bar) depending on casing size

Typical Construction Materials: *Diaphragm Casings*—Cast iron or steel. *Bonnet*—Cast iron or steel. *Actuator Stem*—Steel. *Diaphragm*—Neoprene

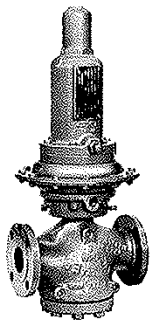
Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position

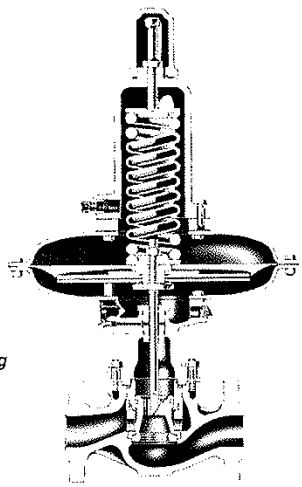
Bulletin Reference: 71.3:616

ACTUATOR TYPE NUMBER	PRESSURE RANGE[1]		VALVE BODY DESIGN	VALVE BODY SIZE (IN.)
	Psig	Bar		
	Pressure Reducing			
616	0.1 to 150	0.007 to 10.3	EDR EKR ETR	1-4
	Pressure Relief			
	0.06 to 130	0.004 to 9.0	ED EK ET	1-6

1. Many different spring ranges are available. Actual range depends on diaphragm casing size.



Type 616 on Reverse-Acting ***easy-e***® *Valve Body*



Type 616-EK

655-E Series & 655-GS Regulators

The 655 Series actuators, in combination with various valve bodies, provide control for a wide variety of pressure regulation applications. See the table below for typical actuator/valve body combinations.

The Types 655 and 655R are pressure-actuated spring-and-diaphragm actuators. The Type 655 is used for pressure reducing service on push-down-to-close valves, and the Type 655R is primarily used for pressure relief service on push-down-to-open valves. Both types are direct-operated.

The valve bodies normally used to construct these regulators are members of the versatile **easy-e**® family of industrial control valves.

The Design GS valve is a very economical, general purpose control valve.

The complete product descriptions for the valve bodies listed in the table are in the "Control Valves" section of the catalog. Use the Type Number Index for a convenient reference to them.

Normal Service: Liquids, steam, and gaseous fluids

Pressure Range: See table below

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: External pressure tap for control line

Control Line Connection: 1/2 in. NPT female

Maximum Diaphragm Casing Pressure: Up to 250 psig (17.2 bar), depending on casing size

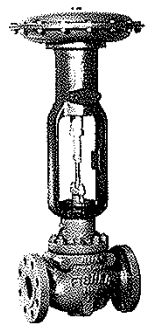
Typical Construction Material: *Diaphragm Casings*—Cast iron or pressed steel. *Yoke*—Cast iron. *Actuator Stem*—Steel. *Diaphragm*—Neoprene

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

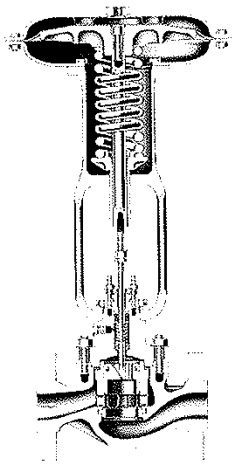
Installation: May be installed in any position. For steam service, the control line should be installed so condensate drains back into the diaphragm casing, maintaining a water seal on the diaphragm

Bulletin Reference: 71.3:655

ACTUATOR TYPE NUMBER	PRESSURE RANGE		VALVE BODY DESIGN	VALVE BODY SIZE (IN.)
	Psig	Bar		
	Pressure Reducing			
655	0.34 to 174	0.02 to 12.0	ED EK ET	1-4
			GS	1/2-2
	Pressure Relief			
655R	0.7 to 146	0.05 to 10.1	EDR EKR ETR	1-4



Type 655 on Direct-Acting ***easy-e***® *Valve Body*



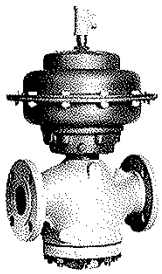
Type 655-ED

796-E Series Pressure-Balanced Regulators

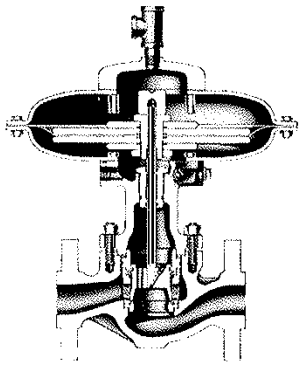
The Type 796-E Series pressure-balanced regulators maintain two pressure systems at equal pressures. The Types 796 and 796R actuators are combined with various valve bodies to construct the pressure-balanced regulators.

The Types 796 and 796R are springless actuators. Outlet or downstream pressure registers on one side of the actuator diaphragm and loading pressure registers on the other side.

The valve bodies normally used to construct these regulators are members of the versatile **easy-e®** family of industrial control valves. The complete product descriptions of the valve bodies listed in the table are in the "Control Valves" section of the catalog. Use the Type Number Index for a convenient reference to them.



*Type 796R on Reverse-Acting **easy-e®** Valve Body*



Type 796-EK

Normal Service: Liquids and gaseous fluids

Typical Configurations:

ACTUATOR TYPE NUMBER	VALVE BODY DESIGN	VALVE BODY SIZE (IN.)
796	ED, EK	1 - 6
796R	EDR, EKR	1 - 4

Pressure Registration: External pressure taps for control lines

Control Line Connection: 1/2 in. NPT screwed

Maximum Diaphragm Differential Pressure: Up to 175 psig (12.1 bar), depending on regulator construction

Maximum Diaphragm Casing Pressure: Up to 175 psig (12.1 bar), depending on regulator construction

Construction Materials: *Diaphragm Casings*—Cast iron, steel or zinc-plated steel. *Distance Piece*—Cast iron or steel. *Diaphragm*—Nylon fabric covered with neoprene. *O-Rings*—Nitrile

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position for which the regulator was sized

Bulletin Reference: 71.5:796

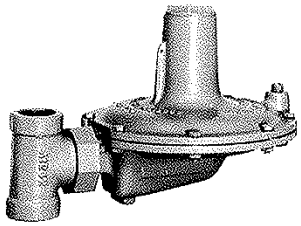
Y600, Y610, Y611 & Y612 Series Equipment

The Y600, Y610, Y611, and Y612 Series are all direct-operated devices.

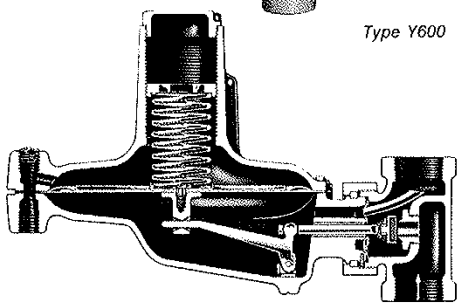
The Y600 Series are used as pressure reducing regulators to maintain a constant reduced downstream pressure. These regulators are available with different vent configurations, low pressure safety shutoff, and/or internal relief. A special monitoring pilot configuration also is available.

The Y610 and Y611 Series are used as vacuum breakers to prevent a vacuum from exceeding a specified value. The Y611 Series are also used as relief valves.

The Y612 Series are used as vacuum regulators to maintain a constant vacuum in the inlet system to the regulator with a higher vacuum at the outlet.



Type Y600



Type Y600 Pressure Reducing Regulator

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: *Y600 Series*—3/4 through 1-1/4 in. NPT screwed. *Y610, Y611, and Y612 Series*—3/4 through 2 in. NPT screwed and 2 in. Classes 125 and 250 flanged

Maximum Inlet Pressure: *Y600 Series*—150 psig (10.3 bar). For maximum pressures on Y610, Y611, and Y612 Series, consult your Fisher representative

Pressure Range: *Y600 Series*—1 in. wc to 7 psig (2 to 483 mbar) in 10 ranges. *Y610 Series*—0 psig to 9.6 in. Hg vac. (0 mbar to 325 mbar vac.) in 11 ranges. *Y611 Series*—2.5 in. wc vac. to 14.25 in Hg vac. (6 mbar to 483 mbar vac.) in 17 ranges when used as vacuum breaker; 2.5 in. wc to 7 psig (6 to 483 mbar) in 17 ranges when used as a relief valve. *Y612 Series*—0 psig to 26 in. Hg vac. (0 bar to 0.9 bar vac.) in 11 ranges

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

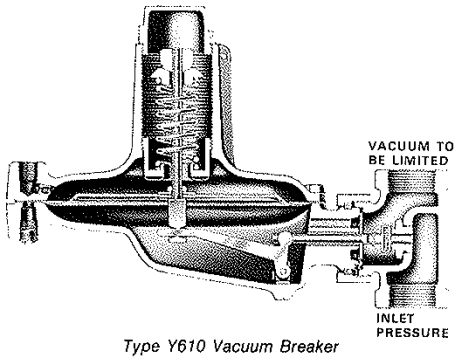
Pressure Registration: Either internal pressure tap or external pressure tap for control line, depending on configuration

Typical Construction Materials: *Y600 Series*—Body, Spring Case and Lower Casing are cast iron or steel. Major Metal Internal Parts are steel and either brass or stainless steel. Diaphragm and Valve Disc are nitrile. *Y610, Y611 and Y612 Series*—Body is cast iron or steel. Spring Case and Lower Casing are cast iron or aluminum. Major Metal Internal Parts are steel, aluminum and either brass or stainless steel. Diaphragm is nitrile. Valve Disc is nitrile or neoprene

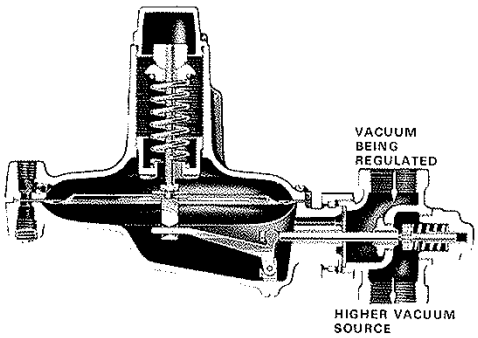
Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: Normally installed in a horizontal pipe with the spring case vertical above the lower casing. If installed in any other position, the weight of the parts will affect the spring setting

Bulletin Reference: 71.1:Y600 or 71.3:Y610



Type Y610 Vacuum Breaker



Type Y612 Vacuum Regulator

63EG Pressure Relief Valve

The Type 63EG pilot-operated pressure relief valve provides intermediate-pressure, large-capacity capability for both liquids and gases. It consists of a spring-to-close Type 63EG main valve with quick-change trim.

Normal Service: Liquids and gaseous fluids

Body Sizes and End Connection Styles: 2 in. NPT screwed. 2 through 6 in. Classes 125B, 150, 250B, 300, and 600 flanged

Maximum Relief (Inlet) Pressure: Depending upon pilot used, either 150 psig (10.3 bar) or 360 psig (25 bar) including buildup.

Relief Pressure Range: Depending upon pilot used, 2 ranges between 10 to 125 psig (0.7 to 8.6 bar) or 2 ranges between 85 to 300 psig (5.9 to 20.1 bar.)

Relief Pressure Adjustment: May be adjusted throughout each spring range by removing pilot closing cap and turning adjusting screw

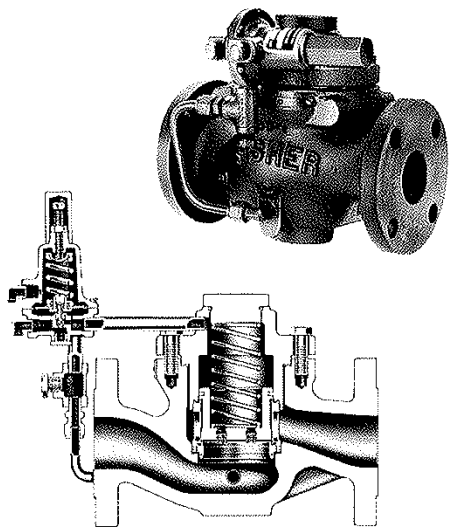
Relief Pressure Registration: Internally in main valve body

Typical Construction Materials: *Main Valve*—Body and body flange are cast iron or steel. Cage is cast iron or stainless steel. Other Major Metal Parts are steel and stainless steel. Piston Ring is TFE. O-Rings are nitrile or fluoroelastomer. *Pilot*—Body and Spring Case are aluminum, brass, steel, or stainless steel. Major Metal Internal Parts are steel and stainless steel. Diaphragm is neoprene. Valve Plug is nitrile

Normal Operating Temperature: − 20 to + 350°F (− 29 to + 177°C) depending on application and construction

Installation: May be installed in any position, but must be oriented so discharge from main valve outlet and pilot exhaust do not create a hazardous condition

Bulletin Reference: 71.4:63EG

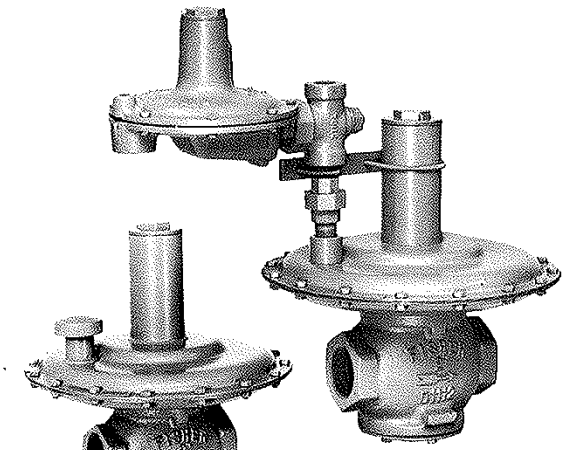


66R & 66RR Pressure Relief Valves

Type 66R and 66RR low pressure relief valves are used to help protect piping, tanks, and other equipment against excessive pressures, or to maintain an inlet or back pressure. The Type 66R is direct-operated while the Type 66RR is pilot-operated.

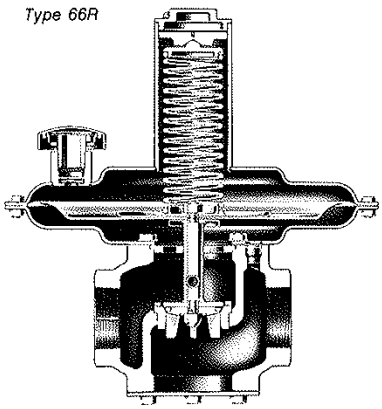
The Type 66R may be constructed with a balancing diaphragm to isolate the main diaphragm from pipeline pressure. In this construction, an upstream external control line is used.

The Type 66RR combines a Type Y611-5 pilot and a Type 66R main valve. This pilot-operated relief valve improves the control characteristics of the direct-operated Type 66R.



Type 66RR

Type 66R



Type 66R

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 2 in. NPT screwed. 2, 3, and 4 in. Classes 125 and 150 flanged. 2 in. Class 300 flanged

Maximum Relief (Inlet) Pressure: *Type 66R*—8 psig (0.6 bar) including buildup. *Type 66RR*—10 psig (0.7 bar) including buildup

Relief Pressure Range: *Type 66R*—2 in. wc to 5 psig (5 to 340 mbar) in 7 ranges for 2 and 3 in. sizes. 2 in. wc to 3 psig (5 to 207 mbar) in 6 ranges for 4 in. size. *Type 66RR*—3 in. wc to 7 psig (7 to 480 mbar) in 8 ranges

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw in the spring case of the Type 66R and the adjusting screw in the pilot of the Type 66RR

Relief Pressure Registration: *Type 66R*—Either internal or with external pressure tap for control line. *Type 66RR*—External pressure tap for control line to pilot

Control Line Connection: *Type 66R*—Where used, this connection is 3/4 in. NPT female. *Type 66RR*—1/2 in. NPT female connection to pilot casings and 3/4 in. NPT female connection to pilot body

Typical Construction Materials: *Complete Type 66R Relief Valve, and Type 66RR Main Valve*—Body is cast iron or steel. Diaphragm casings are steel. Major Metal Internal Parts are steel and either brass or stainless steel. Diaphragm and O-Ring are nitrile or fluoroelastomer. *Type 66RR Pilot*—Body is cast iron or steel. Spring Case and Lower Casing are cast iron. Major Metal Internal Parts are steel and either brass or stainless steel. Diaphragm and Valve Disc are nitrile or fluoroelastomer

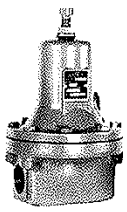
Normal Operating Temperatures: −20 to +350°F (−29 to +177°C) depending on construction

Installation: Normally installed in a horizontal pipe with the spring case vertical above the body. Gas discharge from relief valve outlet must not create a hazardous condition

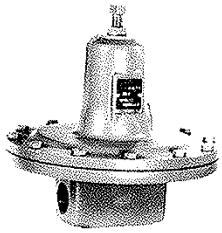
Bulletin Reference: 71.4:66

98 Series Pressure Relief Valves

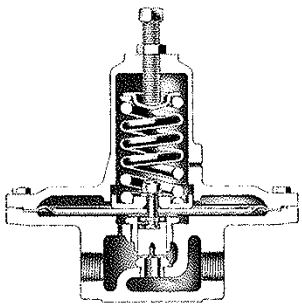
The Types 98L, 98H, and 98HH are versatile direct-operated pressure relief valves used in applications such as test fixtures, wash tanks, fuel and oil lines, and air supply systems. The main difference between the three types is in the relief pressure ranges.



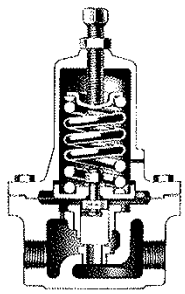
Type 98H



Type 98L



Type 98L with Composition Diaphragm and Seat



Type 98H with Metal Diaphragm and Seat

Normal Service: Liquids, steam, and gaseous fluids

Body Sizes and End Connection Styles: *Type 98L*—1/4 through 1 in. *Type 98H*—1/4 through 2 in. *Type 98HH*—1/4 through 1 in. All types have NPT screwed connections

Maximum Relief (Inlet) Pressure: *Type 98L*—Up to 125 psig (8.6 bar) *Type 98H*—Up to 300 psig (20.7 bar). *Type 98HH*—Up to 400 psig (27.6 bar). Maximum relief pressures listed include buildup and depend on relief valve construction

Relief Pressure Range: *Type 98L*—2 to 38 psig (0.1 to 2.6 bar) in 4 ranges. *Type 98H*—5 to 200 psig (0.3 to 13.8 bar) in 8 ranges. *Type 98HH*—150 to 375 psig (10.3 to 25.9 bar) in 1 range

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

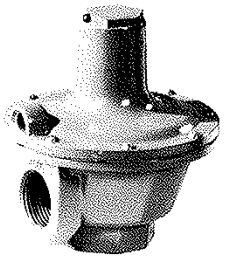
Relief Pressure Registration: Internal

Typical Construction Materials: *Body and Spring Case*—Cast iron, steel or stainless steel. *Major Metal Internal Parts*—Stainless steel. *Diaphragm*—Neoprene, Viton*, or stainless steel. When composition valve plug is used, O-ring seat is nitrile or Viton

Maximum Temperature: Up to 450°F (232°C) depending on application and construction materials

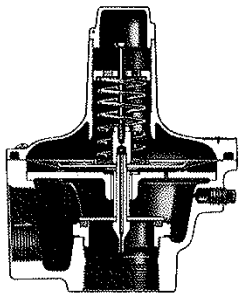
Installation: May be installed in any position, but must be oriented so discharge from relief valve outlet does not create a hazardous condition

Bulletin Reference: 71.4:98



Type 289L

Type 289U



Type 289H

289 Series Pressure Relief Valves

The 289 Series direct-operated, low-pressure relief valves are typically used to limit pressure downstream of pressure reducing regulators

Normal Service: Gaseous fluids

Available Configurations: See table below

Body Sizes and End Connection Styles: See table below

Maximum Relief (Inlet) Pressure: See table below

Relief Pressure Range: See table below

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Relief Pressure Registration: Internal

Typical Construction Materials: *Body*—Zinc, aluminum or cast iron, depending on regulator size and type number. *Spring Case*—Zinc or aluminum, depending on regulator size and type number. *Major Metal Internal Parts*—Aluminum, zinc, steel and stainless steel. *Diaphragm*—Nitrile or neoprene

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position, but must be oriented so discharge from relief valve outlet does not create a hazardous condition

Bulletin Reference: 71.4:289

TYPE NUMBER	BODY SIZE (IN.[1])	RELIEF PRESSURE RANGE		MAXIMUM RELIEF (INLET) PRESSURE[2]	
				Psig	Bar
289A	1/4	3 to 22 psig (2 ranges)	0.2 to 1.5 bar (2 ranges)	45	3.1
289U	1/4	5 in. wc to 3 psig (2 ranges)	12 to 207 mbar (2 ranges)	10	0.7
289L	3/4 or 1	10 to 36 in. wc (2 ranges)	25 to 90 mbar (2 ranges)	7	0.5
289H	1	1 to 50 psig (4 ranges)	0.07 to 38 bar (4 ranges)	65	4.5
289H	2	7 in. wc to 10 psig (4 ranges)	0.02 to 0.7 bar (4 ranges)	25	1.7
289HH	1	45 to 75 psig (1 range)	3.1 to 5.2 bar (1 range)	100	6.9

1. End connections are all NPT screwed.
2. Includes buildup.

*Trademark of DuPont Co.

289P-167AR Pressure Relief Valve

The Type 289P-167AR pilot-operated pressure relief valve is used to provide protection from overpressuring a system. It consists of a Type 167AR pilot mounted on a Type 289P main valve.

Normal Service: Gaseous fluids

Body Size and End Connection Style: 1 in. NPT screwed

Maximum Relief (Inlet) Pressure: 110 psig (7.6 bar), including buildup

Relief Pressure Range: 10 to 100 psig (0.7 to 6.9 bar) in 3 ranges

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the pilot adjusting screw

Relief Pressure Registration: External pressure tap in pilot for control line

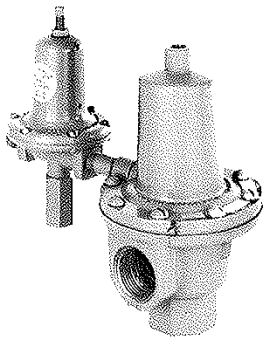
Control Line Connection: 1/4 in. NPT female

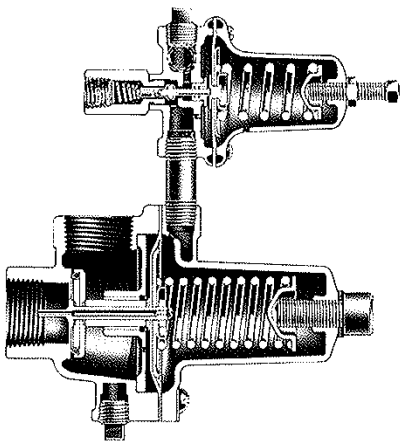
Typical Construction Materials: *Main Valve*—Body and Spring Case are aluminum. Major Metal Internal Parts are zinc, aluminum, steel and stainless steel. Diaphragm is nitrile. Gaskets are composition, neoprene, and copper. *Pilot*—Body and Spring Case are aluminum. Major Metal Internal Parts are aluminum and steel. Diaphragm and Valve Plug are nitrile

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position, but must be oriented so that gas discharge from relief valve outlet and pilot vent does not create a hazardous condition

Bulletin Reference: 71.4:289P-167AR





289P-6355 Pressure Relief Valve

The Type 289P-6365 pilot-operated relief valve is suitable for natural gas, air, propane, water, light oils, and other operating media compatible with the internal parts. A high gain version of the Type 6355 pilot is used for gas service, while a low gain pilot version is used for liquid service. Pilot operation results in very little buildup before the main valve opens wide for maximum relief capacity.

Normal Service: Clean gas and liquids

Body Size and End Connection Style: 2 in. NPT screwed

Maximum Relief (Inlet) Pressure: 15 psig (1.03 bar)

Relief Pressure Ranges: 0.25 to 2 psig (17 to 138 mbar), 1 to 10 psig (0.07 to 0.69 bar)

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the pilot adjusting screw

Relief Pressure Registration: External pressure tap in pilot for control line

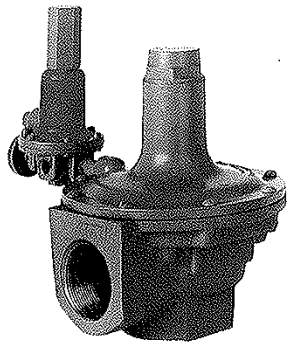
Control Line Connection: 1/4 in. NPT female

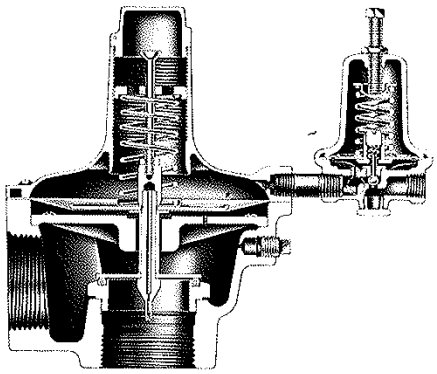
Typical Construction Materials: *Main Valve*—Body is cast iron with an aluminum spring case. Metal internal parts are zinc, aluminum, plated steel and stainless steel. Diaphragm is nitrile. Gaskets are composition material. *Pilot*—Body and spring case are aluminum. Metal internal parts are steel and stainless steel. Valve plug and diaphragm are nitrile.

Normal Operating Temperature: − 20 to 180°F (− 29 to 82°C)

Installation: May be installed in any position, but remote vent piping is required if discharge from the main valve outlet and pilot vents could create a hazardous condition.

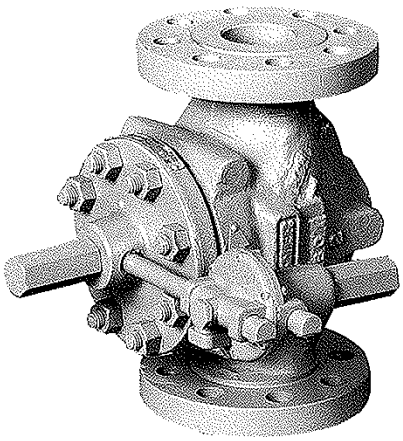
Bulletin Reference: 71.4:289P-6355





399 EASY JOE™ Relief Valve

The Type 399 EASY JOE relief valve features top-entry trim for fast and easy in-line maintenance. Offers high capacity design. Type 6365 pilot is utilized for pressure relief applications, with the Type 6358 pilot being used for backpressure control.



Normal Service: Air or gas compatible with construction materials

Main Valve Body Sizes and End Connection Styles: 2 in. NPT screwed, buttweld or socket weld; 2, 3, 4 and 6 in. Class 125B, 250B, 150, 300 and 600 flanged

Maximum Relief Pressure: Up to 360 psig (25.2 bar) depending upon size and construction

Relief Set Pressure Ranges: *With Type 6358 Pilot*—20 to 125 psig (1.4 to 8.6 bar). *With Type 6365 Pilot*—20 to 300 psig (1.4 to 21 bar) in 5 ranges

Relief Set Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw in the pilot

Pressure Registration: External through downstream control line

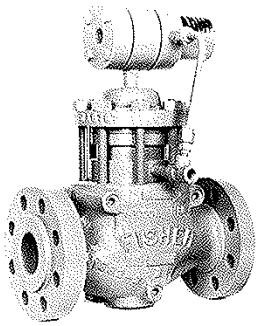
Pilot Supply and Downstream Control Line Connections: 1/4 in. NPT female

Typical Construction Materials: *Main Valve Body and Bonnet*—Cast iron or steel. *Cage*—Heat-treated stainless steel. *Diaphragm*—Fabric-reinforced nitrile rubber. *Diaphragm Support and Cage Retainer*—Hard-anodized aluminum. *O-Ring Seals*—Nitrile rubber. *Other major parts*—Steel and stainless steel. *Type 6365 or 6358 Pilot*—Body, spring case and closing cap in stainless steel or aluminum. Valve plug assembly combines nitrile rubber and stainless steel. Diaphragm is neoprene rubber. Other major components in steel and stainless steel.

Bulletin Reference: 71.4:399-6365/6358

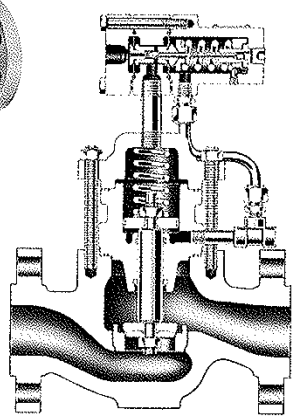
414-6305 Pressure Relief Valve

The Type 414-6305 pilot-operated pressure relief valve provides high-pressure, large-capacity capability for both liquids and gases. This relief valve is suitable in applications where back pressures on the valve outlet will be essentially atmospheric. For liquid or gas service where there will be higher than atmospheric back pressure on the valve outlet, a Type 414-6305B pilot-operated pressure relief valve should be used.



Type 414-6305

Type 6305B



Type 414-6305

Normal Service: Liquids and gaseous fluids

Body Sizes and End Connection Styles: 1, 2, 3, and 4 in. standard with Class 150, 300, or 600 flanges. 6 in. standard with Class 300 or 600 flanges. Other body ratings and flanges available. Drain plug and seat ring puller available for all sizes.

Maximum Relief (Inlet) Pressure: Up to 1440 psig (99.3 bar) including buildup, depending upon pilot control spring and main valve body rating and disc material

Relief Pressure Range: 100 to 1200 psig (6.9 to 82.7 bar) in 3 ranges with Type 6305 or 6305B pilot

Relief Pressure Adjustment: May be adjusted throughout each spring range by removing pilot pipe plug and turning adjusting screw

Relief Pressure Registration: Pilot tapped for upstream control line

Control Line Connection: 1/2 in. NPT female

Typical Construction Materials: *Main Valve*—Body, Spring, Flange, and Studs are steel. Other Major Metal Parts are steel or stainless steel. O-Rings are nitrile or Viton*. Stem and Piston Backup Rings are TFE. Wiper Ring is urethane or TFE. Disc is TFE. *Pilot*—Springs are plated steel. Tubing and Fittings are steel or stainless steel. Pilot Ball is polypropylene. O-Rings are nitrile or Viton

Normal Operating Temperature: − 20 to + 350°F (− 29 to + 177°C) depending on construction

Installation: May be installed in any position, but must be oriented so discharge from main valve outlet and pilot exhaust do not create a hazardous condition

Bulletin Reference: 71.4:414-6305

*Trademark of DuPont Co.

630R Pressure Relief Valve

The Type 630R is a direct-operated relief valve typically used at compressor stations and refineries. This relief valve is a modified version of the Type 630 pressure reducing regulator. The Type 630R may also be pressure loaded to provide greater capacity.

Normal Service: Gaseous fluids

Available Configurations: *Low Pressure*—630R-104. *High Pressure*—630R-103

Body Sizes and End Connection Styles: 1 or 2 in. NPT screwed

Maximum Relief (Inlet) Pressure: *Low Pressure*—75 psig (5.2 bar). *High Pressure*—500 psig (34.5 bar). Maximum relief pressures listed include buildup

Relief Pressure Range: *Low Pressure*—3 to 50 psig (0.2 to 3.4 bar) in 5 ranges. *High Pressure*—30 to 250 psig (2.0 to 17.2 bar) in 4 ranges

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

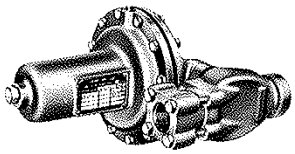
Relief Pressure Registration: Internal

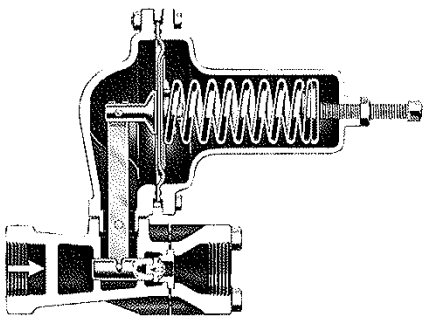
Typical Construction Materials: *Body, Spring Case and Lower Casing*—Cast iron or steel. *Major Metal Internal Parts*—Steel and either brass or stainless steel. *Diaphragm*—Neoprene. *Valve Plug O-Ring*—Nitrile

Normal Operating Temperatures: − 20 to + 150°F (− 29 to + 66°C) with standard metals

Installation: May be installed in any position, but must be oriented so discharge from relief valve outlet does not create a hazardous condition

Bulletin Reference: 71.4:630R





1098-63EGR Pressure Relief Valve

The Type 1098-63EGR pilot-operated pressure relief valve provides low-pressure, large-capacity capability for both liquids and gases. It consists of a Type 1098 diaphragm actuator, spring-to-close Type 63EGR main valve with quick-change trim, and relief pilot.

Normal Service: Liquids and gaseous fluids

Body Sizes and End Connection Styles: 2 in. NPT screwed. 2 through 6 in. Classes 125B, 150, 250B, 300, and 600 flanged

Maximum Relief (Inlet) Pressure: 75 psig (5.2 bar) including buildup

Relief Pressure Range: 3 to 65 psig (0.2 to 4.5 bar) in 2 ranges

Relief Pressure Adjustment: May be adjusted throughout each spring range by removing pilot closing cap and turning adjusting screw

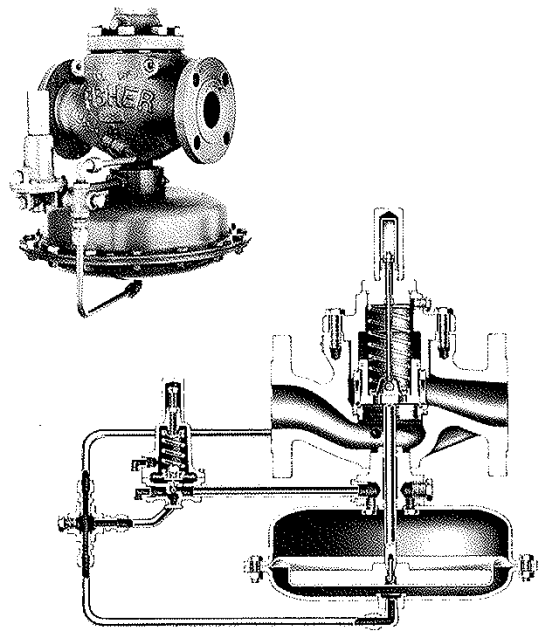
Relief Pressure Registration: Internally in main valve body

Typical Construction Materials: *Main Valve*—Body and body flange are cast iron or steel. Cage is cast iron or stainless steel. Other Major Metal Parts are steel and stainless steel. Piston ring is TFE, and Flange Gasket is composition. O-Rings and Soft Seating Parts are nitrile or fluoroelastomer. *Actuator*—Bonnet and Casings are steel. Major Metal Internal Parts are cast iron and stainless steel. Diaphragm and O-rings are nitrile or fluoroelastomer. Pilot-Body and Spring Case are aluminum, brass, steel, or stainless steel. Major Metal Internal Parts are steel and stainless steel. Diaphragm is neoprene, Valve Plug is nitrile

Normal Operating Temperature: − 20 to + 350°F (− 29 to + 177°C) depending on application and construction

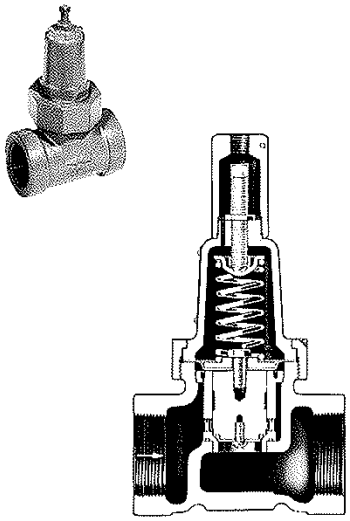
Installation: May be installed in any position, but must be oriented so discharge from main valve outlet and pilot exhaust do not create a hazardous condition

Bulletin Reference: 71.4:63EG



1805 Series Pressure Relief Valves

The 1805 Series are direct-operated relief valves typically used in farm tap applications where a relief valve is needed between the first and second stage pressure reducing regulators. Various configurations of the 1805 Series relief valves are available with adjusting screw caps, and screens for the outlet.



Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 3/4 through 2 in. NPT screwed

Maximum Relief (Inlet) Pressure: 150 psig (10.3 bar) including buildup

Relief Pressure Range: 5 to 125 psig (0.3 to 8.6 bar) in 6 ranges

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Relief Pressure Registration: Internal

Typical Construction Materials: *Body*—Cast iron or malleable iron. *Spring Case*—Cast iron or zinc depending on regulator configuration. *Major Metal Internal Parts*—Aluminum, brass, steel or stainless steel. *Diaphragm*—Nitrile

Normal Operating Temperature: −20 to +150°F (−29 to +66°C) with standard materials

Installation: May be installed in any positon, but must be oriented so gas discharge from relief valve outlet does not create a hazardous condition

Bulletin Reference: 71.4:1805

1805P-167AR Pressure Relief Valve

The Type 1805P-167AR pilot-operated pressure relief valve is used to provide protection from overpressuring a system. It consists of a Type 167AR pilot mounted on a Type 1805P main valve.

Normal Service: Gaseous fluids

Body Size and End Connection Style: 2 in. NPT screwed

Maximum Relief (Inlet) Pressure: 110 psig (7.6 bar) including buildup

Relief Pressure Range: 10 to 100 psig (0.7 to 6.9 bar) in 3 ranges

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the pilot adjusting screw

Relief Pressure Registration: External pressure tap in pilot for control line

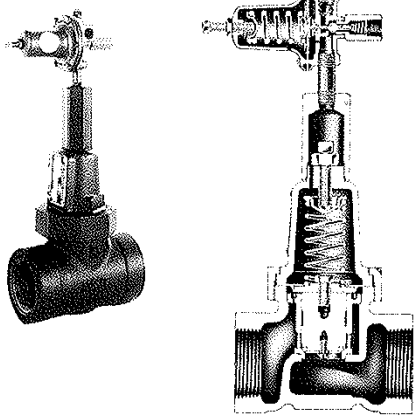
Control Line Connection: 1/4 in. NPT female

Typical Construction Materials: *Main Valve*—Body, Spring Case, and Union Nut are cast and ductile iron. Major Metal Internal Parts are aluminum, brass, steel, and stainless steel. Diaphragm and Sealing O-Rings are nitrile. *Pilot*—Body and Spring Case are aluminum. Major Metal Internal Parts are aluminum and steel. Diaphragm and Valve Plug are nitrile

Normal Operating Temperature: −20 to +150°F (−29 to +66°C) with standard materials

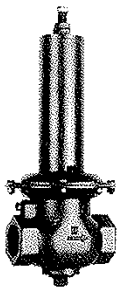
Installation: May be installed in any position, but must be oriented so gas discharge from relief valve outlet does not create a hazardous condition

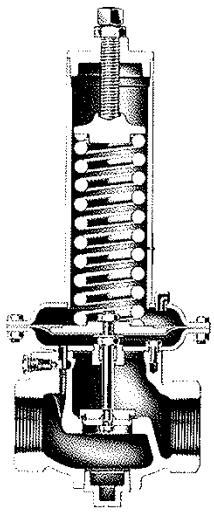
Bulletin Reference: 71.4:1805P-167AR



1807 Pressure Relief Valve

The Type 1807 is a direct-operated relief valve that has a wide range of uses for oil production, gas distribution and municipal water systems.





Normal Service: Liquids and gaseous fluids

Body Sizes and End Connection Styles: 2 in. NPT screwed

Maximum Relief (Inlet) Pressure: 175 psig (12.1 bar)

Relief Pressure Range: 0 to 125 psig (0 to 8.6 bar) in 5 ranges

Relief Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw in the pilot

Relief Pressure Registration: Either internal or external pressure tap for control line

Control Line Connection: Where used, this connection is 1/4 in. NPT female

Construction Materials: *Body*—Cast iron. *Diaphragm Casings*—Steel. *Major Metal Internal Parts*—Cast iron and steel. *Diaphragm*—Neoprene

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be mounted in any position, but must be oriented so discharge from relief valve outlet does not create a hazardous condition

Bulletin Reference: 71.4:1807

1808 Pressure Relief Valve

The Type 1808 main valve uses the Type 6358 pilot for backpressure and pressure relief applications in the oil industry. The unit is small, lightweight, and constructed so that upstream pressure is pre-piped to the pilot, eliminating the need for an upstream control line.

Normal Service: Liquids or gaseous fluids

Body Size and End Connection Style: 2 in. NPT screwed

Maximum Relief (Inlet) Pressure: 150 psig (10.3 bar) including buildup

Relief Set Pressure Range: 5 to 125 psig (0.3 to 8.6 bar) in one range

Relief Pressure Adjustment: May be adjusted by turning adjusting screw in pilot

Relief Pressure Registration: Internal to main valve diaphragm; then external through pilot control line to pilot diaphragm

Typical Construction Materials: *Main Valve*—Body is cast iron or steel. Diaphragm case is steel. Major metal internal parts are steel or stainless steel. Diaphragm is neoprene. O-Rings are nitrile. *Pilot*—Body and spring case are aluminum, steel, or stainless steel. Major metal internal parts are steel or stainless steel. Soft seat parts are polyethylene

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C)

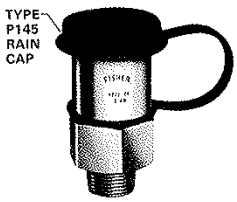
Installation: Normally installed in horizontal pipeline with spring case above the body, but must be positioned so that discharge from main valve outlet and pilot exhaust do not create a hazard

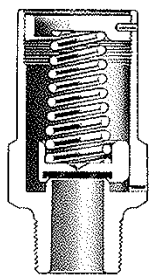
Bulletin Reference: 71.4:1808

Type 1808 with Type 6358 Pilot

H200 Series Pop Relief Valves

The H200 Series are Pop safety relief valves that may be used in any installation where relief to atmosphere is satisfactory.





Normal Service: Gaseous fluids

Available Configurations: Type H202 in 3/4 in. NPT male connection. Type H203 in 1 in. NPT male connection

Maximum Relief (Inlet) Pressure: 400 psig (27.6 bar)

Relief Pressure Range: 25 to 300 psig (1.7 to 20.7 bar) in 9 ranges

Relief Pressure Adjustment: No adjustment can be made. Adjusting screw is pinned to body after specified relief pressure setting is made

Relief Pressure Registration: Internal

Construction Materials: *Body, Retainer and Poppet*—Brass. *Spring*—Stainless steel. *Valve Disc*—Nitrile/Hypalon combination

Normal Operating Temperature: − 20 to + 160°F (− 29 to + 71°C) with standard materials

Installation: May be installed in any position. Normally a Type P145 rain cap is installed to prevent moisture and dirt from entering the relief valve

Bulletin Reference: 71.4:H200

H800 Relief Valve

The Type H800 is a compact, direct-operated relief valve used primarily between a pneumatic instrument and its supply pressure regulator to limit the instrument supply pressure to 50 psig (3.4 bar.)

Normal Service: Air

Available Configuration: 1/4 in. NPT screwed end connections; 1/2 in. NPT screwed vent connection.

Maximum Relief (Inlet) Pressure: 250 psig (17.2 bar)

Relief Pressure Range: Start to discharge between 39 and 44 psig (2.7 and 3.0 bar)

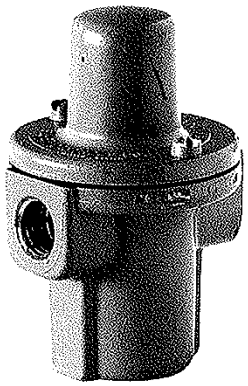
Relief Pressure Adjustment: No adjustment can be made

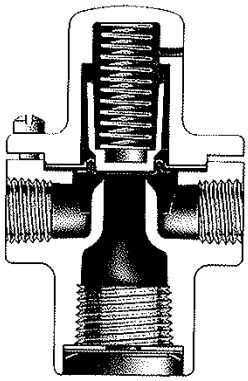
Relief Pressure Registration: Internal

Construction Materials: *Body and Spring Case*—Aluminum. *Diaphragm*—Nitrile. *Disc Restriction and Screen*—Stainless steel.

Normal Operating Temperatures: − 20 to 150°F (− 29 to 66°C)

Bulletin Reference: 71.4:H800





95 Series Differential Pressure Reducing Regulators

The Types 95LD and 95HD regulators are used for pressure reducing service where remote loading is desired. These regulators maintain a differential between the loading pressure and the outlet or downstream pressure. The main difference between these two types is the differential pressure range.

Normal Service: Liquids, steam, and gaseous fluids

Body Sizes and End Connection Styles: *Type 95LD*—1/8 through 1 in. NPT screwed. *Type 95HD*—1/8 through 2 in. NPT screwed

Maximum Inlet Pressure: *Cast Iron Bodies*—250 psig (17.2 bar). *Steel and Stainless Steel Bodies*—300 psig (20.7 bar)

Differential Pressure Range: *Type 95LD*—2 to 30 psig (0.1 to 2.0 bar) in 3 ranges. *Type 95HD*—5 to 150 psig (0.3 to 10.3 bar) in 7 ranges

Differential Pressure Adjustment: May be adjusted throughout each spring range by turning the handwheel

Maximum Diaphragm Differential Pressure: Up to 300 psi (20.7 bar) depending on regulator construction

Maximum Spring Case Pressure: Up to 300 psig (20.7 bar), depending on regulator construction

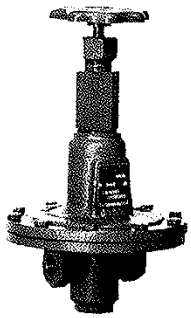
Outlet Pressure Regulation: Internal

Typical Construction Materials: *Body and Spring Case*—Cast iron, steel or stainless steel. *Major Metal Internal Parts*—Brass or stainless steel. *Diaphragm and Valve Plug Seat*—Neoprene or stainless steel

Normal Operating Temperature: *With Neoprene Diaphragm and Valve Plug Seat*— − 20 to + 150°F (− 29 to + 66°C). *With Stainless Steel Diaphragm and Valve Plug Seat*—Cryogenic to + 450°F (232°C) for stainless steel body; − 20 to 450°F (− 29 to + 232°C) for steel body; − 20 to 406°F (− 29 to + 208°C) for cast iron body

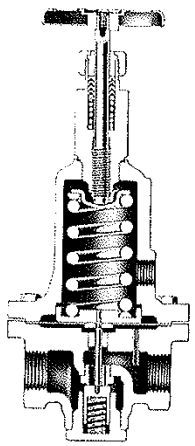
Installation: May be installed in any position

Bulletin Reference: 71.1:95



Type 95LD

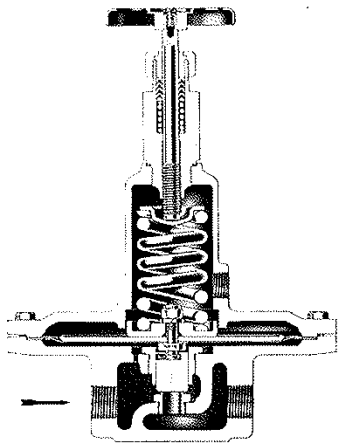
Type 95HD



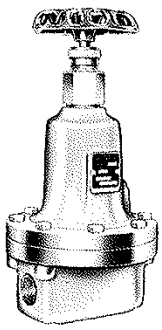
Type 95HD with Metal Diaphragm and Seat

98 Series Differential Pressure Relief Valves

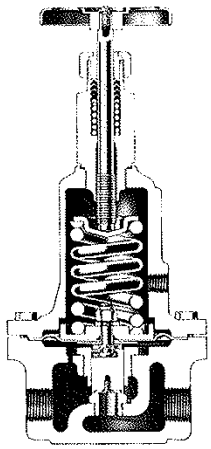
The Types 98LD, 98HD, and 98HHD relief valves are used for pressure relief service where remote loading is desired. These relief valves maintain a differential between the loading pressure and the upstream or inlet pressure. The main difference between the three types is in the differential relief pressure ranges.



Type 98LD with Metal Diaphragm and Seat



Type 98HD



Type 98HD with Composition Diaphragm and Seat

Normal Service: Liquids, steam, and gaseous fluids

Body Sizes and End Connection Styles: *Type 98LD*—1/4 through 1 in. *Type 98HD*—1/4 through 2 in. *Type 98HHD*—1/4 through 1 in. All types have NPT screwed connections

Maximum Relief (Inlet) Pressure: *Type 98LD*—Up to 150 psig (10.3 bar). *Types 98HD and 98HHD*—Up to 400 psig (27.6 bar). Maximum relief pressures listed include buildup and depend on relief valve construction

Differential Relief Pressure Range: *Type 98LD*—2 to 38 psig (0.1 to 2.6 bar) in 4 ranges. *Type 98HD*—5 to 200 psig (0.3 to 13.8 bar) in 8 ranges. *Type 98HHD*—150 to 375 psig (10.3 to 25.9 bar) in 1 range

Differential Pressure Adjustment: May be adjusted throughout each spring range by turning the handwheel

Maximum Diaphragm Differential Pressure and Maximum Spring Case Pressure: *Type 98LD*—Up to 125 psig (8.6 bar) *Type 98HD*—Up to 300 psig (20.7 bar). *Type 98HHD*—Up to 250 psig (17.2 bar). Maximum pressures listed depend on construction materials and temperature

Relief Pressure Registration: Internal

Typical Construction Materials: *Body and Spring Case*—Cast iron, steel, or stainless steel. *Major Metal Internal Parts*—Stainless steel. *Diaphragm*—Neoprene, Viton*, or stainless steel. When composition valve plug is used, O-Ring seat is nitrile or Viton

Maximum Temperature: Up to 450°F (232°C) depending on application and construction materials

Installation: May be installed in any position

Bulletin Reference: 71.4:98

647-E Series for Differential Pressure Reducing or Relief

The 647-E Series are used for either differential pressure reducing or differential pressure relief applications. These units maintain a pressure difference between two locations in the pressure system. The Type 647 actuator is combined with various valve bodies to construct differential pressure reducing regulators or differential pressure relief valves. See the table below for typical actuator/body combinations.

The Type 647 actuator is a compact pressure-actuated spring-and-diaphragm actuator.

The valve bodies normally used to construct these regulators are members of the versatile **easy-e®** family of industrial control valves. The complete product descriptions for the valve bodies listed in the table are in the "Control Valves" section of the catalog. Use the Type Number Index for convenient reference to them.

Normal Service: Liquids and gaseous fluids

Pressure Range: See table below

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: External pressure taps for control lines

Control Line Connections: 1/2 in. NPT female

Maximum Diaphragm Differential Pressure: Up to 200 psi (13.8 bar) depending on regulator construction

Maximum Diaphragm Casing Pressure: Up to 250 psig (17.2 bar) depending on regulator construction

Typical Construction Materials: *Diaphragm Casings*—Cast iron or steel. *Distance Piece*—Cast iron or steel. *Actuator Stem*—Steel. *Diaphragm*—Neoprene

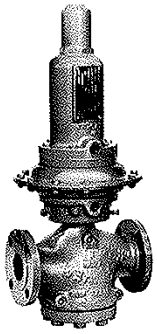
Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position

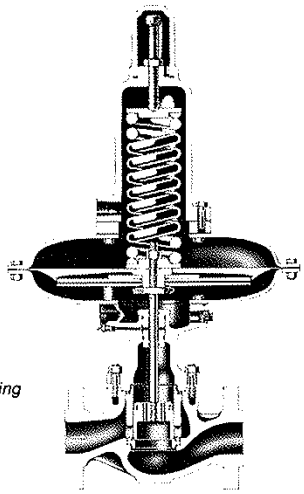
Bulletin Reference: 71.5:647

ACTUATOR TYPE NUMBER	DIFFERENTIAL PRESSURE RANGE[1]		VALVE BODY DESIGN	VALVE BODY SIZE (IN.)
	Psig	Bar		
	Pressure Reducing			
647	0.1 to 150	0.007 to 10.3	EDR EKR	1-4
	Pressure Relief			
	0.06 to 130	0.004 to 9.0	ED EK	1-6

1. Many different spring ranges are available. Actual range depends on diaphragm casing size.



Type 647 on Reverse-Acting easy-e® Valve Body



Type 647-ED

Pressure Registration: External pressure taps for control lines

Control Line Connections: 1/2 in. NPT female

Maximum Diaphragm Differential Pressure: Up to 200 psi (13.8 bar) depending on regulator construction

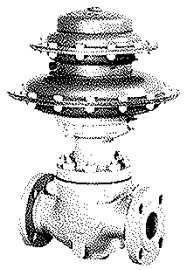
Maximum Diaphragm Casing Pressure: Up to 250 psig (17.2 bar) depending on regulator construction

Construction Materials: *Diaphragm Casings*—Cast iron, steel or zinc-plated steel. *Distance Piece*—Cast iron or steel. *Diaphragms*—Nylon fabric covered with neoprene. *O-Rings*—Nitrile

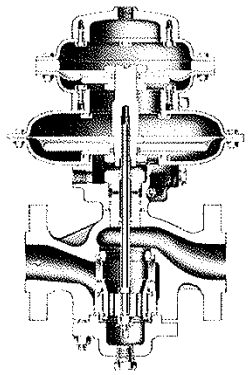
Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position for which the regulator was sized

Bulletin Reference: 71.5:795



Type 795 on Direct-Acting easy-e® Valve Body



Type 795R-EKR

795-E Series Differential Pressure Reducing Regulators

The 795-E Series regulators are used in a variety of applications as differential pressure reducing regulators. These regulators maintain a pressure difference between two locations in the pressure system. The Types 795 and 795R actuators are combined with various valve bodies to construct the differential pressure reducing regulators.

The Types 795 and 795R are springless, double-diaphragm actuators. Different diaphragm sizes may be combined to provide various diaphragm area ratios.

The valve bodies normally used to construct these regulators are members of the versatile **easy-e®** family of industrial control valves. The complete product descriptions for the valve bodies listed in the table below are in the "Control Valves" section of the catalog. Use the Type Number Index for a convenient reference to them.

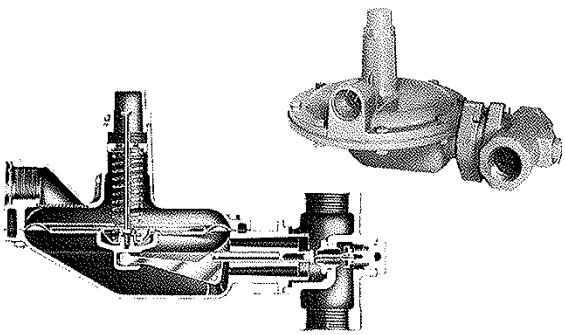
Normal Service: Liquids and gaseous fluids

Typical Configurations:

ACTUATOR TYPE NUMBER	VALVE BODY DESIGN	VALVE BODY SIZE (IN.)
795	ED, EK	1 - 6
795R	EDR, EKR	1 - 4

Y510 Shutoff Regulator

The Type Y510 is used as a safety shutoff regulator in low pressure gas systems similar to those found in many trailer courts. The Type Y510 shuts off the gas supply when the outlet pressure drops below a specified setting. If the downstream connection is broken, the Type Y510 will close, preventing dangerous leakage to atmosphere.



Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 3/4 through 1-1/4 in. NPT screwed. The inlet and outlet connections may be in the different sizes

Spring Case Vent Connection: 3/4 in. NPT female

Maximum Inlet Pressure: 1 psig (69 mbar)

Shutoff Pressure Range: 3 to 5 in. wc (7.5 to 12 mbar)

Pressure Adjustment: May be adjusted throughout the spring range by turning the adjusting screw

Pressure Registration: Internal

Construction Materials: *Body*—Cast iron. *Spring Case and Lower Casing*—Die-cast aluminum. *Major Metal Internal Parts*—Aluminum and steel. *Diaphragm*—Synthetic rubber

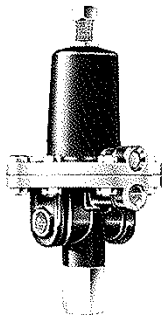
Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: Must be installed so spring case vent is down

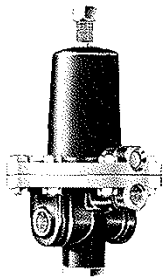
Bulletin Reference: 71.6:Y510

164 and 164A Switching Valves

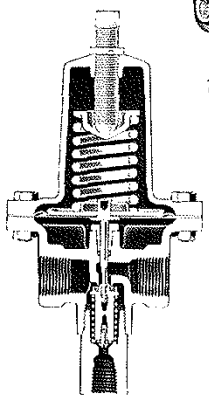
The Types 164 and 164A are compact, rugged switching valves typically used for venting, fail safe and on/off applications. The Type 164 is a two-way valve, and the Type 164A is a three-way valve.



Type 164A



Type 164



Type 164A

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 1/4 or 1/2 in. NPT screwed

Maximum Inlet Pressure: 250 psig (17.2 bar)

Maximum Diaphragm Pressure: 200 psig (13.8 bar)

Pressure Range: *Type 164*—3 to 200 psig (0.2 to 13.8 bar) in 7 ranges. *Type 164A*—3 to 100 psig (0.2 to 6.9 bar) in 5 ranges

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: External pressure tap for control line

Control Line Connection: 1/4 in. NPT female

Typical Construction Materials: *Body*—Aluminum. *Spring Case*—Die-cast aluminum or cast iron. *Major Metal Internal Parts*—Steel and brass. *Diaphragm and Valve Disc*—Nitrile

Normal Operating Temperatures: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position

Bulletin Reference: 71.7:164

167A 3-Way Switching Valve

The Type 167A is a compact three-way switching valve normally installed to provide safety or lockup action.

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 1/4 in. NPT screwed

Maximum Inlet Pressure: 250 psig (17.2 bar)

Maximum Diaphragm Pressure: 100 psig (6.9 bar)

Pressure Range: 5 to 100 psig (0.3 to 6.9 bar) in 3 ranges

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: External pressure tap for control line

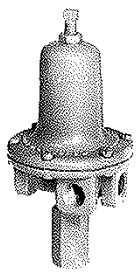
Control Line Connection: 1/4 in. NPT female

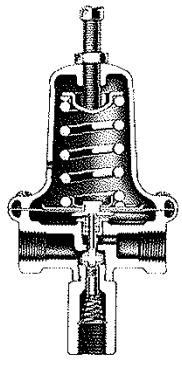
Typical Construction Materials: *Body and Spring Case*—Aluminum. *Major Metal Internal Parts*—Aluminum and steel. *Diaphragm and Valve Disc*—Nitrile

Normal Operating Temperature: − 20 to + 150°F (− 29 to + 66°C) with standard materials

Installation: May be installed in any position. The Type 167A may be panel mounted

Bulletin Reference: 71.7:167A





168, 168H, and 68 Series 3-Way Switching Valves

The 168 and 168H Series three-way snap-acting switching valves are used to open and close pneumatically operated control valves, to load or exhaust pneumatic systems, and to operate a variety of other pneumatic equipment.

The main differences between the 168 and 168H Series are in the diaphragm pressure change between switching points and the maximum allowable diaphragm pressures.

The 68 Series three-way snap-acting body assemblies can be used alone, or to form the valve body portions of the 168 and 168H Series switching valves.

Normal Service: Gaseous fluids

Body Sizes and End Connection Styles: 1/4 in. NPT screwed

Maximum Inlet Pressure: Up to 150 psig (10.3 bar), depending on switching valve and body assembly construction

Maximum Diaphragm Pressure: *168 Series*—100 psig (6.9 bar). *168H Series*—150 psig (10.3 bar)

168 & 168H Series Pressure Adjustment: Switching points may be changed by turning the range adjustment nuts on the stem

168 & 168H Series Pressure Registration: External pressure tap for control line

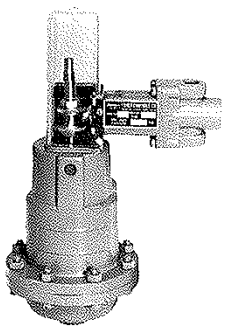
Control Line Connection: 1/4 in. NPT female

Typical Construction Materials: *Body, Diaphragm Case and Lower Spring Case*—Aluminum. *Major Metal Internal Parts*—Steel and stainless steel. *Diaphragm*—Dacron covered with nitrile. *Valve Disc*—Polyurethane

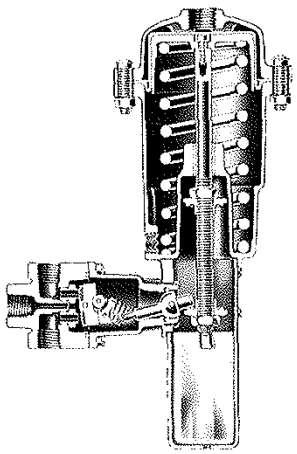
Normal Operating Temperature: − 10 to + 150°F (− 23 to + 66°C) with standard materials

Installation: May be installed in any position

Bulletin Reference: 71.7:168



Type 168-1 or 168-2



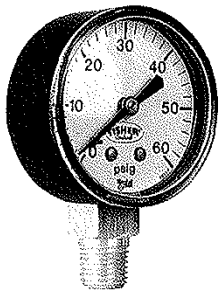
Type 168-1 or 168-2

Type 68-2

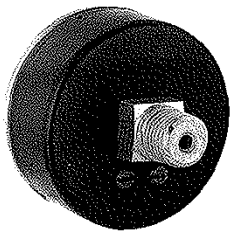
Pressure Gauges

J500 Series gauges have a black steel case with a molded plastic window and are 2 or 2-1/4 inches (51 or 57 mm) in diameter. All gauges have 1/4-inch NPT connections. Bottom-connected gauges are available from 0 to 2000 psig in 11 different calibration ranges while back-connected gauges are available from 0 to 300 psig in 9 different calibration ranges. Other special ranges are available on application.

Bulletin Reference: 71.8:50



J502



J510

111 Needle Valve

The Type 111 needle valve is a small, lightweight manual throttling valve typically used where a small port diameter and large end connections are required, such as for damping in the control line of a gas regulator.

Normal Service: Liquids and gaseous fluids

Body Sizes and End Connection Styles: 1/2 in. NPT screwed

Maximum Inlet Pressure: 400 psig (27.6 bar)

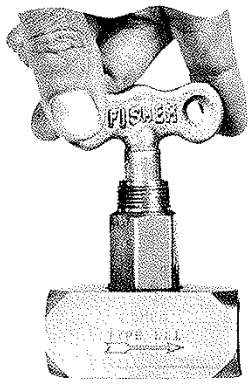
Adjustment: May be adjusted by removing the cap and turning the recessed valve stem with the key

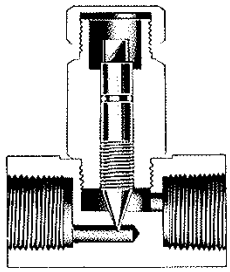
Typical Construction Materials: *Body and Bonnet*—Brass or steel. *Valve Plug*—Brass. *O-Ring*—Nitrile

Normal Operating Temperature: − 20 to + 180°F (− 29 to + 82°C)

Installation: May be installed in any position as long as enough space is available to insert and turn the key

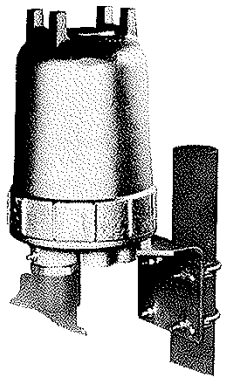
Bulletin Reference: 71.8:111





661 Kixcel Remote Control Pilot Drive Unit

The Type 661 Kixcel drive unit provides an accurate, reliable means of changing the set point (pressure setting) of pilot-operated gas regulators from remote locations. The drive unit and gas regulator pilot are mounted near the main regulator, either on a pipestand or on a vertical surface. When a change in regulator pressure setting is required, an electronic input signal is sent to the Type 661 drive unit. Upon receipt of the input signal, the power supply rotates the motor and adjusting screw. Rotation of the adjusting screw changes the set point of the pilot-operated regulator.



Type 661 Kixcel® Drive Unit Mounted on Spring Case of Typical Pilot

Input Signals: *2-Wire dc Input Signal*—38 to 90 Vdc (into 4500 ohms); polarity of dc input signal determines direction of motor rotation. *3-Wire dc Input Signal*—18 to 40 Vdc (into 700 ohms); input signal is applied to RAISE or LOWER terminal of pilot drive unit to determine direction of motor rotation. *3-Wire ac Input Signal*—90 to 130 Vac, 60 Hz signal is applied to RAISE or LOWER terminal of pilot drive unit to determine direction of motor operation

Power Supply Required: 117 Vac ± 10%, 1 amp maximum, 60 Hz

Operating Influences: *Temperature*—Rate of change in pilot outlet changes less than ± 0.55% per degree F (± 1.0% per degree C) between − 30 and + 140°F (− 34 and + 60°C). *Supply Voltage*—Rate of change in pilot outlet pressure changes less than ± 0.4% per volt between 105 and 130 Vac

Normal Operating Temperature: − 30 to + 140°F (− 34 to + 60°C)

Operating Speeds:

GEAR RATIO	SPEED, RPM
1:2.66	With optional Reduction: 0.229
	Standard: 0.458
1:1.2	1.016
1:2.1	1.464
2.66:1	3.245

Construction Materials: *Base*—Cast iron. *Cover*—Aluminum. *Adjusting Screw*—Stainless steel. *Gears*—Plated steel. *Drive Shear Pin*—Steel. *Mounting Bracket*—Steel

Classification: CSA listed for Class I, Group D Division I Hazardous Location

Mounting: Mounting bracket and pipe clamp available for pipestand mounting; bracket can also be used to mount unit on a vertical surface

Bulletin Reference: 19.2:661 or 71.8:661

1B-E Series Pump Governors

The 1B-E Series pump governors are used to maintain a constant discharge pressure on steam drive turbine or reciprocating pumps and for pressure reducing or pressure relief applications. The Type 1B actuator is combined with various valve bodies to construct the pump governors. See the table below for typical actuator/valve body combinations.

The Type 1B is a pressure-actuated spring-and-piston actuator.

The valve bodies normally used to construct these pump governors are members of the versatile **easy-e®** family of industrial control valves. The complete product descriptions for the valve bodies listed in the table are in the "Control Valve" section of the catalog. Use the Type Number Index for a convenient reference to them.

Normal Service: Liquids, steam, or gaseous fluids

Pressure Range: See table below

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: External pressure tap for control line

Control Line Connection: 1/2 in. NPT female

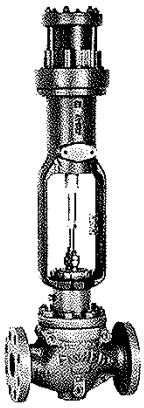
Maximum Cylinder Pressure: 700 psig (48.3 bar)

Construction Materials: *Cylinder*—Brass. *Cylinder Cap*—Cast iron. *Yoke*—Cast iron. *Piston*—Brass. *Piston Rod*—Steel

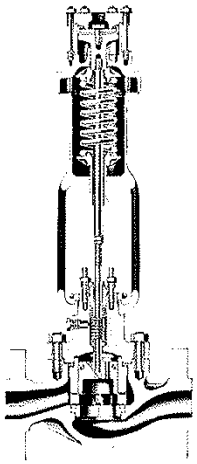
Maximum Operating Temperature: 265°F (129°C)

Installation: May be installed in any position. When used for steam service, install the pump governor so condensate drains back into the cylinder, maintaining a water seal on the piston

Bulletin Reference: 72.1:1B



Type 1B on Direct-Acting easy-e® Valve Body



Type 1B-ED

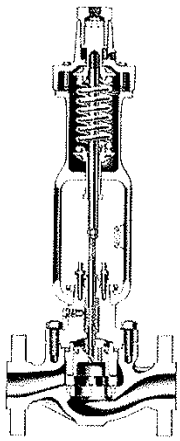
ACTUATOR TYPE NUMBER	PRESSURE RANGE		VALVE BODY DESIGN	VALVE BODY SIZE (IN.)
	Psig	Bar		
1B	**Pressure Reducing or Constant Pressure Pump Governors**			
	95 to 500 (5 ranges)	6.6 to 34.5 (5 ranges)	ED, EK	1-4
	Pressure Relief			
	95 to 500 (5 ranges)	6.6 to 34.5 (5 ranges)	EDR, EKR	1-4

603-E Series Pump Governors

The 603-E Series pump governors are used to maintain a wide range of constant discharge pressures from steam driven pumps and for pressure reducing or pressure relief applications. The Type 603 actuator is combined with various valve bodies to construct the pump governors. See the table below for typical actuator/valve body combinations.

The Type 603 is a pressure-actuated spring-and-piston actuator.

The valve bodies normally used to construct these pump governors are members of the versatile **easy-e®** family of industrial control valves. The complete product descriptions for the valve bodies listed in the table are in the "Control Valves" section of the catalog. Use the Type Number Index for a convenient reference to them.



Type 603-ED

Normal Service: Liquids, steam, or gaseous fluids

Pressure Range: See table below

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: External pressure tap for control line

Control Line Connection: 1/2 in. NPT female

Maximum Cylinder Pressure: Up to 4600 psig (317 bar), depending on the application and cylinder size

Construction Materials: *Cylinder*—Steel. *Yoke and Adaptor*—Cast iron. *Piston*—Brass

Maximum Operating Temperature: 150°F (66°C) with standard materials

Installation: May be installed in any position. When used for steam service, install the pump governor so condensate drains back into the cylinder, maintaining a water seal on the piston

Bulletin Reference: 72.1:603

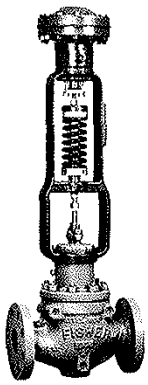
ACTUATOR TYPE NUMBER	PRESSURE RANGE		VALVE BODY DESIGN	VALVE BODY SIZE (IN.)
	Psig	Bar		
603	**Pressure Reducing or Constant Pressure Pump Governors**			
	500 to 4600 (6 ranges)	34.5 to 317 (6 ranges)	ED, EK	1-4
	Pressure Relief			
	500 to 1440 (1 range)	34.5 to 99.3 (1 range)	EDR, EKR	1-4

644-E Series Differential Pressure Pump Governors

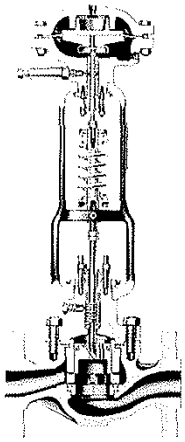
The 644-E Series pump governors maintain a pressure difference between two locations in the pressure system. The Type 644 actuator is normally combined with the Designs ED and EDR valve bodies to form the pump governors.

The Type 644 is a pressure-actuated spring-and-diaphragm actuator.

The complete product descriptions for the Design ED and EDR valve bodies are in the "Control Valves" section of the catalog. Use the Type Number index for a convenient reference to them.



Type 644 on Directing Acting easy-e® Valve Body



Type 644-ED

Normal Service: Liquids, steam, or gaseous fluids

Available Configurations: Type 644-ED in 1 through 4 in. sizes for differential pressure reducing applications. Type 644-EDR in 1 through 4 in. sizes for differential pressure relief applications

Differential Pressure Range: 5 to 100 psig (0.3 to 6.9 bar) in 6 ranges

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: External pressure taps for control lines

Control Line Connections: 1/4 in. NPT female

Maximum Diaphragm Differential Pressure: Up to 100 psi (6.9 bar) depending on pump governor construction

Maximum Diaphragm Casing Pressure: *Cast Iron Casings*—300 psig (20.7 bar). *Steel Casings*—600 psig (41.4 bar)

Construction Materials: *Diaphragm Casings*—Cast iron or steel. *Yoke*—Cast iron. *Diaphragm Heads*—Cast iron or steel. *Diaphragm*—Neoprene or stainless steel

Maximum Operating Temperature: 180°F (82°C) with standard materials

Installation: May be installed in any position except for steam service. When used for steam service, the pump governor should be installed so condensate drains back into the diaphragm casing, maintaining a water seal on the diaphragm.

Bulletin Reference: 72.1:644

645-E Series Differential Pressure Pump Governors

The 645-E Series pump governors maintain a pressure difference between two locations in the pressure system. The Type 645 actuator is normally combined with the Designs ED and EDR valve bodies to form the pump governors.

The Type 645 is a pressure-actuated spring-and-diaphragm actuator.

The complete product descriptions for the Design ED and EDR valve bodies are in the "Control Valves" section of the catalog. Use the Type Number index for a convenient reference to them.

Normal Service: Liquids, steam, or gaseous fluids

Available Configurations: Type 645-ED in 1 through 4 in. sizes for differential pressure reducing applications. Type 645-EDR in 1 through 4 in. sizes for differential pressure relief applications

Differential Pressure Range: 14 to 155 psig (0.9 to 10.7 bar) in 10 ranges

Pressure Adjustment: May be adjusted throughout each spring range by turning the adjusting screw

Pressure Registration: External pressure taps for control lines

Control Line Connections: 1/4 in. NPT female

Maximum Diaphragm Differential Pressure: Up to 155 psi (10.7 bar), depending on pump governor construction

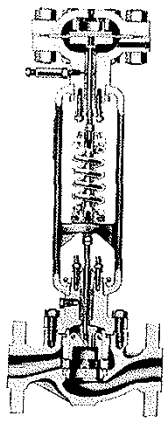
Maximum Diaphragm Casing Pressure: *Cast Iron Casings*—500 psig (34.5 bar). *Steel Casings*—1000 psig (69 bar)

Typical Construction Materials: *Diaphragm Casings*—Cast iron or steel. *Yoke*—Cast iron. *Diaphragm Heads*—Cast iron or steel. *Diaphragm*—Neoprene

Maximum Operating Temperature: 180°F (82°C) with standard materials

Installation: May be installed in any position except for steam service. When used for steam service, the pump governor should be installed so condensate drains back into the diaphragm casing, maintaining a water seal on the diaphragm

Bulletin Reference: 72.1:644



Type 645-ED

171F Level Regulator & 171L Lever Valve

The Types 171F and 171L were designed to control non-corrosive liquid levels in unpressurized containers by regulating the entering flow rate as needed. Typical applications include their use in tanks, reservoirs, and air conditioning and concrete plant towers.

Available Configurations: *Type 171F*—A ball float actuator and valve body assembly used on open containers. rising liquid level raises the lever and closes the valve plug. *Type 171L*—A lever actuator and a valve body assembly used with closed containers. It requires the use of a ball float sensor on the container.

Body Sizes and Maximum Flow Coefficients (C_v): 1/2 in. = 4.51, 3/4 in. = 5.71, 1 in. = 10.1, 1-1/4 in. = 22.8, 1-1/2 in. = 28.2, 2 in. = 43.3

End Connection Styles: NPT screwed

Shutoff Classifications: Leakage less than one bubble per minute

Maximum Inlet Pressure and Pressure Drop: 150 psig (10.3 bar)

Maximum Operating Temperature: 150°F (66°C) with standard materials

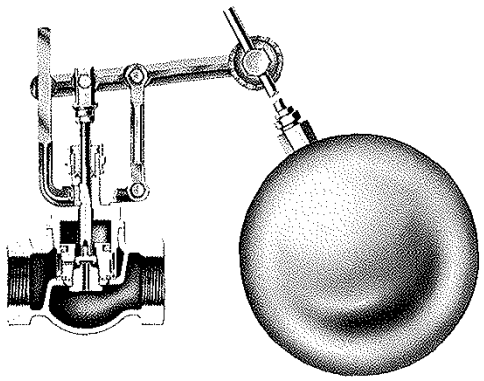
Flow Characteristic: Quick opening

Flow Direction: Down through the seat ring

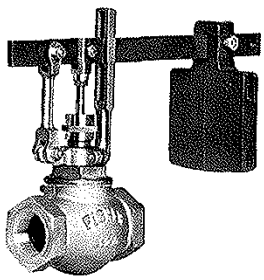
Typical Construction Materials: *Body, Bonnet and Yoke*—Bronze. *Valve Plug Assembly*—Brass and nitrile (standard). *O-Rings*—Nitrile (standard). *Valve Plug Stem*—Stainless steel. *Vertical Link and Lever Connection*—Brass. *Lever*—Type 171F, bronze; Type 171L, steel. *Float Rod (Type 171F Only)*—Steel. *Float (Type 171F Only)*—Copper. *Weight (Type 171L Only)*—Cast iron

Float Diameter (Type 171F Only): 6 in. (152 mm) for 1/2 through 1 in. body sizes, and 8 in. (203 mm) for 1-1/4 through 2 in. body sizes

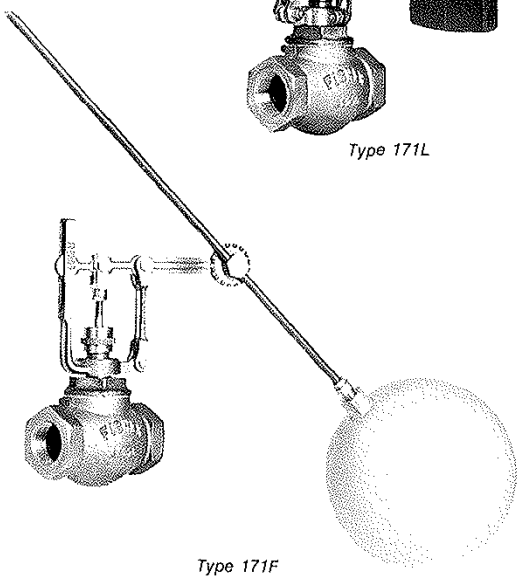
Bulletin Reference: 61.7:171



Typical of Type 171F or 171L



Type 171L



Type 171F

Contents

Introduction

The Occupational Safety and Health Act (OSHA) of 1970 mandates that all companies engaged in interstate commerce limit their employees' noise exposure to 90 decibels for an 8-hour day. Since valves (and regulators) can be substantial noise contributors when controlling industrial processes, Fisher Controls is in an ideal position to help you meet OSHA requirements. Our research and development engineers have studied the major sources of control valve noise, and have not only determined how to predict it, but have also developed the hardware options needed to control it effectively.

Noise Prediction Technique

The first step toward effective noise control is accurate noise prediction. Through an extensive testing program, we have developed a technique to accurately predict the noise levels of control valves handling either liquid flow (hydrodynamic noise) or gas or vapor flow (aerodynamic noise.)

In addition to being accurate, the prediction technique is quick and easy to use. It involves simple additive equations which are documented in the Fisher Sizing and Selection Data Catalog 10. The noise prediction technique is computer-based as well, which allows a quick determination of not only how "noisy" valve control valve will be when installed in a flow system, but also which noise abatement product options can be used to bring the system within legal or required limits.

Noise Control Products

The next step toward effective noise control is the selection of the proper combination of equipment to meet all of your requirements. Fisher Controls has a complete line of product options to effectively provide the necessary degree of noise control for your application—from internal control valve trim to in-line vent silencers.

These products help your Fisher sales office or sales representative utilize two basic approaches to control noise: source treatment and path treatment. Source treatment products (e.g., internal control valve parts such as Cavitrol® and Whisper Trim® cages) are used to reduce or eliminate noise that would otherwise be generated within a control valve. Path treatment products (e.g., acoustical insulation and heavy wall pipe) are used to reduce noise after it has been produced by the control valve.

Selection Guide

The Fisher sales office or sales representative that you rely on for your control valve and regulator needs will assist you in determining whether to use source treatment, path treatment, or both. If it is determined that your combination of flow rate and noise limit requires the use of noise abatement equipment, recommendations on noise control equipment options will be presented. That way, you can select the preferred solution for your particular application.

Although you should rely on your Fisher sales office or sales representative to assist in selecting noise abatement equipment, the following selection table and referenced product descriptions are provided to give you a general idea of the products we manufacture.

Noise Abatement Equipment for	Type of Treatment	Type Number	See Page
Aerodynamic Noise (from gas or vapor flow)	Source Treatment	**Whisper Trim** I Cage **Whisper Trim** III Cage	8-2
		6010 In-Line Diffuser 6011 In-Line Diffuser **Whisper Disc** Diffuser	8-3
	Path Treatment	Acoustical Insulation Heavy-walled Pipe	See Note
Hydrodynamic Noise (from liquid flow)	Source Treatment	**Cavitrol** III Trim **Cavitrol** IV Trim **Cavitrol** V Trim	8-3
	Path Treatment	Acoustical Insulation Heavy-walled pipe	See Note

Note: Contact your Fisher sales office or sales representative for additional information.

Whisper Trim® I & III Cages

The Whisper Trim cage is a unique valve trim that utilizes multiple orifices of a special shape, size and spacing to minimize noise resulting from gas or vapor flow.

Using a Whisper Trim I cage in a properly selected valve body assembly can result in noise reduction up to 18 decibels below the noise level of a valve selected only on the basis of capacity and control requirements. A Whisper Trim III cage as applied above can result in noise reduction up to 30 decibels.

Available Trim Configurations: *Whisper Trim I*—A cage design which utilizes slotted orifices. *Whisper Trim III*—A cage design which utilizes multi-hole orifices, and which is particularly effective for applications involving high pressure drop ratios (the ratio of pressure drop to inlet pressure)

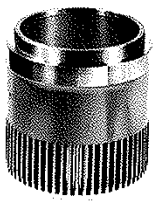
Available Body Styles: *Whisper Trim I*—Cages are available for the design ED, ES, ET and EW—Series valve bodies. *Whisper Trim III*—cages are available for the design ED, ES and ET valve bodies, as well as the EH-Series, EL-Series, EW-Series, and FB-Series valves.

Flow Characteristic: Linear

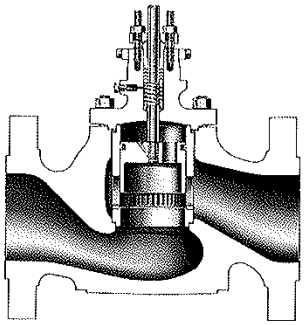
Flow Direction: Up through the bottom of the cage and out through the cage wall orifices

Cage Material: Stainless steel

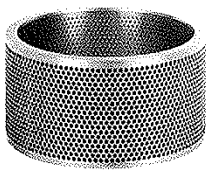
Bulletin References: *Whisper Trim I Cage*—80.1:006. *Whisper Trim III Cage*—80.1:010



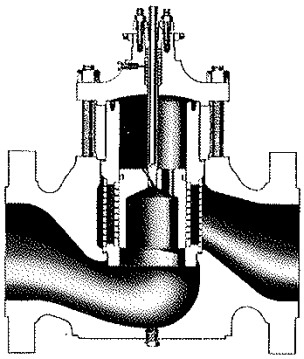
Whisper Trim I with Slotted Orifices



Design EWT Metal-Seat Body with Whisper Trim I Cage



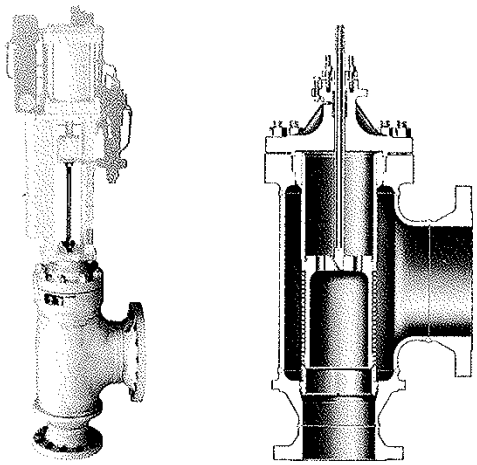
Whisper Trim III Cage



Whisper Trim III Cage in Design EWD Control Valve Body Assembly

FB-Series Angle-Style Control Valves

The FB-Series fabricated angle valves meet the combined application needs of maximum noise attenuation and high capacity. Use of a Whisper Trim III cage in the FB valve helps reduce noise produced by high flow rates and large pressure drops up to 30 dBA below the normal valve noise level. The expanded outlet design of the valve body limits the outlet flow velocity to significantly reduce the regeneration of valve noise. The hanging cage design provides gasket and sealing integrity while allowing unrestricted movement during thermal expansion.



Type 490-FBT Control Valve (Type 490 Actuator on Design FBT Valve Body Assembly)

Available Configurations: *Common Characteristics*—Single-port, angle-style valve body assemblies with bolted-on bonnet, cage-guided balanced valve plug, hanging-style Whisper Trim III cage, and push-down-to-close valve plug action. Design FBD—This configuration features the seat ring welded to the body for temperatures above 450°F (232°C). *Design FBT*— This configuration has a spring-loaded seal ring on the seat ring and on the valve plug. The seat ring is screwed to the cage. For temperatures up to 450°F (232°C)

Body Sizes: 12, 16, 18, 20, 24, 30, and 36 in. outlet; each outlet size is available with several inlet sizes from 8″ through 36″.

End Connection Styles: Classes 150, 300, and 600 raised-face flanges; buttwelding ends

Shutoff Classification: *Design FBD*—ANSI Class II; *Design FBT*—ANSI Class IV

Maximum Inlet Pressures and Pressure Drops: Up to 1480 psig (102 bar) depending on specific construction and temperature requirements

Process Temperature Capabilities: From − 20 to 800°F (− 29 to + 427°C) depending on specific construction and pressure requirements

Maximum Flow Coefficients: From 35 C_g to 309,000 C_g (this is equivalent to a C_v range from 1.1 to 9,650)

Flow Characteristic: Linear

Flow Direction: Up through the valve body seat ring and out through the cage openings

Typical Construction Materials: *Valve Body, Bonnet, and Flanges*—Carbon steel or stainless steel. *Valve Plug and Seat Ring*—Hardened stainless steel or hardened stainless steel with cobalt-base Alloy 6 facing. *Cage and Stem*—Hardened stainless steel. *Packing*—TFE V-ring or graphite laminate/filament

Bulletin Reference: 80.1:FB

6010, 6011 & Whisper Disk In-Line Diffusers

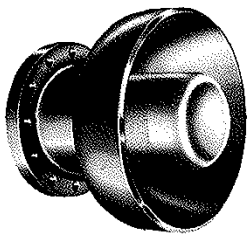
A Type 6010, 6011 or Whisper Disk in-line diffuser is installed downstream of a control valve to serve as pressure reduction device. The diffuser divides the total pressure drop across the valve and itself, enabling the valve to operate at a lower pressure drop to inlet pressure ratio. The result is a greatly reduced noise level (up to a 40 dBA noise reduction) for valves used in steam, gas, or vapor flow applications.

Available Configurations: *Type 6010*—In-line diffuser with integral outlet head. *Type 6011*—In-line diffuser, insert style. *Whisper Disk*—In-line diffuser, flat plate design.

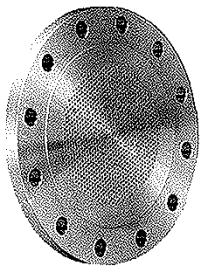
Sizes and End Connections: *Type 6010*—Both ends butt weld or both ends flanged, any combination. Nominal inlet sizes from 1″ through 24″ with minimum outlet head (NPS) sizes from 2″ through 30″. *Type 6011*—No bolted connections; designed to be retained between mating flanges. Flange sizes from 2″ through 24″ *Whisper Disk*—Insert design retained by flange through bolts. Nominal pipe sizes from 2″ through 24″

Diffuser Material: Steel, alloy steel, or stainless steel

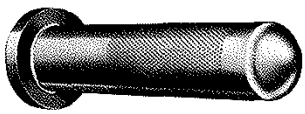
Bulletin Reference: 80.1:6012



Type 6010



Whisper Disk



Type 6011

Cavitrol III, IV, & V Trims

Cavitrol trim is used in liquid flow applications to prevent cavitation damage and reduce noise. Cavitrol III cages are used in a variety of cage-style globe and angle valve body assemblies, depending upon the ratio of pressure drop to inlet pressure. Cavitrol IV trim is used with an angle valve body on high pressure applications. Cavitrol V trim is used in Vee-Ball® ball valve body assemblies.

Available Configurations: *Cavitrol III Cage*—Designed for standard cage-type valve bodies, eliminates cavitation and the resultant damage and noise at pressure drops up to 3000 psi (207 bar). The Cavitrol III cage consists of one or more concentric cylindrical sections referred to as stages. The number of stages required depends on the inlet pressure and the pressure drop. In operation, the liquid undergoes a portion of the total pressure drop in each stage of the cage. This prevents the liquid in any one stage of the cage from falling to or below its vapor pressure. Therefore, formation of vapor bubbles and their subsequent collapse is eliminated. *Cavitrol IV Trim*—Uses a patented pressure staging design for pressure drops above 3,000 psi (207 bar) to eliminate cavitation. The expanding flow area design takes advantage of the ability of the liquid to undergo a greater pressure drop in initial stages without cavitating. This results in a much lower inlet pressure to the final stage. This design also separates the shutoff and throttling locations to prevent clearance-flow erosion. Used with the Design CAV4 valve body. *Cavitrol V Trim*—This trim consists of a carefully designed bundle of tubes which minimizes cavitation noise and damage by controlling the formation of cavitation bubbles. The tubes serve three functions: they prevent the flow stream from reaching its potential minimum area, they maintain maximum pressure head to reduce cavitation bubble formation, and they limit the size and number of cavitation bubbles that do form. Used with Vee Ball® ball valves.

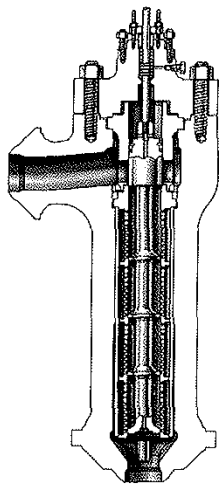
Flow Characteristic: Linear

Flow Direction: *Cavitrol III Cage*—In through the outer cage wall orifices and down through the bottom of the cage. *Cavitrol IV Trim*—In through the top cage wall and out through the bottom of the cage.
Cavitrol V Trim—Through the tube bundle from left to right as the bundle is shown in the left-hand picture below

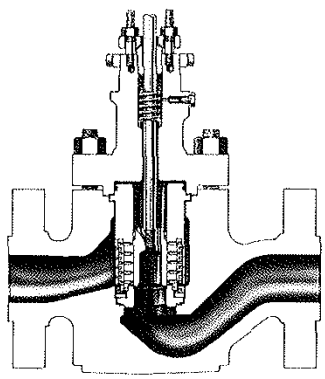
Maximum Pressure Drops: *Cavitrol III Trim*—3,000 psi (207 bar). *Cavitrol IV Trim*—6,000 psi (414 bar). *Cavitrol V Trim*-500 psi (34.5 bar)

Typical Construction Materials: *Cavitrol III, and IV Trims*—Stainless steel. *Cavitrol V Trim*—Carbon steel and stainless steel

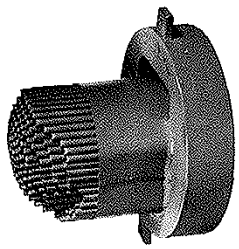
Bulletin Reference: *Cavitrol III Cage*—80.2:010 and 80.2:018. *Cavitrol IV Trim*—80.2:019. *Cavitrol V Trim*—80.2:020



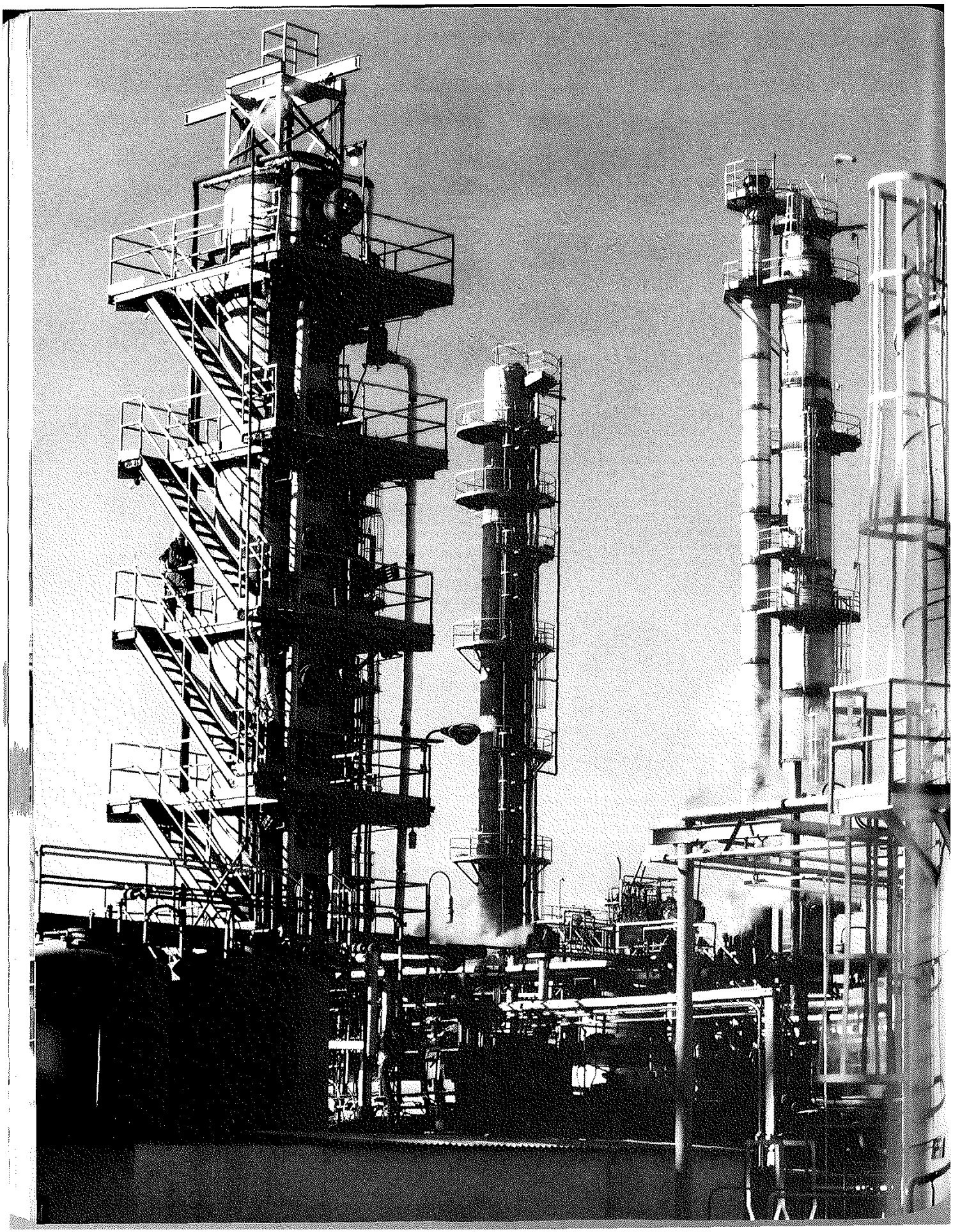
Design CAV4 Valve Body with Cavitrol IV Trim



Design EHT Valve Body with Three-Stage Cavitrol II Trim



Cavitrol V Trim



Contents

Introduction

Virtually any facility which generates, handles or consumes steam has a requirement for steam conditioning valves and desuperheating equipment. Typical industrial users include power utilities, co-generation plants, pulp mills, food processing plants, refineries and chemical plants. Also, non-process companies and institutions such as universities, military bases and large assembly factories can utilize this equipment for steam heating and other steam usage requirements.

Steam conditioning products are utilized to match steam usage conditions to steam generating conditions. Attemperation, for example, is desired to: improve the efficiency of thermal transfer in heat exchangers; reduce or control superheated steam temperatures which might otherwise be harmful to equipment, the process, or the end product; and control temperature and flow with load variation.

Steam which is generated to accomplish mechanical work (e.g., to drive turbines, compressors, and fans) is typically utilized in a superheated state where condensate cannot be tolerated.

Conversely, thermal processes require high temperature differentials to obtain efficient thermal transfer, and in these instances, use of superheated steam is very inefficient. However, if the steam is treated to bring it closer to saturation, its heat transfer properties improve significantly. The resultant increase in efficiency given by desuperheated steam will very quickly pay back the costs involved in purchasing and installing steam treatment equipment.

Desuperheaters

The purpose of a desuperheater is to reduce the temperature of superheated steam. The simplest construction of this device involves single or multiple spray nozzles that are inserted into the steam header, allowing water to be sprayed into the steam flow to reduce its temperature. By regulating the water quantity through the desuperheater, the degree of heat absorption can be controlled and the desired steam temperature maintained. This mechanically atomized desuperheater is used on both small and large pipelines.

Other desuperheater designs utilize atomizing steam flow to produce a fine spray of atomized cooling water into the steam line. The steam-assisted design offers excellent performance at low cost.

Yet another desuperheater incorporates variable geometry spray nozzles to achieve the desired steam conditions. This type provides higher rangeability than the fixed orifice desuperheater.

For small process lines, a desuperheater which relies on full circle water injection can maintain final temperatures to within 20°F of saturation in pipe sizes down to 1″.

Steam Conditioning Valves

A steam conditioning valve combines pressure reduction and temperature control capabilities within a single valve body. Incorporating coordinated pressure reducing and spraywater orifices, the valve allows only the correct mixture of water to steam at any flow condition. It injects water near the vena contracta of the valve, just after the pressure reduction has been completed. By injecting the water in this highly turbulent area, a steam assisted desuperheater effect is created which enables turndowns of 50:1 and precise temperature control to within 7°F to 10°F of saturation.

Condenser Dump Valves

During plant start-up, load reject, or trip conditions, the condenser dump valve is used as part of the bypass system to condition steam pressure and temperature to the condenser. Although it is primarily a bypass control valve, it is also part of the protection system for the condenser.

Selection

To help you select a desuperheater or steam conditioning valve, familiarize yourself with the following application considerations and contact your Fisher sales office or sales representative.

- Steam flow
- Inlet pressure
- Outlet pressure
- Inlet temperature
- Outlet temperature
- Water pressure
- Water temperature
- Required noise level
- Pipeline size
- Turndown required

DMA Mechanically Atomizing Desuperheater

The DMA desuperheater is used typically for applications with near constant loads, although it is also suited to applications requiring moderate turndown ratios (i.e., less than 5:1.) Featuring a streamlined construction that causes minimal obstruction to steam flow, the DMA can be installed in pipe headers, elbows, tees or other fittings.

Available Configurations: One, two or three spray nozzles

Steam Pipe Sizes: 6″-24″

Maximum Turndown: 10:1

Minimum Pipe Velocity: 25 fps

Water Pressure Required: 50 - 500 psi greater than steam line pressure

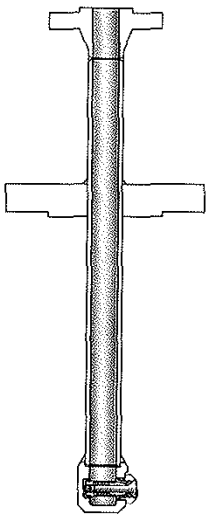
Installation: 90° tee or elbow

Mounting Connection: Flanged, ANSI Class 150-2500. Sizes 3″, 4″, 5″

Water Connection: Flanged, 1″, 1-1/4″, 1-1/2″

Typical Construction Materials: *Body*—Carbon steel, stainless steel, alloy steel. *Nozzle & springs*—Stainless steel. *Packing*—Graphite

Bulletin Reference: 85.2:DMA



DVG Variable Geometry Spray Desuperheater

The DVG desuperheater covers a broad range of steam and water flow conditions. Its internal spray water valve provides control of water without need for separate control valves, while its multiple, variable-geometry nozzles allow an optimum turn-down ratio and give excellent spray water dispersion. Maintains steam temperature to within 10°F of saturation.

Available Configurations: One, two or three variable geometry spray nozzles

Steam Pipe Sizes: 6″-24″

Maximum Turndown: 50:1

Minimum Pipe Velocity: 20 fps

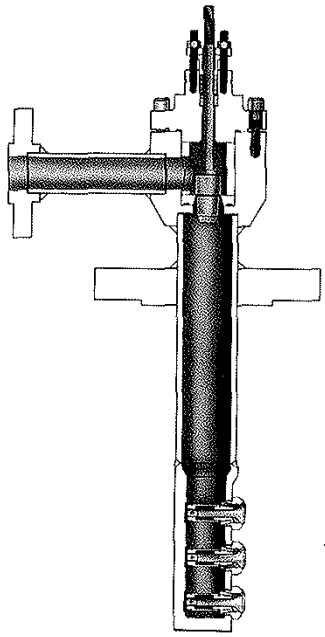
Water Pressure Required: 50-500 psi greater than steam line pressure

Installation: 90° tee or elbow

Mounting Connection: 3″ or 4″ Flanged; ANSI Class 150-2500

Water Connection: Flanged, 1″, 1-1/2″, 2″

Typical Construction Materials: *Body*—Carbon steel, stainless steel, alloy steel. *Nozzle*—Stainless steel. *Packing*—Graphite



DSA Steam Atomized Desuperheater

The DSA serves those desuperheating installations which require high rangeability in low steam velocity pipelines. Mixing of steam provides an efficient means of atomizing spraywater over wide fluctuations in the flow rate while maintaining downstream steam temperatures to with 10°F of saturation. The design is ideal for combination pressure-reducing and desuperheating operations or when high pressure steam (i.e., 1.5 to 2.0 times line pressure) is available.

Available Configurations: Body inserts directly into the steam line and features no moving parts

Steam Pipe Sizes: 6″-32″

Maximum Turndown: 50:1

Minimum Pipe Velocity: 5 fps

Atomizing Steam Pressure: 2x steam line pressure

Water Pressure Required: 20-500 psig greater than steam pressure

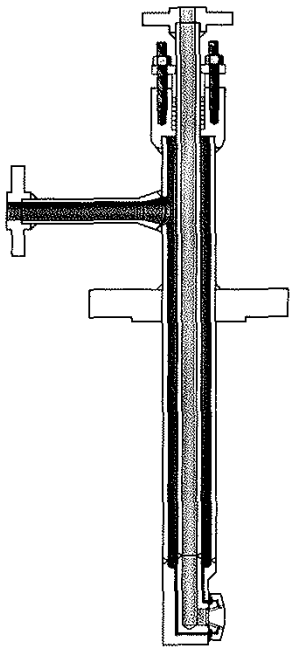
Atomizing Steam Flow: 0.15 x maximum spraywater flow

Installation: 90° tee or elbow

Mounting Connection: 3″ RF flange, ANSI Class 250-2500

Water and Steam Connections: 1″, 1-1/2″, 2″ RF flanged

Typical Construction Materials: *Body and Nozzle*—Carbon steel, alloy steel. *Nozzle*—Stainless steel. *Packing*—Graphite



SPD Small Pipeline Desuperheater

The SPD desuperheater injects spray water around the entire circumference of the pipe and tangent to steam flow, providing rapid and thorough mixing. It can maintain final temperatures to within 20°F of saturation in pipe sizes down to 1″. Efficiency of the mixing action is promoted by the venturi design of the flow passage.

Available Configurations: Wafer through-bolt design

Steam Pipe Sizes: 1″, 2″, 3″ 4″

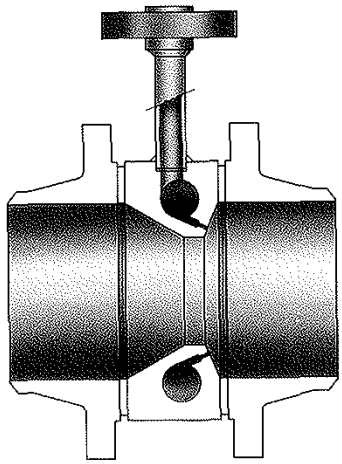
Pressure Rating: ANSI Class 150-900

Maximum Turndown: 10:1

Minimum Pipe Velocity: 5 fps

Water Pressure Required: 50-500 psi greater than steam pressure

Typical Construction Materials: Carbon steel, alloy steel



SPD-ST Small Pipeline Desuperheater

The SPD-ST is designed particularly for rugged service and can maintain final temperatures to within 20°F of saturation. It introduces spray water around the entire circumference of the pipeline and tangent to steam flow, providing rapid and thorough mixing. The design features an internal water throttling valve in a construction similar to the SPD desuperheater.

Available Configurations: Wafer through-bolt design

Steam Pipe Sizes: 1″, 2″, 3″, 4″

Pressure Rating: ANSI Class 150-900

Maximum Turndown: 15:1

Minimum Pipe Velocity: 5 fps

Water Pressure Required: 50-500 psi greater than steam pressure

Typical Construction Materials: *Body*—Carbon steel, alloy steel. *Trim*—Stainless steel. *Packing*—graphite.

CVS Steam Conditioning Valve

The CVS series of combined pressure reducing and desuperheating valves simultaneously reduce steam pressure and temperature to levels most efficient for the given application. The design provides water injection after all pressure reduction stages to control steam temperature to within 7 to 10°F (4 to 7°C) of saturation.

Available Configurations: Angle, globe, and Y-pattern

Body Sizes: *Inlet*—1″-20″. *Outlet*—2″-48″

End Connection Style: Socket weld (1″-3″), butt weld, flanged, Graylock hub

Shutoff Classification: ANSI Class V

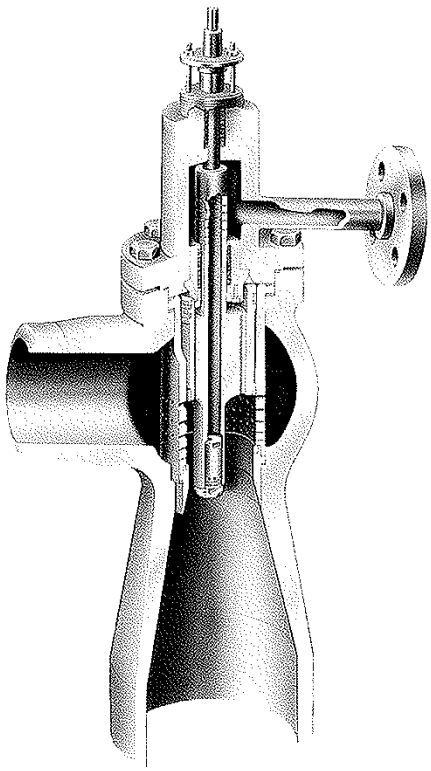
Pressure Ratings: ANSI Class 150-4500

Flow Characteristic: Linear (std.); equal percentage

Rangeability: 50:1

Typical Construction Materials: *Body*—carbon steel, alloy steel. *Trim*—stainless steel. *Packing*—graphite.

Bulletin Reference: 85.1:CVS



CVS-C Condenser Dump Valve

During power plant startup, load reject, or trip conditions, the CVS-C is used as part of the bypass system to condition steam pressure and temperature to the condenser. It is a bypass control valve, but it also serves as part of the protection system for the condenser. The design provides high steam flow with maximum desuperheating spray to handle critical condenser dump applications.

Available Configurations: Single seat design in angle, globe or slant configuration

Body Sizes: *Inlet*—1″-20″. *Outlet*—2″-48″

End Connection Style: Socket weld, butt weld, flanged, Graylock hub

Shutoff Classification: ANSI Class V

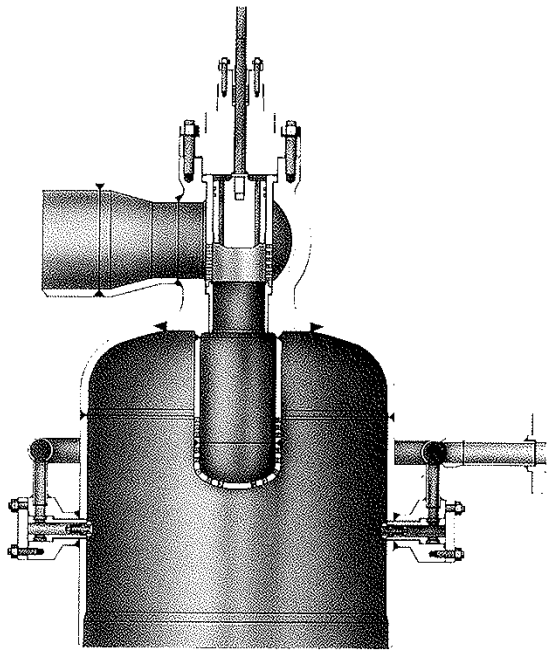
Pressure Ratings: ANSI Class 150-2500

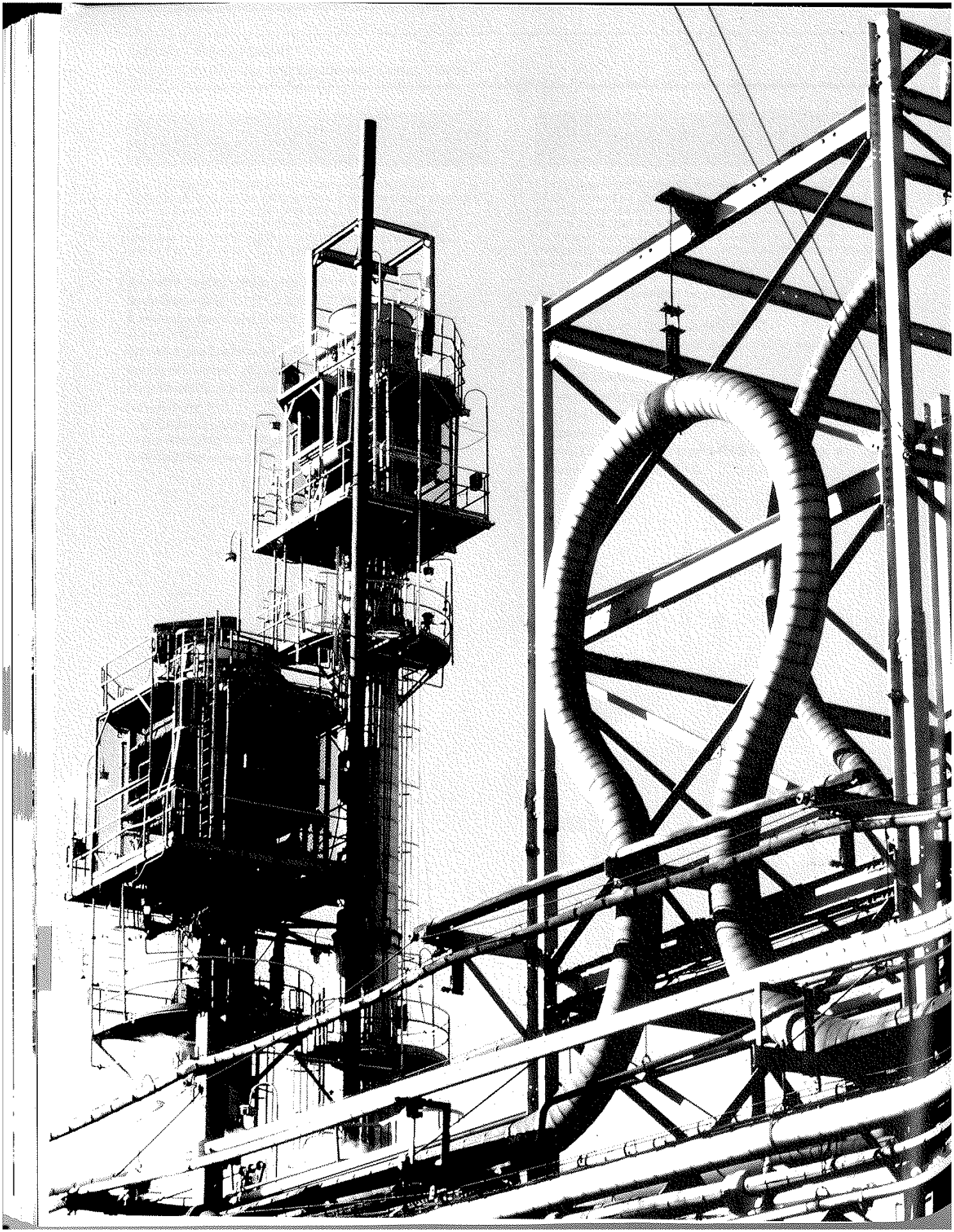
Flow Characteristic: Linear (std.); equal percentage

Rangeability: 50:1

Typical Construction Materials: *Body*—carbon steel, alloy steel.

Bulletin Reference: 85.1:CVS





Contents

Introduction

This section includes a variety of accessory equipment which is often used in control valve and regulator piping systems. The accessories and their usages are listed in the following selection guide.

Selection Guide

The accessory equipment type numbers and page references are provided along the right-hand side of the following selection table to guide you to the appropriate product description(s). To help you make your final selection of any of these accessories, familiarize yourself with the following general application considerations and contact your Fisher sales office or sales representative:

- Type of fluid which will contact the equipment
  Specific gravity
  Temperature
  Chemical composition, if unusual
- Range of inlet pressure
- Pressure drop
  Range of flowing pressure drop
  Maximum at shutoff, if applicable
- Flow rate
  Minimum controlled flow, if applicable
  Normal flow
  Maximum flow
- Line size and schedule
- Type of environment where equipment will be installed

Accessory Equipment	Use			Type Number	See Page
Vent Traps	To automatically and continuously vent collected gas from liquid systems			30	10-1
Strainers	To remove dirt, scale or other solid substances from the flow stream just upstream from control valves and regulators			260C 262C	10-2
Filters	To remove moisture, dust, rust or other fine substances from air or gas lines just upstream from small volume regulators or control instruments	175 psig maximum cold working pressure	12.1 bar maximum cold working pressure	361	10-3
		250 psig maximum cold working pressure	17 bar maximum cold working pressure	67AFD	10-2
		600 psig maximum cold working pressure	41.4 bar maximum cold working pressure	P590 Series	10-3
		2400 psig maximum cold working pressure	165 bar maximum cold working pressure	254 Series	10-2

30 Vent Trap

The Type 30 vent trap is designed to automatically and continuously vent air or gas from tanks, pipes, engine water jackets or any other liquid system without loss of the liquid. It is widely used on heat exchangers, surface condensers, and hot water heating systems.

Available Configuration: The type 30 consists of a float-operated valve plug assembly, a float chamber, and a cover with vent cock

Connection Sizes: *Inlet*—3/4 in. NPT screwed. *Outlet*—1/2 in. NPT screwed

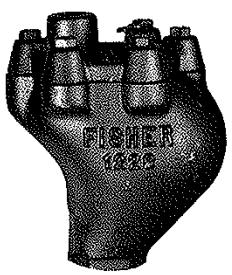
Pressure and Temperature Ratings: *With Copper Float*—100 psig (6.9 bar) up to 350°F (177°C). *With Stainless Steel Float*—300 psig (20.7 bar) up to 450°F (232°C)

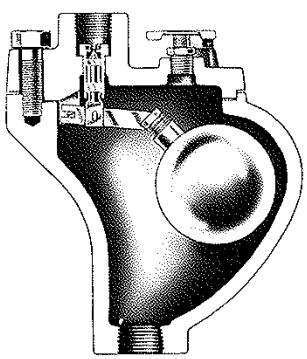
Spherical Float Size: 2-1/2 in. (63.5 mm) diameter

Typical Construction Materials: *Valve Plug and Lever Assembly*—Stainless steel. *Float*—Copper or stainless steel. *Float Chamber and Cover*—High-tensile cast iron. *Vent Cock*—Brass

Minimum Specific Gravity Requirement for Shutoff: *With Copper Float*—0.81. *With Stainless Steel Float*—0.90

Bulletin Reference: 90.1:30





260C and 262C Strainers

The 260C and 262C strainers are designed to remove dirt, scale or other solid substances from liquids, gases and vapors just upstream from control valves and regulators. The large free area of the 260C strainer screen offers practically no more resistance to flow than a pipe bend.

Available Configurations: *Type 260C*—1/4 through 2 in. cast iron constructions for up to 400 psig at 100°F (27.6 bar at 38°C) depending upon construction. *Type 262C*—3/4 in. cast iron construction for up to 400 psig at 100°F (27.6 bar at 38°C) depending upon construction. Uses cellulose filter to remove particles larger than 0.0016 in. (40 µm) in diameter

Connection Sizes[1] and Styles: *Type 260C*—1/4 through 2 in. screwed or 1-1/2 through 2 in. flanged (Class 125 or 250). *Type 262C*—3/4 in. NPT screwed

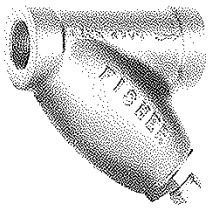
Pressure and Temperature Ratings: *Type 260C*—Up to 400 psig at 100°F and 250 psig at a maximum temperature of 406°F (up to 27.6 bar at 38°C and 17.2 bar at a maximum temperature of 208°C). *Type 262C*—400 psig at 100°F and 250 psig at 406°F (27.6 bar at 38°C and 17.2 bar at 208°C)

Screen Perforation Sizes (not applicable to Type 262C): *Type 260C*—From 0.020 to 0.125 in. (0.5 to 3.2 mm) diameter depending upon screen material.

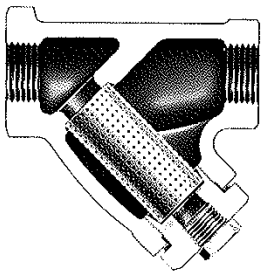
Screen Area Ratios (not applicable to Type 262C): *Type 260C*—From 2.80 to 8.70 depending upon line size and screen perforation diameters.

Typical Construction Materials: *Type 260C*—Body and Bottom Plug, cast iron; Pipe Plug, carbon steel; Screen, brass or stainless steel; Gasket, steel and composition material. *Type 262C*—Strainer Body, cast iron; Body Bottom Plug and Pipe Plug, carbon steel; Gaskets, neoprene and either iron or steel; Filter Element, cellulose filter impregnated with a phenolic resin.

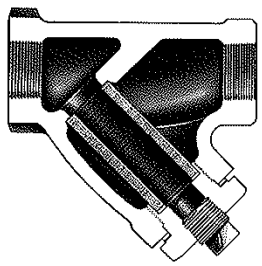
Bulletin Reference: 90.1:260



Typical of Type 260C or 262C



Type 260C



Type 262C

67AFD Filter

The Type 67AFD filter with drip pot removes dirt, moisture, and other particles from air or gas lines. This economical filter is commonly used in the supply line to a pneumatic instrument that does not require a pressure-reducing regulator.

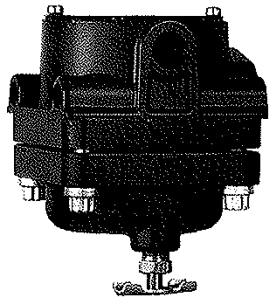
Available Configuration: The Type 67AFD is a medium pressure filter with a celulose filter capable of removing particles greater than 0.0016 inch (0.040 mm) in diameter

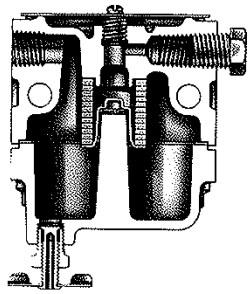
Connection Sizes: 1/4 in. NPT screwed inlet and outlet connections

Pressure and Temperature Ratings: 250 psig (17 bar) up to 150°F (66°C)

Typical Construction Materials: *Filter Body and Cover*—Aluminum. *Drain Valve*—Brass, aluminum or stainless steel. *Filter Element*—Cellulose (standard) or stainless steel. *Gasket*—Neoprene or high-temperature fluoroelastomer. *Retainer Assembly*—Steel and stainless steel.

Option: Pressure gauge





254 Series Filters

The 254 Series filters are designed to remove moisture, dust, rust or other fine substances from air or gas lines. They are often used in the operating medium line which supplies air or gas to instruments or small-volume pressure regulators.

Available Configurations: *Type 254*—Low pressure filter with filter element consisting of twelve fine-grade felt rings which fit tightly around a tubular core. Includes petcock. *Type 254E*—High pressure filter with a bonded felt filter element for removal of particles larger than 0.001 in. (25 µm) in diameter. Includes drain valve. *Type 254F*—Same as Type 254E with the addition of a mounting bracket welded to the cover to permit yoke mounting on a control valve.

Connection Sizes: 1/4 in. NPT screwed inlet and outlet connections

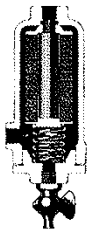
Pressure and Temperature Ratings: *Type 254*—250 psig up to 150°F (17.2 bar up to 66°C). *Type 254E or 254F*—2400 psig up to 150°F and 3600 psig for oil field use (303 bar up to 66°C and 248 bar for oil field use)

[1]Standard sizes include 1/4, 3/8, 1/2, 3/4, 1, 1-1/4, 1-1/2, 2, 2-1/2, 3, 4, or 6 in.

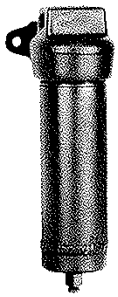
Typical Construction Materials: *Type 254*—Filter Body, cast iron; Petcock, bronze; Body Bottom Plug, Filter Screen and Screen Supports, brass; Spring, cadmium-plated steel; Filter Element, felt. *Type 254E or 254F*—Filter Body and Mounting Flange (Type 254F only), carbon steel; Body Cap, forged steel; Drain Valve, stainless steel; O-ring, nitrile; Filter Retaining Pipe and Washer, carbon steel; Stop Nut, cadmium-plated steel; Filter Element, felt

Bulletin Reference: 90.1:254

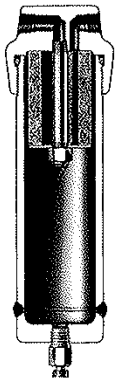
Type 254



Type 254



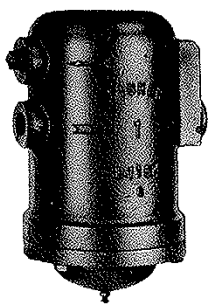
Type 254F

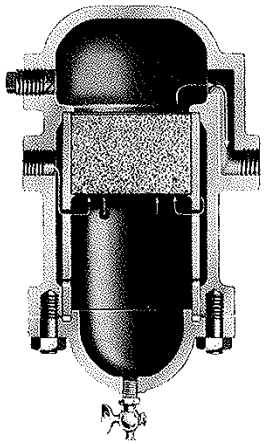


Typical of Type 254E or 254F

361 Filter

The Type 361 Filter is designed to remove moisture, dust, rust or other fine substances from air or gas lines. It is used to protect a variety of expensive equipment, including controllers, air-driven tools, and control valve actuators.





Available Configuration: The Type 361 is a low pressure filter with a cage-retained aluminum oxide filter stone for removal of particles larger that 0.01 in. (250 um) in diameter

Connection Sizes: 1/2, 3/4, or 1 in. NPT screwed inlet and outlet connections

Pressure and Temperature Ratings: 175 psig up to 150°F and 125 psig at 360°F (12.1 bar up to 66°C and 17.2 bar at 182°C)

Typical Construction Materials: *Filter Body and Cover*—Cast iron or bronze. *Petcock and Filter Retainer Cage*—Brass. *Filter Stone*—Aluminum oxide

Bulletin Reference: 90.1:361

P590 Series Filters

The P590 Series filters are designed to remove moisture, dust, rust or other fine substances from air or gas lines. They are commonly used with pilot-operated gas pressure regulators, but can also be used for filtering supply pressure to instruments.

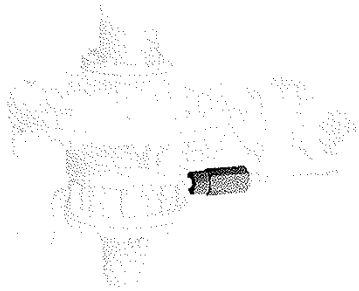
Available Configurations: *Types P593-1 and P594-1*—Small filters using a cellulose filter element capable of removing particles larger than 0.0016 in. (40µm) in diameter.

Connection Sizes: 1/4 in. NPT screwed inlet and outlet connections

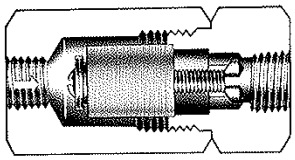
Pressure and Temperature Rating: 600 psig up to 150°F (41.4 bar up to 66°C)

Typical Construction Materials: *Type P593-1*—Body and End Cap, aluminum; Filter Element, cellulose impregnated with phenolic resin; Spring Washer, cadmium-plated steel; Gasket, asbestos. *Type P594-1*—Same as Type P593-1 except with brass body and end cap.

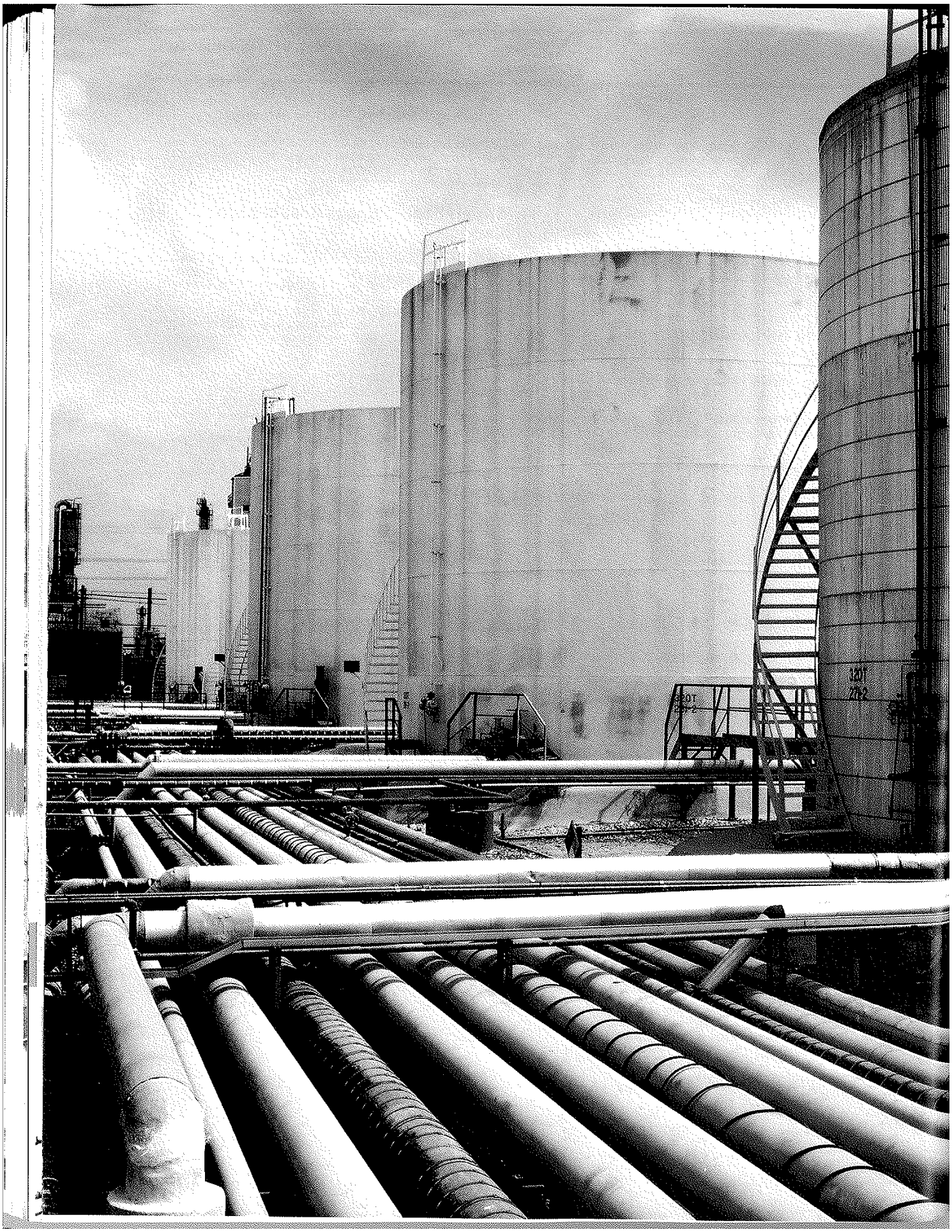
Bulletin Reference: 90.1:P594



Type P594-1 (Used Here to Filter Gas to Pilot on a 99 Seres Regulator)



Type P594-1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With a new emphasis throughout industry on efficiency and quality, the strategy for success now focuses on the skillful management of available resources. When the resource is people, training and education can make a measurable contribution to that management strategy.

Training is one of the best investments any company can make, since the return on investment can be anticipated to be getting the job done better, faster, and at least cost. The impact of quality training can be measured in terms of increased throughput and improved efficiency of total operations with a direct and positive impact on the bottom line.

Providing the training you need

Fisher Controls is among the world leaders in the development of control valves, regulators, instrumentation, and distributed control systems used in the following industries:

- Chemical and Specialty Chemical
- Pulp and Paper
- Power Generation
- Hydrocarbon
- Pharmaceutical
- Food and Beverage
- Original Equipment Manufacturers
- . . . plus others

Because of our continuing close involvement with these industries, Fisher Controls' Educational Services is well positioned to identify and develop practical hands-on training programs to satisfy a broad range of traditional and newly emerging product and process specific training needs. Our training courses apply the experience we've gained in thousands of customer installations around the world and share the knowledge gained in working with a multitude of applications.

New information is continuously integrated into course content to ensure developing skills that are immediately useful in day-to-day operations. Subject matter is logically sequenced to build a progressive understanding. And, subsequent courses are planned to match the changing needs of the plant and the skill levels of the employees.

Within North America, Educational Services offers both standard courses and custom courses. Regularly scheduled standard schools address topics on the following broad areas:

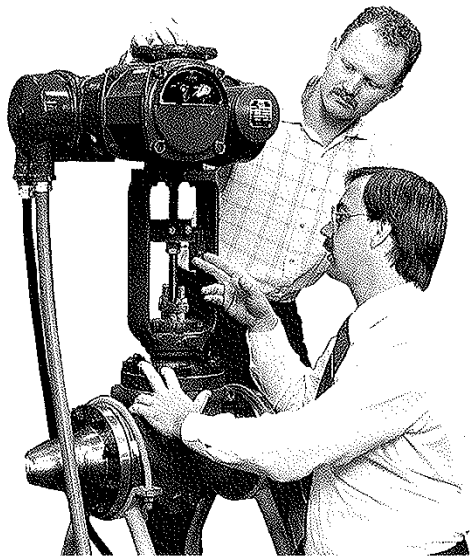
- Control Valves and Regulators
- Measurement Instrumentation
- PROVOX Distributed Control Systems
- Process and Applications Topics

Within each of these areas, specific courses address the unique interests and needs of:

- Process Engineers
- Instrument Engineers
- Technicians and Maintenance Personnel
- Operators
- Supervisors
- Managers

Quality programs and performance based training

The overall value of a training program is determined by its components, its goals, and its resources. Fisher Controls' Educational Services provides:



Training by Objective

For each course offered, general and specific objectives are established. Whenever possible, the specific objectives are matched to the unique needs of the class. These objectives are addressed to ensure that the student gains proficiency in the desired skill areas.

Dedication to Performance Based Training

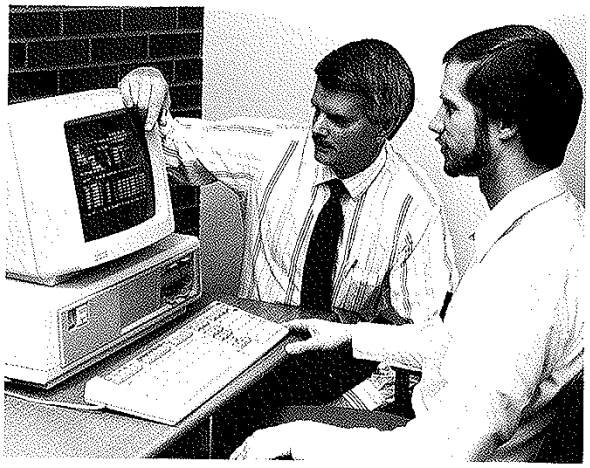
Hands-on workshops, case studies, and problem solving sessions are used to apply new skills to real-world problems in a no-risk, off-line environment. Through such simulations, students can immediately analyze the results of their judgments and actions. These activities and the accompanying lectures and discussions prepare the student to make informed decisions when working with on-line equipment.

Experienced Full-Time Trainers

With backgrounds in education and expertise in their respective technology areas, our trainers are continuously expanding their knowledge base and integrating new concepts into training programs. Because our trainers specialize in a particular technology area, they are well positioned to stay abreast of all the latest developments.

Dedicated Facilities

Classes are taught in exclusive-use facilities with the latest in equipment and products. Classes are optimally sized, large enough to provide interaction with other students yet small enough to allow individual access to instructors and equipment.



Continuous Controller Configuration

Synopsis—Covers the configuration, tuning, and operation of regulatory controllers (configurable, computing, and interactive) in non-communicating and communicating systems. Lectures and workshops provide both theory and hands-on experience using the CS6002 tuner and a DH6200 Series PROFLEX Configuration Workshop (DEC-based). In addition, an opportunity to use the CS6001 Configuration and Tuning Interface and the CD6300 Series Display Interface is available upon request.

Topics
PID control review
Controller overview
Controller capabilities
Single loop, cascade, and feedforward control
FST applications
Trace utility
Controller tuning
Controller PCA discussion

PROVUE Console Based System Configuration

Synopsis—During hands-on workshops, devices within a typical system are defined and configured using the PROFLEX Configuration Workstation (DEC-based). The devices are then operated as a system using the PROVUE Console.

Topics
System overview
PROVUE Console keyboard operation
Configuration system operation
Multiplexer configuration
Configurable controller configuration
PROVUE console configuration
Trend unit configuration
Programmable controller interface unit configuration

System Configuration: IFC/UOC + /PROVUE Console

Synopsis—Devices within a typical system are defined and configured using the PROFLEX Configuration Workstation (DEC-based). The devices are then operated as a system using the PROVUE Console. This course or course 5100 is a prerequisite for Courses 5200 and 5300.

Topics
System overview
PROVUE console keyboard operation
Configuration system operation
Basic IFC/UOC + configuration
PROVUE console configuration
PLC interface options

Unit Operations Controller (UOC +) and PROVUE Console Configuration

Synopsis—During hands-on workshops the PROFLEX Configuration Workstation (DEC-based) is used to configure a UOC + and a PROVUE Console to perform batch control.

Topics
UOC + hardware
UOC + device and point definition
UOC + DCSs and DCD templates
UOC + regulator control
Groups and group templates
Logic control points
Function sequence tables
Time sequence diagramming
Unit and operation configuration
UOC + loading and sizing calculations
Batch cycle control
Activity and procedure configuration
Batch end reporting
Unit/point sets
Operation/procedure coordination
Batch simulator project

Unit Operations Controller (UOC +) and PROVUE Console (HP to Dec Transition)

Synopsis—This course consists of classroom lectures, lab demonstrations, and hands-on workshops utilizing the PROFLEX configuration workstation to configure a UOC + and the PROVUE console to perform batch control.

Topics
PROFLEX configuration workstation
PROVUE console configuration
UOC + device and point definition
UOC + DCDs and DCD templates
UOC + regulatory control
Groups and group templates
Logic control points
Function sequence tables
Unit and operation configuration
Activity and procedure configuration
Batch end reporting
Unit/point sets

Integrated Function Controller (IFC) Configuration

Synopsis—During hands-on workshops the student uses a PROFLEX Configuration Workstation (DEC-based) to configure an IFC and corresponding information for the PROVUE Console

Topics
IFC hardware and diagnostics
IFC device definition
IFC data acquisition points
DCDs and DCD templates
IFC regulatory control loops
Groups and group templates
Logic control points and FSTs
Trace utility for IFC FSTs
PROVUE console configuration (optional)
PROVUE console display building (optional)
Final simulator project

PROVUE Console Based System Maintenance

Synopsis—Lectures and hands-on workshops give the student an understanding of total system operation. A logical approach to troubleshooting is emphasized using system self-tests, error codes and off-line diagnostics.

Topics
System overview
System addressing
PROVOX calibrators
Static damage prevention
System diagnostics
Troubleshooting
Local area start-up
Network start-up
Communications
Configurable, computing and interactive controllers
Unit operations controllers
Integrated function controllers
Trend units
PROFLEX workstations
PROVUE consoles
Multiplexers
AC, DC power and grounding
Highway cable and connector building

UOC + /IFC PROVUE Console Maintenance

Synopsis—Lectures and hands-on workshops give the student an understanding of the UOC + /IFC and PROVUE Console operation. A logical approach to troubleshooting is emphasized using self-tests, error codes and off-line diagnostics.

Topics
System overview
System addressing
Static damage prevention
System diagnostics
Troubleshooting
Local area start-up
Communications
Unit operations controllers
Integrated function controllers
PROFLEX workstations
PROVUE consoles
AD, DC power and grounding
Highway cable and connector building

Data Historian

Synopsis—Lectures and workshops cover configuration and use of the Data Historian to enable the user to store, access, trend and generate reports of historical process data.

Topics
Review of PROVOX point types
Initial configuration of the Data Historian
Configuring historical data files
Archival of data from HDFs
Retrieval of data from archival files
Use of tabular reports
Use of custom reports
Trending historical data on a PROVUE console

Management Overview

Synopsis—Lectures and hands-on workshops provide an in-depth overview of PROVUE Console Based Systems. Principles of operation, configuration, diagnostics and maintenance are discussed to enable students to assess the impact of the introduction of a system.

Topics
Basic control theory
Principles of a distributed control system
PROVUE system overview
Systems communication
System planning and specification
Configuration overview
Diagnostics and maintenance overview
Documentation

UNIVOX Configuration for Batch Process Control

Synopsis—After reviewing the basic functionality of the UNIVOX Control Center, students participate in hands-on workshops to define and configure both the control and display parameters for various batch control applications.

Topics
UNIVOX functionality review
Units and operations
Unit point operation
Time sequence diagramming
Attributes and step instructions
Multiple unit coordination
UNIVOX features in a communicating PROVOX system
Logic control points and recipes

UNIVOX Configuration for IFC, UOC and UOC +

Synopsis—After learning the basic functionality of the UNIVOX Control Center, students participate in hands-on workshops to define and configure both the control and display parameters for various continuous and batch control applications. Only those portions of UNIVOX functionality that are new and different from the IFC, UOC or UOC + devices are covered in detail; therefore, this is not an introductory level course.

Topics
UNIVOX hardware functional overview
UNIVOX keyboard operation
Device and data acquisition point definition
Discrete control devices and templates
Regulatory control
Groups and group templates
Graphic display building
Logic control points and FSTs
Units and operations
New attributes and step instructions
UNIVOX features in a communicating PROVOX system
Logic control points and recipes

UNIVOX Maintenance

Synopsis—Workshop sessions give the student hands-on experience in troubleshooting using self-tests, error codes, and diagnostics.

Topics
Static damage prevention
Operation
Control unit
Input/output files
Keyboard
Video display units
Video controller units
UNIVOX on a highway based system
PROVOX calibrators
Diagnostics
Troubleshooting
AC and DC power and grounding

UNIVOX Configuration for Continuous Process Control

Synopsis—In this course students participate in hands-on workshops to define and configure both the control and display parameters for various continuous control applications of the UNIVOX control center.

Topics
UNIVOX hardware functional overview
UNIVOX keyboard operations
Device-wide parameter definition
Data acquisition points
Discrete control devices and templates
Regulatory control
Groups and group templates
Graphic display building
Logic control points

REGENT Configuration

Synopsis—During hands-on workshops, the Program Development Station is used to configure a REGENT fault tolerant controller. Applications programs are developed to familiarize the student with sequential logic and continuous control programming techniques.

Topics
System overview
Controller unit
I/O unit
I/O power supply
Guarded output modules
Program development station
Modbus protocol translator
Input/output module configuration
Shared variable configuration
Ladder logic
Continuous control (PID)
Scaling
ASCII output
Floating point math
I/O forcing
Application program documentation

REGENT Maintenance

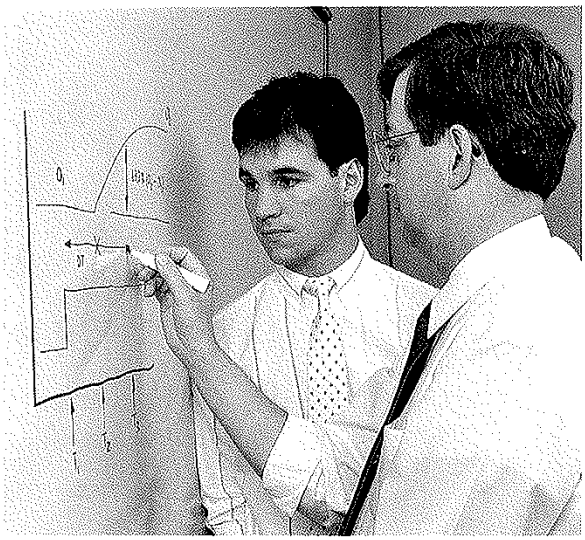
Synopsis—Lectures and hands-on workshops give the student an understanding of the REGENT fault tolerant controller system. A logical approach to troubleshooting is emphasized using the on-line fault status and fault history features of the Program Development Station.

Topics
System overview
Controller unit
I/O unit
I/O power supply unit
Modbus protocol translator
Program development station
Installation guidelines
Troubleshooting
Analog I/O module calibration

Fundamentals of Process Control

Synopsis—Introduces the student to terms and techniques used in the process control industry. Lectures by factory people acquainted with the problems of process control along with demonstrations and problem-solving sessions help students understand the principles of process control. A computer process model is used to demonstrate loop dynamics.

Topics
Organized approach to solving control problems
Feedback control
Feedforward control
Cascade control
Loop tuning
Process dead time
Process gain
Process response time
Positioner guidelines
Valve characteristics
Transmitter response time



Advanced Process Control Concepts

Synopsis—This course uses lectures and demonstrations of advanced process control methods. The student has the opportunity to solve actual process control problems during the class sessions.

Topics
Control system objective
Organizing the control problem
Manual control
Feedback control
Loop tuning
Cascade control
Obtaining control measurements
Dynamic compensation
Feedforward control
Ratio control
Handling operating constraints
Process interaction
Designing processes for controllability
Control system documentation

Boiler Control Concepts

Synopsis—Basic and advanced boiler control methods for various types of boilers are presented during lectures. The student has the opportunity to submit a problem (prior to the course) for possible solution by the class.

Topics
Combustion and control principles review
Boiler mechanical systems review
Subsystem control requirements
Fuel handling requirements
Control of various types of boilers
Boiler efficiency and optimization
Multiple boiler operation
Solution of submitted problems
Future boiler control directions

Fundamentals of Statistical Process Control

Synopsis—This course consists of classroom lectures, hands-on workshops, and sample problems to introduce simple statistical methods. The course is consistent with and based on the American National Standards Institute for Quality Control Charts (ANSI/ASQC Z1.1, Z1.2, Z1.3, 1985.)

Topics
Competition and quality
Introduction to statistical process control
Variation
Statistical methods
Problem solving techniques
Control charts for variables
Process capability and other issues
Control charts for attribute data
Computer software

Computer Integrated Manufacturing Technology Seminar

Synopsis—An introduction to key elements of computer integrated manufacturing (CIM). Technology elements are explored with an emphasis on communications standards used to incorporate CIM, networking and software technologies associated with CIM.

Topics
Business aspects of CIM
Communications standards
Distributed control systems communications
Networks
Computer networking
Statistical quality control
Statistical process control
Relational database technology
Expert systems technology
Optimization and modeling
CIM features of PROVOX instrumentation

Gas Control Conference

Synopsis—Lectures by factory people with gas control expertise, live demonstrations, discussions, hands-on workshops and problem-solving sessions demonstrate the fundamentals of and advancements in gas pressure control.

Topics
Direct-operated regulators
Pilot-operated regulators
Regulator failure analysis
Overpressure protection
Regulator stability
Pressure factor measurement
New products
Pneumatic controllers
Controller tuning
Actuators
Positioners
Valve and regulator sizing
Valve noise
Troubleshooting
Valve and regulator selection

Valve Engineering

Synopsis—This course uses lectures, demonstrations, problem-solving sessions, and hands-on workshops to explain how to match the valve, actuator and accessory to the process and to other equipment. A computer process model is used to demonstrate loop dynamics.

Topics
Control valve selection
Valve design parameters
Valve packing considerations
Material considerations
Cavitation
Valve noise
Valve characteristics
Valve sizing
Special fluid sizing
Actuator selection and sizing
Positioners
Regulators
Valve application guidelines

Valve Technician

Synopsis—This course use lectures, demonstrations and hands-on workshops to explain how valves and actuators function and how they are services.

Topics
Control valve terminology
Globe valves
Butterfly valves
Ball valves
Eccentric disc valves
Actuators and positioners
Control valve noise and cavitation
Special service valves
Valve characteristics
Pressure regulators

Instrument Maintenance

Synopsis—This school uses a guided workshop concept in which small groups of students learn principles of operation, calibration, troubleshooting and repair for selected instruments. Tools and equipment are provided. Computer process simulation and live loops are used to teach controller tuning. Detailed maintenance procedures are also taught.

Topics
Pneumatic controllers
Pneumatic positioners
I/P transducer
I/P positioner
Electronic stem position transmitter
Electronic liquid level transmitter
Electro-pneumatic temperature controller

Instrument Technician

Synopsis—This course used classroom lectures, demonstrations, and hands-on workshops to clarify the principles of operation, calibration, and installation procedures for Fisher electronic and pneumatic instruments. A computer process model is used to demonstrate loop dynamics.

Topics
Instrument terminology
Pneumatic and electronic temperature controllers
Pneumatic pressure controllers
Pneumatic and electro-pneumatic positioners
Pneumatic displacer level controllers
Current-to-pneumatic transducers
Electronic level transmitters
Electronic position transmitters
Direct-operated and pilot-operated regulators

Fundamentals of Process Control

Overview—A comprehensive introduction to the basic concepts of process control, including theory, terminology, descriptions, and applications of frequently encountered control strategies. From this understanding, students may expand their knowledge to more complex control strategies.

Unit Topics
Process control basics
Understanding control loops
Loop tuning and valve considerations
PID and cascade control basics
Feedforward control basics

Advanced Process Control

Overview—An in-depth look at the major concepts of process control terminology, system descriptions, and applications of frequently encountered control strategies. The course expands on control techniques introduced in Fundamentals of Process Control and looks at methods of analyzing complex control strategies with refinements aimed at tightening existing control parameters.

Unit Topics
Process control terminology and behavior
Manual, feedback, and cascade control
Feedforward control
Ratio control and other control considerations

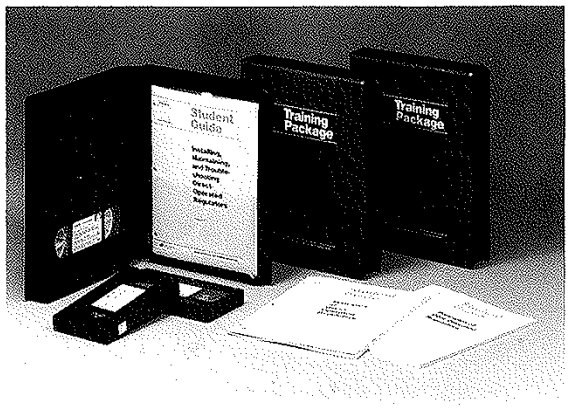
Fundamentals of Shutoff Valves

Overview—An introduction to shutoff valves that discusses design, application, installation and maintenance considerations. Students will gain a working vocabulary, a knowledge of equipment function, and fundamental troubleshooting and repair skills. Emphasis is placed on practical selection, installation, and maintenance issues.

Unit Topics
Shutoff valve designs and application considerations
Selecting shutoff valves and accessories
Installing shutoff valves
Maintaining shutoff valves

Fundamentals of Chemical Process Operations

Overview—This course provides a comprehensive introduction to the operation of a typical chemical processing plant by actually creating a generic chemical plant. Included are terminology, various types of special purpose equipment, and typical control strategy concepts. Students will gain a basic understanding of common services, feedstock handling and storage, feedstock preparation, product synthesis, recovery and purification, as well as packaging and distribution.



Unit Topics
Introduction to chemical process operations
Plant utilities and common services
Feedstock handling and product distribution
Feedstock preparation
Product synthesis, recovery, and purification

Fundamentals of Statistical Process Control

Overview—An introduction to the history and principles of statistical process control. Specific applications are identified, and step-by-step procedures for implementing statistical process control are outlined. Students may then expand this basic knowledge to more comprehensive plantwide control strategies such as Computer Integrated Manufacturing (CIM)

Unit Topics
Introduction to statistical process control
Simple statistical methods and variation
Variables charting
Attributes charting
Improvement process and computers

Boiler Operation and Control

Overview—This course presents boiler operation basics and control concepts, techniques and strategies. It includes terminology, descriptions and applications most frequently encountered in process control and power generation situations. Emphasis is on efficiency, safety, and the use of proper control techniques in both coal fired and gas fired applications.

Unit Topics
Basic boiler operation
Boiler mechanical systems
Combustion process overview
Boiler type operating considerations
Review of control terminology and fundamentals
Firing rate control and air/fuel coordination
Combustion air and fuel control systems
Drum level, blowdown, and steam temperature control

Boiler Efficiency and Optimization

Overview—The theory, mathematical concepts, and techniques of boiler optimization and efficiency strategies are introduced. Emphasis is placed on increasing boiler efficiency through optimization techniques in both the boiler and the firebox. Guidelines and appropriate mathematical calculations for improving and refining operating parameters are discussed in detail.

Unit Topics
Draft pressure and burner management control
Boiler and combustion efficiency calculations
Parameters affecting boiler performance
Boiler load allocation
Boiler soot control

Instrumentation Wiring and Grounding

Overview—This course discusses the techniques and treatments used to reduce or eliminate the adverse effects of natural and man-made electrical noise on control instruments and systems. Various types and sources of electrical noise are examined. Real-life examples acquaint the student with workable solutions to problems commonly encountered during the wiring task.

Unit Topics
AC/DC power and ground wiring
Signal wiring and shielding

Pressure Regulator Technology

Overview—A progressive treatment of pressure reducing regulators that begins with the fundamentals of purpose and design. Different styles of regulators are introduced and theory of operation, performance, safe maintenance techniques, and sizing are discussed. Treatments of relief valves and monitor regulator systems are included

Unit Topics
Principles of direct-operated regulators
Installing, maintaining, and troubleshooting direct-operated regulators
Principles of pilot-operated regulators
Installing, maintaining, and troubleshooting pilot-operated regulators
Pressure regulator application and selection criteria
Selecting and sizing pressure regulators
Relief valves: operation, selection, installation and maintenance
Monitor regulators: operation, selection, installation and maintenance

Fundamentals of Control Valve Positioners

Overview—This course begins by looking at control valve positioners on a fundamental level and progresses through more complex issues such as control loop stability and split ranging. Upon completion of the course, the student will be able to make better informed decisions in the selection, application, calibration, and trouble-shooting of control valve positioners.

Unit Topics
Control valve positioner operation and calibration concepts
Control valve positioner application guidelines
Split ranging and characterizing with positioners

Fundamentals of Control Valve and Actuator Maintenance

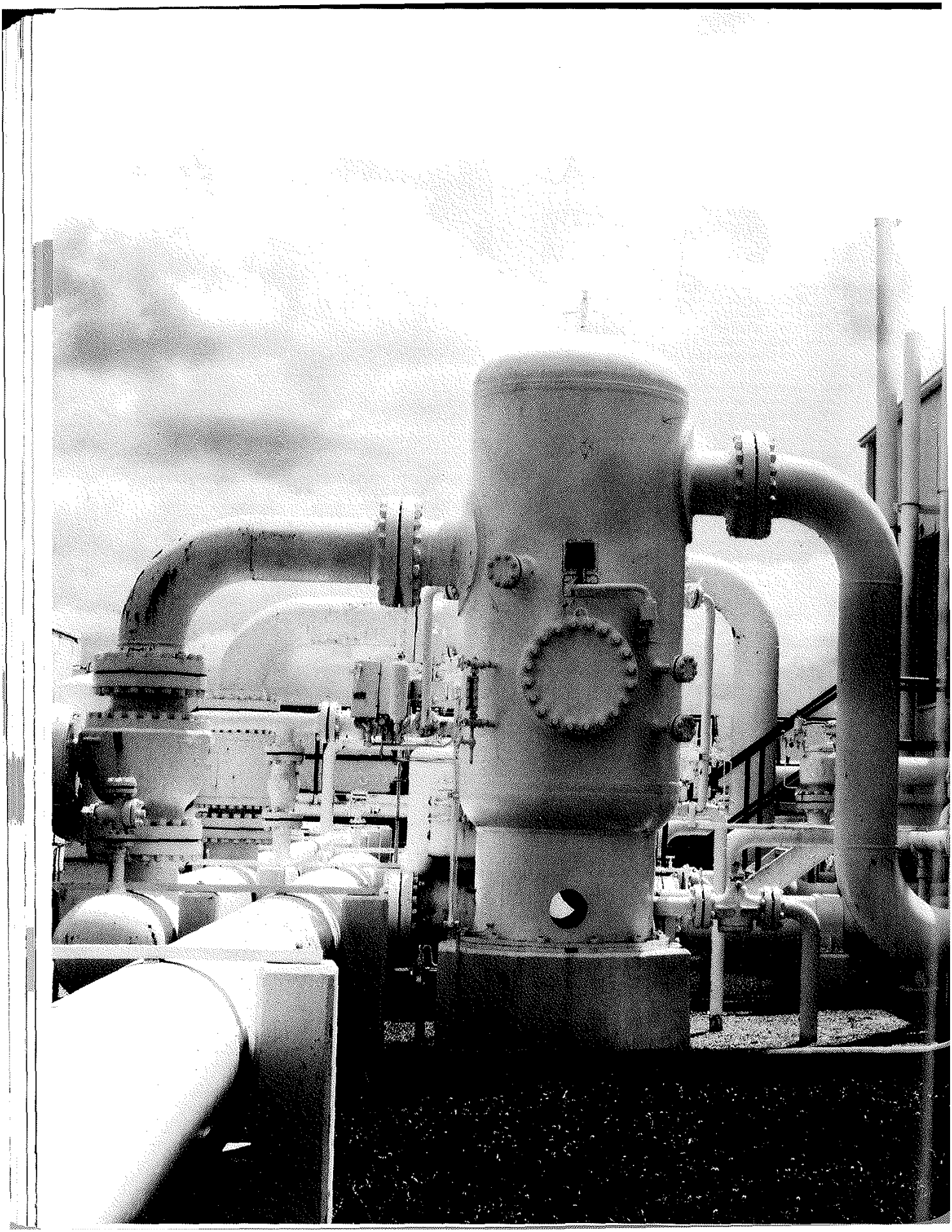
Overview—An introduction to and a description of the operations most commonly performed to maintain proper operation of control valves and actuators. The course provides basic information with general emphasis on safety and the use of proper documentation, tools, and techniques. Guidelines are given for troubleshooting and repairing common problems.

Unit Topics
Maintaining sliding stem control valves
Maintaining butterfly control valves
Maintaining ball and eccentric rotary plug valves
Maintaining spring and diaphragm actuators
Maintaining pneumatic piston actuators

Fundamentals of Control Valve Engineering

Overview—This course provides a progressive understanding of control valves, actuators, and basic instruments and explains how all this equipment is integrated to form a closed loop control system. Emphasis is placed on practical engineering concepts.

Unit Topics
Control valve terms, types, and selection parameters
Sliding stem control valves
Rotary shaft control valves
Pneumatic spring and diaphragm actuators
Pneumatic piston actuators
Fundamentals of control valve noise
Fundamentals of control valve flashing and cavitation
Actuator sizing for sliding stem control valves
Actuator sizing for rotary shaft control valves
Control valve sizing for liquid service
Control valve sizing for gas and steam service
Basic pneumatic instrumentation
Fundamentals of closed loop control
PID actions and controller tuning



Elastomer Information

The data which follows serves as a useful guide when selecting elastomer materials. However, the selection can be only as accurate as the selection criteria utilized. Known factors should include: (1) temperature, (2) pressure, (3) all primary as well as trace chemicals in the flowing fluid, (4) rate of flow, and (5) type of control action, throttling or on-off.

For applications requiring special elastomers, contact your Fisher sales office or sales representative.

General Properties

The following tabulation gives general properties for many of the elastomers commonly used within the control valve industry and should be used only as a guide. Specific compounds within a given material category may change the usage rating.

Service Temperature Limitations

The table below indicates temperature ranges over which various elastomers will function adequately. However, performance requirements should be considered in determining an applicable temperature range (e.g., tear strength and other associated physical properties decrease rapidly as the service temperature increases.)

Service Temperature Limitations

MATERIAL	LOW LIMIT		HIGH LIMIT	
	°F	°C	°F	°C
Natural Rubber	−60	−51	160	71
Neoprene	−40	−40	175	79
Nitrile	−20	−29	200	93
Polyurethane	−40	−40	200	93
Hypalon*	0	−18	225	107
Butyl	−20	−29	300	149
Ethylene Propylene (EPT)	−40	−40	300	149
Viton*	0	−18	400	204
Silicone	−65	−54	400	204

*Trademark of Du Pont Co.

General Properties

Property			Natural Rubber	Buna-S	Nitrile	Neoprene	Butyl	Thiokol[1]	Silicone	Hypalon[2]	Viton[2,3,4]	Polyurethane[4]	Polyacrylic[3]	Ethylene Propylene[5]
Tensile Strength	Psi	Pure Gum	3000	400	600	3500	3000	300	200-450	4000	. . .	. . .	100	. . .
		Reinforced	4500	3000	4000	3500	3000	1500	1100	4400	2300	6500	1800	2500
	MPa	Pure Gum	21	2.8	4.1	24	21	2.1	1.4-3.1	28	. . .	. . .	0.69	. . .
		Reinforced	31	21	28	24	21	10	7.6	30	16	45	12	17
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			Poor	Poor	Poor	Excellent	Excellent	Good	Good	Excellent	Excellent	Excellent	Excellent	Excellent
Oxidation			Good	Fair	Fair	Good	Good	Good	Very Good	Very Good	Excellent	Excellent	Excellent	Good
Heat (Max. Temp.)	°F		200	200	250	200	200	140	450	300	400	200	350	350
	°C		93	93	121	93	93	60	232	149	204	93	177	177
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			Very Poor	Very Poor	Good	Fair	Poor	Excellent	Poor	Fair	Excellent	Very Good	Good	Poor
Aromatic Hydrocarbon			Very Poor	Very Poor	Fair	Poor	Very Poor	Good	Very Poor	Poor	Very Good	Fair	Poor	Fair
Oxygenated Solvent			Good	Good	Poor	Fair	Good	Fair	Poor	Poor	Good	Poor	Poor	. . .
Halogenated Solvent			Very Poor	Very Poor	Very Poor	Very Poor	Poor	Poor	Very Poor	Very Poor	. . .	. . .	Poor	Poor
Oil Resistance:														
Low Aniline Mineral Oil			Very Poor	Very Poor	Excellent	Fair	Very Poor	Excellent	Poor	Fair	Excellent	. . .	Excellent	Poor
High Aniline Mineral Oil			Very Poor	Very Poor	Excellent	Good	Very Poor	Excellent	Good	Good	Excellent	. . .	Excellent	Poor
Synthetic Lubricants			Very Poor	Very Poor	Fair	Very Poor	Poor	Poor	Fair	Poor	. . .	. . .	Fair	Poor
Organic Phosphates			Very Poor	Very Poor	Very Poor	Very Poor	Good	Poor	Poor	Poor	Poor	Poor	Poor	Very Good
Gasoline Resistance:														
Aromatic			Very Poor	Very Poor	Good	Poor	Very Poor	Excellent	Poor	Poor	Good	Fair	Fair	Fair
Non-Aromatic			Very Poor	Very Poor	Excellent	Good	Very Poor	Excellent	Good	Fair	Very Good	Good	Poor	Poor
Acid Resistance:														
Diluted (Under 10%)			Good	Good	Good	Fair	Good	Poor	Fair	Good	Excellent	Fair	Poor	Very Good
Concentrated[6]			Fair	Poor	Poor	Fair	Fair	Very Poor	Poor	Good	Very Good	Poor	Poor	Good
Low Temperature Flexibility (Max.)	°F		−65	−50	−40	−40	−40	−40	−100	−20	−30	−40	−10	−50
	°C		−54	−46	−40	−40	−40	−40	−73	−29	−34	−40	−23	−46
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%)			Good	Good	Good	Good	Very Good	Poor	Fair	Good	Excellent	Fair	Poor	Excellent
Concentrated			Fair	Fair	Fair	Good	Very Good	Poor	Poor	Good	Very Good	Poor	Poor	Good
Resilience			Very Good	Fair	Fair	Very Good	Very Good	Poor	Good	Good	Good	Fair	Very Poor	Very Good
Elongation (Max.)			700%	500%	500%	500%	700%	400%	300%	300%	425%	625%	200%	500%

1. Trademark of Thiokol Chemical Co.
2. Trademark of Du Pont Co.
3. Do not use with steam.
4. Do not use with ammonia.
5. Do not use with petroleum base fluids. Use with ester base non-flammable hydraulic oils and low pressure steam applications to 300°F (149°C).
6. Except for nitric and sulfuric acid.

Fluid Compatibility

The following table rates and compares the compatibility of elastomer material with specific fluids. Note that this information should be used as a guide only, since an elastomer may not be compatible with a fluid over the entire range of its temperature capability. In general, elastomer compatibility with a chemical decreases with an increase in service temperature.

Fluid Compatibility

Fluid	Natural Rubber	Neoprene	Nitrile	EPT	Poly-urethane	Viton*	Hypalon*	Butyl	Silicone
Acetic Acid (30%)	B	C	B	A+	C	B	B	A	A
Acetone	B	B	C	A	C	C	B	A	B
Air, Ambient	B	A	A	A	A	A	A	A	A
Air, Hot at 200°F (93°C)	C	C	A	A	B	A	A	A	C
Air, Hot at 400°F (204°C)	C	C	C	C	C	B	C	C	C
Alcohol, Ethyl	A	A	A	A	B	B	A	A	A
Alcohol, Methyl	A	A+	A	A	C	C	A	A	A
Ammonia, Anhydrous	C	A	C	A	C	C	B	A	C
Ammonia, Gas (Hot)	C	B	C	B	C	C	B	C	B
Beer (Beverage)	A	A	B	A	C	A	A	A	A
Benzene	C	C	C	C	C	A	C	C	C
Black Liquor	B	B	A	B	C	A+	C	C	C
Blast Furnace Gas	C	C	B	C	C	A	C	C	A
Brine (Calcium Chloride)	A	A	A	A	A	B	A	A	A
Butadiene Gas	C	B	C	C	C	B	B	C	C
Butane, Gas	C	A	A+	C	B	A	A	C	C
Butane, Liquid	C	B	A	C	C	A	C	C	C
Carbon Tetrachloride	C	C	C	C	C	A	C	C	C
Chlorine, Dry	C	C	C	C	C	A	C	B	C
Chlorine, Wet	C	C	C	C	C	A	C	C	C
Coke Oven Gas	C	C	B	C	C	A+	B	C	B
Dowthermt A	C	C	C	C	C	A	C	C	C
Ethyl Acetate	C	C	C	B	C	C	C	B	B
Ethylene Glycol	A	A	A	A+	B	A	A	A	A
Freon 11	C	B	A	C	C	A+	A	C	C
Freon 12	B	A+	A	B	A	B	A	B	C
Freon 22	C	A+	C	A	C	C	A	A	C
Freon 114	A	A	A	A	A	B	B	A	C
Gasoline	C	B	A+	C	B	A	B	C	C
Hydrogen Gas	B	A	A	A	A	A	A	A	C
Hydrogen Sulfide (Dry)	B	A	C	A+	B	C	A	A	C
Hydrogen Sulfide (Wet)	C	B	C	A+	C	C	C	A	C
Jet Fuel (JP-4)	C	C	A	C	B	A	C	C	C
Methylene Chloride	C	C	C	C	C	B‡	C	C	C
Milk	A	A	A+	A	C	A	A	A	A
Natural Gas	C	A	A+	C	B	A	A	C	C
Natural Gas + H_2S (Sour Gas)	C	A	B	C	B	C	A	C	C
Natural Gas, Sour + Ammonia	C	B	B	C	C	C	B	C	C
Naphthalene	C	C	C	C	B	A	C	C	C
Nitric Acid (10%)	C	B	C	B	C	A	B	B	B
Nitric Acid (50 to 100%)	C	C	C	C	C	A	C	C	C
Nitric Acid Vapor	C	B	C	B	C	A	B	B	C
Nitrogen	A	A	A	A	A	A	A	A	A
Oil (Fuel)	C	B	A+	C	C	A	A	C	C
Ozone	C	B	C	A	A	A	A	B	A
Paper Stock	C	B	B	B	C	A	B	B	C
Propane	C	A	A	C	B	A	A	C	C
Sea Water	B	B	A	A	B	A	B	A	B
Sea Water + Sulfuric Acid	C	B	C	B	B	A	B	B	C
Soap Solutions	B	A	A	A	A	A	A	A	A
Steam	C	C	C	B‡	C	C	C	B	C
Sulfur Dioxide	C	A	C	A+	B	A	C	B	A
Sulfuric Acid (to 50%)	C	B	C	B	B	A	B	B	C
Sulfuric Acid (50 to 100%)	C	C	C	B	C	A	C	B	C
Water (Ambient)	A	A	A	A	A	A	A	A	A
Water at 200°F (93°C)	C	C	B	A+	C	B	B	B	C
Water at 300°F (149°C)	C	C	C	B‡	C	C	C	B	C
Water (De-ionized)	A	A	A	A	A	A	A	A	A
Water, White	B	B	A	A	B	A	B	A	B

*Trademark of Du Pont Co.
†Trademark of Dow Chemical Co.
‡Minor or moderate effect. Best choice presently available for this fluid.
A+—Best possible selection.
A—Recommended.
B—Minor to moderate effect. Proceed with caution.
C—Unsatisfactory.

Corrosion Information

The following table is intended to give only a general indication of how various materials will react when in contact with certain fluids. The recommendations cannot be absolute because concentration, temperature, pressure, and other conditions may alter the suitability of a particular material. There are also economic considerations that may influence material selection. Use this table as a guide only.

Corrosion Information

FLUID	MATERIAL													
	Carbon Steel	Cast Iron	302 or 304 Stainless Steel	316 Stainless Steel	Bronze	Monel*	Hastelloy† B	Hastelloy† C	Durimet‡ 20	Titanium	Cobalt-Base Alloy 6	416 Stainless Steel	440C Hard Stainless Steel	17-4PH Hard Stainless Steel
Acetaldehyde	A	A	A	A	A	A	I.L.	A	A	I.L.	I.L.	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	I.L.	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	I.L.	A	A	A	A	I.L.	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	I.L.	C	C	I.L.
Ammonia	A	A	A	A	C	A	A	A	A	A	A	A	A	I.L.
Ammonium Chloride	C	C	B	B	B	B	A	A	A	A	B	C	C	I.L.
Ammonium Nitrate	A	C	A	A	C	C	A	A	A	A	A	C	B	I.L.
Ammonium Phosphate (Mono-Basic)	C	C	A	A	B	B	A	A	B	A	A	B	B	I.L.
Ammonium Sulfate	C	C	B	A	B	A	A	A	A	A	A	C	C	I.L.
Ammonium Sulfite	C	C	A	A	C	C	I.L.	A	A	A	A	B	B	I.L.
Aniline	C	C	A	A	C	B	A	A	A	A	A	C	C	I.L.
Asphalt	A	A	A	A	A	A	A	A	A	I.L.	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	I.L.	A	A	A	I.L.	A	A	A
Boric Acid	C	C	A	A	A	A	A	A	A	A	A	B	B	I.L.
Butane	A	A	A	A	A	A	A	A	A	I.L.	A	A	A	A
Calcium Chloride (Alkaline)	B	B	C	B	C	A	A	A	A	A	I.L.	C	C	I.L.
Calcium Hypochlorite	C	C	B	B	B	B	C	A	A	A	I.L.	C	C	I.L.
Carbolic Acid	B	B	A	A	A	A	A	A	A	A	A	I.L.	I.L.	I.L.
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	I.L.
Carbon Tetrachloride	B	B	B	B	A	A	B	A	A	A	I.L.	C	A	I.L.
Carbonic Acid	C	C	B	B	B	A	A	A	A	I.L.	I.L.	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	I.L.	C	B	A	A	B	A	A	A	A	I.L.	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	I.L.	A	A	A	I.L.	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	I.L.	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	I.L.
Ethylene	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethylene Glycol	A	A	A	A	A	A	I.L.	I.L.	A	I.L.	A	A	A	A
Ferric Chloride	C	C	C	C	C	C	C	B	C	A	B	C	C	I.L.
Formaldehyde	B	B	A	A	A	A	A	A	A	A	A	A	A	A
Formic Acid	I.L.	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	I.L.	I.L.	I.L.
Freon, Dry	B	B	A	A	A	A	A	A	A	A	A	I.L.	I.L.	I.L.
Furfural	A	A	A	A	A	A	A	A	A	A	A	B	B	I.L.
Gasoline, Refined	A	A	A	A	A	A	A	A	A	A	A	A	A	A
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	I.L.	C	C	I.L.

*Trademark of International Nickel Co.
†Trademark of Stellite Div., Cabot Corp.
‡Trademark of Duriron Co.

A—Recommended.
B—Minor to moderate effect. Proceed with caution.
C—Unsatisfactory.
I.L.—Information lacking.

Corrosion Information (continued)

FLUID	MATERIAL													
	Carbon Steel	Cast Iron	302 or 304 Stainless Steel	316 Stainless Steel	Bronze	Monel*	Hastelloy† B	Hastelloy† C	Durimet‡ 20	Titanium	Cobalt-Base Alloy 6	416 Stainless Steel	440C Hard Stainless Steel	17-4PH Hard Stainless Steel
Hydrogen	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Hydrogen Peroxide	I.L.	A	A	A	C	A	B	B	A	A	I.L.	B	B	I.L.
Hydrogen Sulfide, Liquid	C	C	A	A	C	C	A	A	B	A	A	C	C	I.L.
Magnesium Hydroxide	A	A	A	A	B	A	A	A	A	A	A	A	A	I.L.
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	I.L.	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	I.L.
Oxalic Acid	C	C	B	B	B	B	A	A	A	B	B	B	B	I.L.
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	C
Phosphoric Acid (Air Free)	C	C	A	A	C	B	A	A	A	B	A	C	C	C
Phosphoric Acid Vapors	C	C	B	B	C	C	A	I.L.	A	B	C	C	C	C
Picric Acid	C	C	A	A	C	C	A	A	A	I.L.	I.L.	B	B	I.L.
Potassium Chloride	B	B	A	A	B	B	A	A	A	A	I.L.	C	C	I.L.
Potassium Hydroxide	B	B	A	A	B	A	A	A	A	A	I.L.	B	B	I.L.
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	I.L.	A	A	A	A
Silver Nitrate	C	C	A	A	C	C	A	A	A	A	B	B	B	I.L.
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	A	A	C	A	A	A	A	A	A	B	B	A
Sodium Hypochloride	C	C	C	C	B-C	B-C	C	A	B	A	I.L.	C	C	I.L.
Sodium Thiosulfate	C	C	A	A	C	C	A	A	A	A	I.L.	B	B	I.L.
Stannous Chloride	B	B	C	A	C	B	A	A	A	A	I.L.	C	C	I.L.
Stearic Acid	A	C	A	A	B	B	A	A	A	A	B	B	B	I.L.
Sulfate Liquor (Black)	A	A	A	A	C	A	A	A	A	A	A	I.L.	IL.	I.L.
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	I.L.
Sulfur Trioxide, Dry	A	A	A	A	A	A	B	A	A	A	A	B	B	I.L.
Sulfuric Acid (Aerated)	C	C	C	C	C	C	A	A	A	B	B	C	C	C
Sulfuric 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	I.L.
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	I.L.
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	I.L.	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	I.L.
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	I.L.
Zinc Chloride	C	C	C	C	C	C	A	A	A	A	B	C	C	I.L.
Zinc Sulfate	C	C	A	A	B	A	A	A	A	A	A	B	B	I.L.

*Trademark of International Nickel Co.
†Trademark of Stellite Div., Cabot Corp.
‡Trademark of Durron Co.

A—Recommended.
B—Minor to moderate effect. Proceed with caution.
C—Unsatisfactory.
I.L.—Information lacking.

Metric Conversions

Length Conversions

To Obtain / by / Multiply Number of	Meters	Inches	Feet	Millimeters	Miles	Kilometers
Meters	1	39.37	3.2808	1000	0.0006214	0.001
Inches	0.0254	1	0.0833	25.4	0.00001578	0.0000254
Feet	0.3048	12	1	304.8	0.0001894	0.0003048
Millimeters	0.001	0.03937	0.0032808	1	0.0000006214	0.000001
Miles	1609.35	63,360	5,280	1,609,350	1	1.60935
Kilometers	1,000	39,370	3280.83	1,000,000	0.62137	1

1 meter = 100 centimeters = 1000 millimeters = 0.001 kilometers = 1,000,000 micrometers
To convert metric units, merely adjust the decimal point.
1 millimeter = 1000 microns = 0.03937 inches = 39.37 mils.

Length Equivalents—Whole Inches to Millimeters

In.	0	1	2	3	4	5	6	7	8	9
	mm									
0	0.0	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. By manipulation of the decimal point any decimal value or multiple of an inch may be converted to its exact equivalent in millimeters.

Length Equivalents—Fractional Inches to Millimeters

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

Length Equivalents—Fractional and Decimal Inches to Millimeters

IN.		mm	IN.		mm	IN.		mm
Fractions	Decimals		Fractions	Decimals		Fractions	Decimals	
	.00394	.1		.2	5.08		.44	11.176
	.00787	.2	13/64	.203125	5.1594		.45	11.430
	.01	.254		.21	5.334	29/64	.453125	11.5094
	.01181	.3	7/32	.21875	5.5562		.46	11.684
1/64	.015625	.3969		.22	5.588	15/32	.46875	11.9062
	.01575	.4		.23	5.842		.47	11.938
	.01969	.5	15/64	.234375	5.9531		.47244	12.0
	.02	.508		.23622	6.0		.48	12.192
	.02362	.6		.24	6.096	31/64	.484375	12.3031
	.02756	.7	1/4	.25	6.35		.49	12.446
	.03	.762		.26	6.604	1/2	.50	12.7
1/32	.03125	.7938	17/64	.265625	6.7469		.51	12.954
	.0315	.8		.27	6.858		.51181	13.0
	.03543	.9		.27559	7.0	33/64	.515625	13.0969
	.03937	1.0		.28	7.112		.52	13.208
	.04	1.016	9/32	.28125	7.1438		.53	13.462
3/64	.046875	1.1906		.29	7.366	17/32	.53125	13.4938
	.05	1.27	19/64	.296875	7.5406		.54	13.716
	.06	1.524		.30	7.62	35/64	.546875	13.8906
1/16	.0625	1.5875		.31	7.874		.55	13.970
	.07	1.778	5/16	.3125	7.9375		.55118	14.0
5/64	.078125	1.9844		.31496	8.0		.56	14.224
	.07874	2.0		.32	8.128	9/16	.5625	14.2875
	.08	2.032	21/64	.328125	8.3344		.57	14.478
	.09	2.286		.33	8.382	37/64	.578125	14.6844
3/32	.09375	2.3812		.34	8.636		.58	14.732
	.1	2.54	11/32	.34375	8.7312		.59	14.986
7/64	.109375	2.7781		.35	8.89		.59055	15.0
	.11	2.794		.35433	9.0	19/32	.59375	15.0812
	.11811	3.0	23/64	.359375	9.1281		.60	15.24
	.12	3.048		.36	9.144	39/64	.609375	15.4781
1/8	.125	3.175		.37	9.398		.61	15.494
	.13	3.302	3/8	.375	9.525		.62	15.748
	.14	3.556		.38	9.652	5/8	.625	15.875
9/64	.140625	3.5719		.39	9.906		.62992	16.0
	.15	3.810	25/64	.390625	9.9219		.63	16.002
5/32	.15625	3.9688		.39370	10.0		.64	16.256
	.15748	4.0		.40	10.16	41/64	.640625	16.2719
	.16	4.064	13/32	.40625	10.3188		.65	16.510
	.17	4.318		.41	10.414	21/32	.65625	16.6688
11/64	.171875	4.3656		.42	10.668		.66	16.764
	.18	4.572	27/64	.421875	10.7156		.66929	17.0
3/16	.1875	4.7625		.43	10.922		.67	17.018
	.19	4.826		.43307	11.0	43/64	.671875	17.0656
	.19685	5.0	7/16	.4375	11.1125		.68	17.272

· Continued ·

Length Equivalents—Fractional and Decimal Inches to Millimeters (continued)

IN.		mm	IN.		mm	IN.		mm
Fractions	Decimals		Fractions	Decimals		Fractions	Decimals	
11/16	.6875	17.4625	51/64	.796875	20.2406		.90551	23.0
	.69	17.526		.80	20.320	29/32	.90625	23.0188
	.70	17.78		.81	20.574		.91	23.114
45/64	.703125	17.8594	13/16	.8125	20.6375		.92	23.368
	.70866	18.0		.82	20.828	59/64	.921875	23.4156
	.71	18.034		.82677	21.0		.93	23.622
23/32	.71875	18.2562	53/64	.828125	21.0344	15/16	.9375	23.8125
	.72	18.288		.83	21.082		.94	23.876
	.73	18.542		.84	21.336		.94488	24.0
47/64	.734375	18.6531	27/32	.84375	21.4312		.95	24.130
	74	18.796		.85	21.590	61/64	.953125	24.2094
	.74803	19.0	55/64	.859375	21.8281		.96	24.384
3/4	.75	19.050		.86	21.844	31/32	.96875	24.6062
	.76	19.304		.86614	22.0		.97	24.638
49/64	.765625	19.4469		.87	22.098		.98	24.892
	.77	19.558	7/8	.875	22.225		.98425	25.0
	.78	19.812		.88	22.352	63/64	.984375	25.0031
25/32	.78125	19.8438		.89	22.606		.99	25.146
	.78740	20.0	57/64	.890625	22.6219	1	1.00000	25.4000
	.79	20.066		.90	22.860			

Note: Round off decimal points to provide no more than the desired degree of accuracy.

Area Conversions

Multiply Number of / To Obtain by	Square Meters	Square Inches	Square Feet	Square Miles	Square Kilometers
Square Meters	1	1549.99	10.7639	3.861×10^{-7}	1×10^{-6}
Square Inches	0.0006452	1	6.944×10^{-3}	2.491×10^{-10}	6.452×10^{-10}
Square Feet	0.0929	144	1	3.587×10^{-8}	9.29×10^{-8}
Square Miles	2,589,999	. . .	27,878,400	1	2.59
Square Kilometers	1,000,000	. . .	10,763,867	0.3861	1

1 square meter = 10,000 square centimeters.
1 square millimeter = 0.01 square centimeter = 0.00155 square inches.

Pressure Conversions

Multiply Number of / To Obtain by	Pounds per Square Inch	Inches of Water Column	Feet of Water Column	Inches of Mercury	Ounces per Square Inch	Bar	Millibar	Kilopascals	Kilograms per Square Centimeter
Pounds per Square Inch	1	27.68	2.307	2.036	16	0.06895	68.95	6.895	0.0703
Inches of Water Column	0.0361	1	0.8333	0.07355	0.5776	0.002491	2.491	0.2491	0.00254
Feet of Water Column	0.4335	12	1	0.8826	6.936	0.02989	29.89	2.989	0.0305
Inches of Mercury	0.4911	13.60	1.133	1	7.858	0.03386	33.86	3.386	0.03453
Ounces per Square Inch	0.0625	1.73	0.144	0.127	1	0.00431	4.309	0.4309	0.0044
Bar	14.50	401.5	33.45	29.53	232	1	1000	100	1.020
Millibar	0.0145	0.4015	0.03345	0.02953	0.232	0.001	1	0.100	0.00102
Kilopascals	0.1450	4.015	0.3345	0.2953	2.32	0.01		1	0.0102
Kilograms per Square Centimeter	14.22	393.7	32.81	28.96	227.5	0.9807	980.7	98.07	1

*Pressure Equivalents—Pounds per Square Inch to Bar**

Psi	0	1	2	3	4	5	6	7	8	9
	Bar									
0	0.000000	0.068948	0.137895	0.206843	0.275790	0.344738	0.413685	0.482633	0.551581	0.620528
10	0.689476	0.758423	0.827371	0.896318	0.965266	1.034214	1.103161	1.172109	1.241056	1.310004
20	1.378951	1.447899	1.516847	1.585794	1.654742	1.723689	1.792637	1.861584	1.930532	1.999480
30	2.068427	2.137375	2.206322	2.275270	2.344217	2.413165	2.482113	2.551060	2.620008	2.688955
40	2.757903	2.826850	2.895798	2.964746	3.033693	3.102641	3.171588	3.240536	3.309484	3.378431
50	3.447379	3.516326	3.585274	3.654221	3.723169	3.792117	3.861064	3.930012	3.998959	4.067907
60	4.136854	4.205802	4.274750	4.343697	4.412645	4.481592	4.550540	4.619487	4.688435	4.757383
70	4.826330	4.895278	4.964225	5.033173	5.102120	5.171068	5.240016	5.308963	5.377911	5.446858
80	5.515806	5.584753	5.653701	5.722649	5.791596	5.860544	5.929491	5.998439	6.067386	6.136334
90	6.205282	6.274229	6.343177	6.412124	6.481072	6.550019	6.618967	6.687915	6.756862	6.825810
100	6.894757	6.963705	7.032652	7.101600	7.170548	7.239495	7.308443	7.377390	7.446338	7.515285

*To convert to kilopascals, move decimal point two positions to right; to convert to Megapascals, move decimal point one position to left. For example, 30 psi = 2.068427 bar = 206.8427 kPa = 0.2068427 MPa.
Note: Round off decimal points to provide no more than the desired degree of accuracy.

Volume Conversions

To Obtain / by / Multiply Number of	Cubic Decimeters (Liters)	Cubic Inches	Cubic Feet	U.S. Quart	U.S. Gallon	Imperial Gallon	U.S. Barrel (Petroleum)
Cubic Decimeters (Liters)	1	61.0234	0.03531	1.05668	0.264178	0.220083	0.00629
Cubic Inches	0.01639	1	5.787×10^{-4}	0.01732	0.004329	0.003606	0.000103
Cubic Feet	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. Gallon	3.78543	231	0.13368	4	1	0.833	0.02381
Imperial Gallon	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 cubic meter = 1,000,000 cubic centimeters.
1 liter = 1000 milliliters = 1000 cubic centimeters.

Volumetric Rate of Flow Conversions

To Obtain / by / Multiply Number of	Liters per Second	Liters per Minute	Cubic Meters per Hour	Cubic Feet per Hour	Cubic Feet per Minute	Imperial Gallons per Minute	U.S. Gallons per Minute	U.S. Barrels per Day (42 U.S. Gal)
Liters per Second	1	60	3.600	127.1	21.19	13.20	15.85	543.4
Liters per Minute	0.01667	1	0.06000	2.119	0.03532	0.2200	0.2642	9.057
Cubic Meters per Hours	0.2778	16.67	1	35.31	0.5886	3.666	4.403	150.9
Cubic Feet per Hour	0.007865	0.4719	0.02832	1	0.01667	0.1038	0.1247	4.275
Cubic Feet per Minute	0.4719	28.32	1.699	60.00	1	6.229	7.481	256.5
Imperial Gallons per Minute	0.07577	4.546	0.2727	9.633	0.1606	1	1.201	41.17
U.S. Gallons per Minute	0.06309	3.785	0.2271	8.021	0.1337	0.8327	1	34.29
U.S. Barrels per Day	0.001840	0.1104	0.006624	0.2339	0.003899	0.02428	0.02917	1

Temperature Conversions

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 Rankin	(°F + 459.69)

Temperature Equivalents

°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	−459.69		−34.44	−30	−22.0	26.7	80	176.0	287.8	550	1022.0
−267.78	−450		−33.33	−28	−18.4	27.8	82	179.6	293.3	560	1040.0
−262.22	−440		−32.22	−26	−14.8	28.9	84	183.2	298.9	570	1058.0
−256.67	−430		−31.11	−24	−11.2	30.0	86	186.8	304.4	580	1076.0
−251.11	−420		−30.00	−22	−7.6	31.1	88	190.4	310.0	590	1094.0
−245.56	−410		−28.89	−20	−4.0	32.2	90	194.0	315.6	600	1112.0
−240.00	−400		−27.78	−18	−0.4	33.3	92	197.6	321.1	610	1130.0
−234.44	−390		−26.67	−16	3.2	34.4	94	201.2	326.7	620	1148.0
−228.89	−380		−25.56	−14	6.8	35.6	96	204.8	332.2	630	1166.0
−223.33	−370		−24.44	−12	10.4	36.7	98	208.4	337.8	640	1184.0
−217.78	−360		−23.33	−10	14.0	37.8	100	212.0	343.3	650	1202.0
−212.22	−350		−22.22	−8	17.6	43.3	110	230.0	348.9	660	1220.0
−206.67	−340		−21.11	−6	21.2	48.9	120	248.0	354.4	670	1238.0
−201.11	−330		−20.00	−4	24.8	54.4	130	266.0	360.0	680	1256.0
−195.56	−320		−18.89	−2	28.4	60.0	140	284.0	365.6	690	1274.0
−190.00	−310		−17.8	0	32.0	65.6	150	302.0	371.1	700	1292.0
−184.44	−300		−16.7	2	35.6	71.1	160	320.0	376.7	710	1310.0
−178.89	−290		−15.6	4	39.2	76.7	170	338.0	382.2	720	1328.0
−173.33	−280		−14.4	6	42.8	82.2	180	356.0	387.8	730	1346.0
−169.53	−273.16	−459.69	−13.3	8	46.4	87.8	190	374.0	393.3	740	1364.0
−168.89	−272	−457.6	−12.2	10	50.0	93.3	200	392.0	398.9	750	1382.0
−167.78	−270	−454.0	−11.1	12	53.6	98.9	210	410.0	404.4	760	1400.0
−162.22	−260	−436.0	−10.0	14	57.2	104.4	220	428.0	410.0	770	1418.0
−156.67	−250	−418.0	−8.89	16	60.8	110.0	230	446.0	415.6	780	1436.0
−151.11	−240	−400.0	−7.78	18	64.4	115.6	240	464.0	421.1	790	1454.0
−145.56	−230	−382.0	−6.67	20	68.0	121.1	250	482.0	426.7	800	1472.0
−140.00	−220	−364.0	−5.56	22	71.6	126.7	260	500.0	432.2	810	1490.0
−134.44	−210	−346.0	−4.44	24	75.2	132.2	270	518.0	437.8	820	1508.0
−128.89	−200	−328.0	−3.33	26	78.8	137.8	280	536.0	443.3	830	1526.0
−123.33	−190	−310.0	−2.22	28	82.4	143.3	290	554.0	448.9	840	1544.0
−117.78	−180	−292.0	−1.11	30	86.0	148.9	300	572.0	454.4	850	1562.0
−112.22	−170	−274.0	0	32	89.6	154.4	310	590.0	460.0	860	1580.0
−106.67	−160	−256.0	1.11	34	93.2	160.0	320	608.0	465.6	870	1598.0
−101.11	−150	−238.0	2.22	36	96.8	165.6	330	626.0	471.1	880	1616.0
−95.56	−140	−220.0	3.33	38	100.4	171.1	340	644.0	476.7	890	1634.0
−90.00	−130	−202.0	4.44	40	104.0	176.7	350	662.0	482.2	900	1652.0
−84.44	−120	−184.0	5.56	42	107.6	182.2	360	680.0	487.8	910	1670.0
−78.89	−110	−166.0	6.67	44	111.2	187.8	370	698.0	493.3	920	1688.0
−73.33	−100	−148.0	7.78	46	114.8	193.3	380	716.0	498.9	930	1706.0
−70.56	−95	−139.0	8.89	48	118.4	198.9	390	734.0	504.4	940	1724.0
−67.78	−90	−130.0	10.0	50	122.0	204.4	400	752.0	510.0	950	1742.0
−65.00	−85	−121.0	11.1	52	125.6	210.0	410	770.0	515.6	960	1760.0
−62.22	−80	−112.0	12.2	54	129.2	215.6	420	788.0	521.1	970	1778.0
−59.45	−75	−103.0	13.3	56	132.8	221.1	430	806.0	526.7	980	1796.0
−56.67	−70	−94.0	14.4	58	136.4	226.7	440	824.0	532.2	990	1814.0
−53.89	−65	−85.0	15.6	60	140.0	232.2	450	842.0	537.8	1000	1832.0
−51.11	−60	−76.0	16.7	62	143.6	237.8	460	860.0	543.3	1010	1850.0
−48.34	−55	−67.0	17.8	64	147.2	243.3	470	878.0	548.9	1020	1868.0
−45.56	−50	−58.0	18.9	66	150.8	248.9	480	896.0	554.4	1030	1886.0
−42.78	−45	−49.0	20.0	68	154.4	254.4	490	914.0	560.0	1040	1904.0
−40.00	−40	−40.0	21.1	70	158.0	260.0	500	932.0	565.6	1050	1922.0
−38.89	−38	−36.4	22.2	72	161.6	265.6	510	950.0	571.1	1060	1940.0
−37.78	−36	−32.8	23.3	74	165.2	271.1	520	968.0	576.7	1070	1958.0
−36.67	−34	−29.2	24.4	76	168.8	276.7	530	986.0	582.2	1080	1976.0
−35.56	−32	−25.6	25.6	78	172.4	282.2	540	1004.0	587.8	1090	1994.0

— Continued —

Temperature Equivalents (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
593.3	1100	2012.0	648.9	1200	2192.0	704.4	1300	2372.0	760.0	1400	2552.0
598.9	1110	2030.0	654.4	1210	2210.0	710.0	1310	2390.0	765.6	1410	2570.0
604.4	1120	2048.0	660.0	1220	2228.0	715.6	1320	2408.0	771.1	1420	2588.0
610.0	1130	2066.0	665.6	1230	2246.0	721.1	1330	2426.0	776.7	1430	2606.0
615.6	1140	2084.0	671.1	1240	2264.0	726.7	1340	2444.0	782.2	1440	2624.0
621.1	1150	2102.0	676.7	1250	2282.0	732.2	1350	2462.0	787.0	1450	2642.0
626.7	1160	2120.0	682.2	1260	2300.0	737.8	1360	2480.0	793.3	1460	2660.0
632.2	1170	2138.0	687.8	1270	2318.0	743.3	1370	2498.0	798.9	1470	2678.0
637.8	1180	2156.0	693.3	1280	2336.0	748.9	1380	2516.0	804.4	1480	2696.0
643.3	1190	2174.0	698.9	1290	2354.0	754.4	1390	2534.0	810.0	1490	2714.0
									815.6	1500	2732.0

Mass Equivalents—Pounds to Kilograms
(1 pound = 0.4536 kilogram)

Lb	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

Density Conversions

Multiply Number of / To Obtain by	Grams per Milliliter	Kilograms per Cubic Meter	Pounds per Cubic Foot	Pounds per Cubic Inch
Grams per Milliliter	1	1000	62.43	0.03613
Kilograms per Cubic Meter	0.001000	1	0.06243	0.00003613
Pounds per Cubic Foot	0.01602	16.02	1	0.0005787
Pounds per Cubic Inch	27.68	27,680	1728	1

Velocity Conversions

Multiply Number of / To Obtain by	Feet per Second	Feet per Minute	Miles per Hour	Meters per Second	Meters per Minute	Kilometers per Hour
Feet per Second	1	60.00	0.6818	0.3048	18.29	1.097
Feet per Minute	0.01667	1	0.01136	0.005080	0.3048	0.01829
Miles per Hour	1.467	88.00	1	0.4470	26.82	1.609
Meters per Second	3.280	196.9	2.237	1	60.00	3.600
Meters per Minute	0.05468	3.281	0.03728	0.01667	1	0.06000
Kilometers per Hour	0.9113	54.68	0.6214	0.2778	16.67	1

Heat Flow Rate Conversions

Multiply Number of / by / To Obtain	Watts	Calories per Second	Kilocalories per Hour	British Thermal Units per Hour
Watts	1	0.2390	0.8604	3.412
Calories per Second	4.184	1	3.600	14.28
Kilocalories per Hour	1.162	0.2778	1	3.966
British Thermal Units per Hour	0.2831	0.07000	0.2522	1

Force Conversions

Multiply Number of / by / To Obtain	Kilonewtons	Kilogram Force	Pound Force	Poundals
Kilonewtons	1	102.0	224.8	7233
Kilogram Force	0.009807	1	2.205	70.93
Pound Force	0.004448	0.4536	1	32.17
Poundals	0.0001383	0.01410	0.03108	1

Power Conversions

Multiply Number of / by / To Obtain	Watts	Kilogram Force Meters per Second	Metric Horsepower	Foot Pound Force per Second	U.S. Horsepower
Watts	1	0.1020	.001360	0.7376	0.001341
Kilogram Force Meters per Second	9.807	1	0.01333	7.233	0.01315
Metric Horsepower	735.5	75.00	1	542.5	0.9863
Foot Pound Force per Second	1.356	0.1383	0.001843	1	0.001818
U.S. Horsepower	745.7	76.04	1.014	550.0	1

Torque Conversions

Multiply Number of / by / To Obtain	Newton Meters	Kilogram Force Meters	Foot Pounds	Inch Pounds
Newton Meters	1	0.1020	0.7376	8.851
Kilogram Force Meters	9.807	1	7.233	86.80
Foot Pounds	1.356	0.1383	1	12.00
Inch Pounds	0.1130	0.01152	0.08333	1

Additional Data

Fisher Controls publishes a variety of materials to meet the technical needs of industry and to share the results of Fisher research and experience. Some of these materials are listed below and are available from your Fisher sales office or sales representative.

- Planning Guides
- Reprints of Published Articles
- Technical Monographs
- Textbooks
- Educational Programs (video format)
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