DANIEL® **NITROGEN LOADED LIQUID CONTROL VALVES** PRODUCT GUIDE

Series 700





NITROGEN LOADED RELIEF / BACK PRESSURE VALVES

Overview

The Daniel Series 700 (Models 762, 763, 765, 766 and 767) nitrogen loaded relief / back pressure control valves are specifically designed to regulate and control maximum pipeline pressures or to maintain a minimum back pressure in a system. They have proven to be reliable, rugged and very responsive in controlling pipeline surges and pressures. The Daniel Models 762, 763, 765, 766 and 767 nitrogen loaded relief / back pressure control valves are not pilot operated.

They incorporate an integral oil reservoir mounted on the external surface of the valve cylinder head, which upon installation, is partially filled with a light oil. Nitrogen under pressure is then applied to the reservoir. The oil is a moveable barrier between the nitrogen and the valve piston. This insures that nitrogen gas does not permeate the piston seals which would result in nitrogen consumption and the need to constantly replenish the system. A major benefit of the valve design is that all internal parts, including cylinder, piston and seat ring are removed as a cartridge assembly which keeps your line connections intact.

Applications

- Back pressure control
- Pipeline pump station by-pass
- Pipeline pressure and surge relief
- By-pass pressure control

Features and Benefits

- Modular construction
- No diaphragms or stuffing boxes
- Linear control characteristics
- · Exceptionally fast response speed
- · Positive shut-off
- · High flow capacity
- · Balanced piston design
- · No pilot controls

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- Can pass dirty or viscous products
- Screwed seat rings on all sizes
- No consumption of nitrogen gas



Principles of Operation

The Daniel Models 762, 763, 765, 766 and 767 control valves are normally closed and open on increasing inlet pressure. The basic valve is of the balanced piston operated design. Pressure applied to the inlet side of the piston is equally transmitted to the spring side of the piston. When the line pressure on the inlet side exceeds the gas pressure plus the pressure exerted by the spring, the moveable barrier of oil compresses the gas and the valve opens. As line pressure falls below set point, the gas pressure, added to the spring pressure, closes the valve and it remains closed as long as gas pressure is greater than the line pressure. Opening and closing speeds are controlled by a check valve mounted to the internal surface of the cylinder head as shown in Figure 1.

Opening speed is relatively unrestricted which results in very fast opening speed. Closing speed is controlled by the fixed orifice in the check valve.

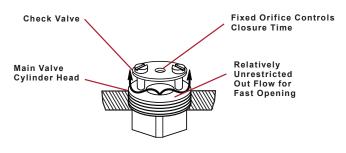


Figure 1: Check Valve

Oil Reservoir

The Oil Reservoir is supplied with two (2) sight gauges. In a closed position, the oil is visible only at the lower sight gauge. Should oil be visible in the upper sight gauge, this indicates line product is leaking into the reservoir or that the valve is open. If no oil is visible in the lower sight gauge, this indicates the reservoir oil is leaking into the product stream.

Oil Specifications

Use a light weight non-detergent oil between 5-30 Centipoise based on climate conditions of user.

The oil to fill the reservoir, nitrogen tank, pressure switch and other interconnecting pieces is to be supplied by the customer.

Opening / Closing Speed

The opening speed of the valve is virtually unrestricted. Closing speed is standard at three (3) seconds from a full open position, based on gas pressure being 25 psi (1,724 kPa) above line pressure. The fastest closure is limited to 0.5 seconds at 1,500 psi (10,342 kPa) differential pressure to protect the piston and seat ring. For closure speeds longer than three (3) seconds, the orifice size can be changed to match customer requirements. It should be noted that the calculated closing speeds are a function of the viscosity of the oil in the reservoir. Typical valve opening times are illustrated in Figure 2.

Pressure Switch

The valve will open any time gas pressure is less than line pressure. A pressure switch is recommended in the gas supply line to the valve for alarm actuation should gas pressure decrease below an acceptable operating level.



Horizontal Pipeline Installation

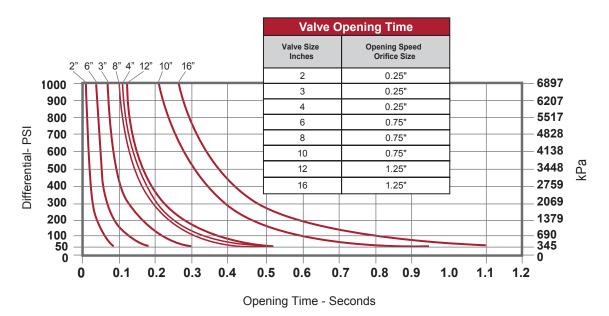


Figure 2: Typical Valve Opening Time

Gas Plenum Tank Installation and Sizing

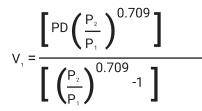
The gas plenum should be buried underground to keep the gas at a constant temperature. Thermal expansion, caused by increases in temperature, will change the relief set point.

The effective volume of the gas plenum decreases as the valve opens by an amount equal to the piston displacement. The size of the gas plenum determines the percentage that the pressure relief set point will change as the valve opens. For example, a 12" valve piston displacement is 554 cubic inches from a closed to an open position. Thus, when fully opened, an equal amount of gas is contained in a volume that is decreased by 554 cubic inches. From Boyles Law, we can see the proportional increase in pressure as: $P_1V_1 = P_2V_2$. For example, a 12" valve piston displacement is 554 cubic inches from a closed to an open position.

Before the gas tank is sized, determine:

- 1. Set point (PSI)⁽¹⁾
- 2. Valve size
- 3. Allowable over-pressure (PSI) ⁽¹⁾ (typically 10%).

Gas Plenum Sizing Formula



- P₁ = Valve required set pressure, valve closed
- P₂ = Maximum allowable overpressure, valve open
- V₁ = Total Gas Volume (gas chamber and volume behind main valve piston)
- PD = Volume displacement of main valve piston

Exponent = 0.709 derived from K factor of Nitrogen (1.41).

No consideration is given to the volume of gas contained in tubing, fittings and the top portion of the valve itself.

| Volume Displacement (Main Valve Piston) | | | | | | | | | | |
|---|---|-----|-------|--|--|--|--|--|--|--|
| Valve Size | Valve Size Cubic Inches Valve Size Cubic Inches | | | | | | | | | |
| 2" | 3.7 | 8" | 165 | | | | | | | |
| 3" | 12.6 | 10" | 347 | | | | | | | |
| 4" | 20 | 12" | 554 | | | | | | | |
| 6" | 66 | 16" | 1,207 | | | | | | | |

Example:

- (12" Valve, Set point 640 psi and Over-pressure is 40 psi)
- P₁ = 640 psi set point required, minus 4 psi spring load plus 14.7 psi (adjustment to absolute) = 650.7 psi
- P₂ = 680 psi maximum allowable over-pressure, minus 6 psi spring load plus 14.7 psi (adjustment to absolute) = 688.7 psi

 $V_1 = Unknown$

1 U.S. Gallon = 231 cu. in.

$$V_1 = \frac{576.74779}{0.041061} = 14,046.121 \text{ in}^3$$

$$V_1 = \frac{14,046.121}{231}$$
 = 60.80 U.S. Gallons (Tank Volume)

NOTE: Valve is fitted with light piston spring which provides:

4 psi Preload with valve closed 6 psi Preload with valve open

This 4 and 6 psi Preload must be subtracted from $P_1 \& P_2$, respectively, to arrive at actual gas pressure.

Conditions assume adiabatic compression.

⁽¹⁾ Must be provided by customer

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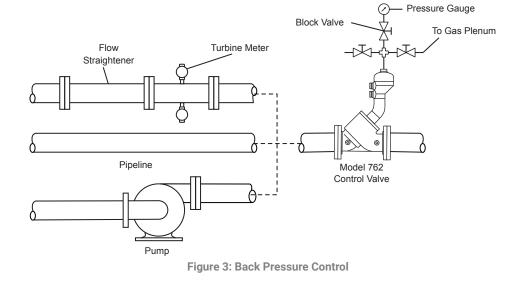
Applications

Back Pressure Control

The Model 762 is ideally suited for back pressure control and minimum pressure drop. When line pressure exceeds the gas pressure, the valve will open and follow the CV curve for pressure loss.

Typical applications for minimum back pressure control requirements are illustrated in Figure 3.

- Reference API Chapter 5 for minimum back pressure requirements of turbine and ultrasonic meters.
- On the end of a pipeline or any point along the pipeline where the upstream pressure is subject to drop below minimum requirements.
- Discharge of centrifugal pumps to maintain maximum efficiency and to start against a closed valve.



Pipeline Pump Station By-Pass

Most pipeline have booster pumps at intervals along the pipeline. If a pump station is shutdown, it must be by-passed or the entire pipeline is subject to being shutdown. The Model 766 control valve, when installed as shown in Figure 4, will automatically open and by-pass the pump station when line pressure exceeds set point.

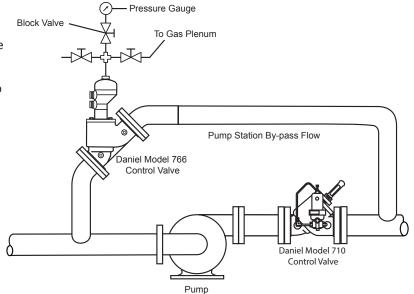


Figure 4: Pipeline Pump Station By-Pass

Pipeline Pressure and Surge Relief

Product movement by pipeline requires over-pressure protection. Response time to pressure rise is very critical. Many times a pilot operated or a conventional direct operated spring biased relief valve cannot react fast enough to limit surge pressure to a desirable level. The Model 762 will respond timely to relieve the volume of product necessary to decrease pipeline pressure to or below set-point. The installation shown in Figure 5 is very common in pipeline applications.

The schematic also shows the installation of a 45° in-line position valve design that keeps the piston alignment vertical. This distributes the weight of the piston equally and gives equal resistance to piston O-ring movement. Horizontal or vertical installation is also available. Whether installed at 45°, horizontally, or vertically with flow traveling up, the oil reservoir is in a vertical position. The type of installation must be specified on the order. Installing the valve in a vertical line with flow traveling down is not recommended.

Normal causes of surges and excess pressure

- Inadvertently closing a main line valve
- · Closing a main line valve too fast
- Pump startup
- · Stopping a pump with potential reverse flow
- Failure of a pipeline booster pump. In addition, the following factors can become very important with pipeline aging which reduce the maximum surge pressure the pipeline can withstand.
- Wear from product movement
- Internal and external corrosion
- Frequency and amplitude of surge and shock pressures

By-Pass Pressure Control

The Model 762 is suited for constant pump by-pass control to regulate pump discharge pressure. In this application the valve will also control surges. (Reference Figure 5).

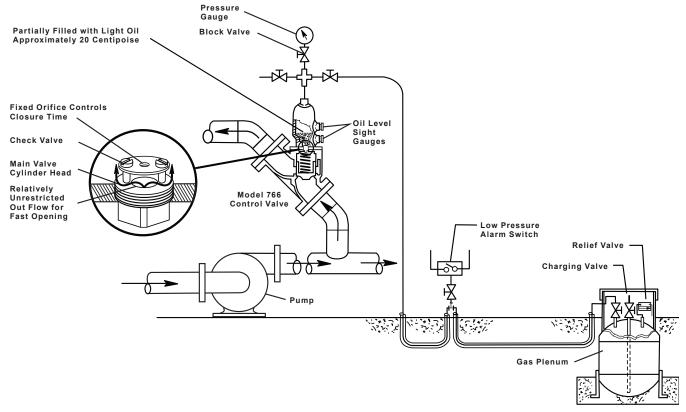


Figure 5: Excess Pressure and Surge Relief or Pump By-Pass Control

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Nitrogen System Panel

A nitrogen control panel may be advantageous if there are large variations in ambient temperature or if it is not practical to bury the nitrogen plenum underground.

The control panel can be used to provide a precise output which is used to regulate the set point of the gas loaded relief valve.

The Nitrogen Supply Cylinders shown in Figure 6 below are used as a source of nitrogen and the control panel will use this to replenish the nitrogen pressure within the valve anytime it falls below the desired set point. Conversely if the set point at the valve is higher than the desired set point, the control panel will relieve the excess pressure from the valve. Since the Daniel valve does not consume nitrogen, unlike competitive valves, the need to adjust nitrogen is normally due to changes in pressure due to ambient temperatures.

The nitrogen set point pressure is measured using a pressure transmitter, which can be transmitted to a remote control room. The system nitrogen set point is field adjustable by authorized personnel. Daniel Measurement and Control can furnish a complete system that will include the surge relief valve, inlet / outlet piping, nitrogen control panel, supply cylinders and the plenum. The system is carefully designed, engineered and assembled onto a structural skid with a lifting facility (as shown below in Figure 6).

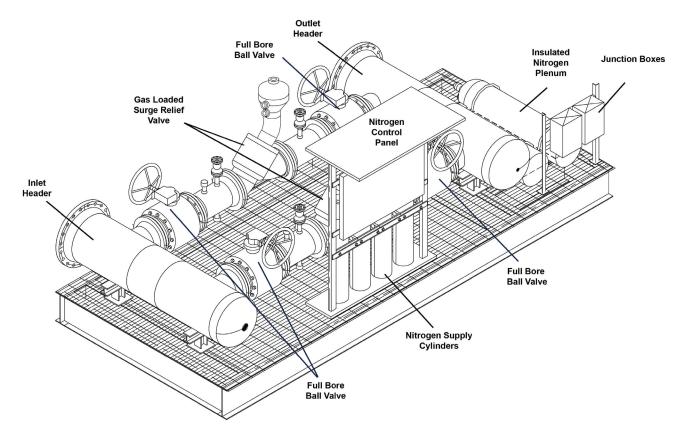


Figure 6: Surge Relief System with Nitrogen Panel and Plenum

STANDARD SPECIFICATIONS

Please consult Daniel if your requirements are outside the specifications noted below. Other product and material offerings may be available depending on the application. For world area locations and contact information, refer to the back page of the data sheet.

Materials of Construction

Main Valve Body

• Steel - ASTM-A352-GR-LCC

Main Valve Cylinder

- 2" 4" Stainless Steel on 150 600 ANSI
- 6" 16" Steel, Nickel Coated on 150 600 ANSI

Main Valve Piston

• 2" - 16" Stainless Steel standard

Seat Ring

- 2" 6" Stainless Steel
- 8" 16" Steel, Nickel Coated standard 150#, 300#, 600#

O-Rings

- Standard Viton® Dynamic, Buna-N Static
- Optional Neoprene, EPR, all Viton[®], GFLT, all Buna-N, AP (Aggressive Products) Options

Other internal parts: Stainless Steel

- Reservoir Carbon Steel ASRM A333
- Cylinder Head ASTM A516 GR70
- Elbow, Cap, Reducers ASTM A-350LF2
- Studs and Nuts A193 Gr BT, 194 Gr 2H

Recommended Spare Parts

O-rings

Process Parameter

 Temperature Range⁽¹⁾: -15°F to 400°F (-26°C to 205°C) Optional 400°F (204°C) (not available for solenoid operated valves)

Valve Capacity

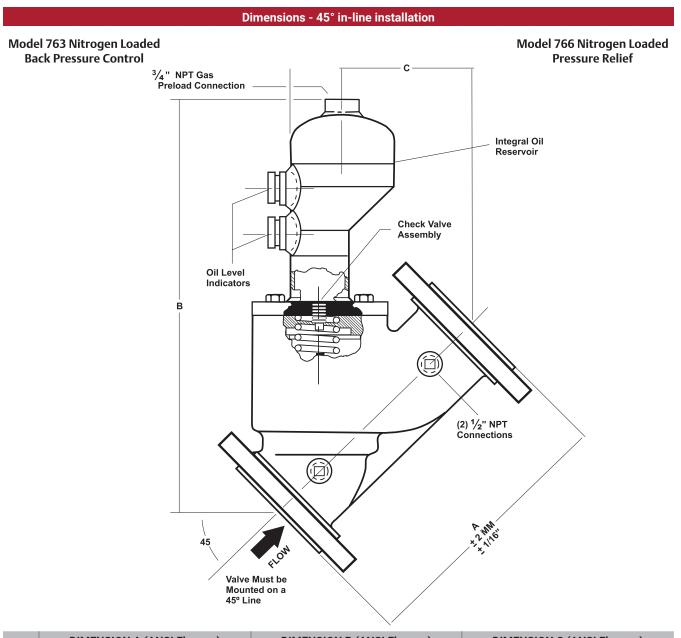
| Valve Capacity | | | | | | | | | | | | |
|----------------------|----|-----|-----|-----|-------|-------|-------|-------|--|--|--|--|
| Valve size | 2" | 3" | 4" | 6" | 8" | 10" | 12" | 16" | | | | |
| C _v (GPM) | 86 | 186 | 309 | 688 | 1,296 | 2,040 | 2,920 | 5,360 | | | | |

| Flange Connections / Ratings (ANSI) | | | | | | | | | |
|-------------------------------------|-----------------------|-----------------------|-----------------------|--|--|--|--|--|--|
| Valve Size | 150 ANSI MWP at 100°F | 300 ANSI MWP at 100°F | 600 ANSI MWP at 100°F | | | | | | |
| 2" - 16" | 285 psi | 740 psi | 1,480 psi | | | | | | |
| MWP: Maximum Working Pressure | | | | | | | | | |

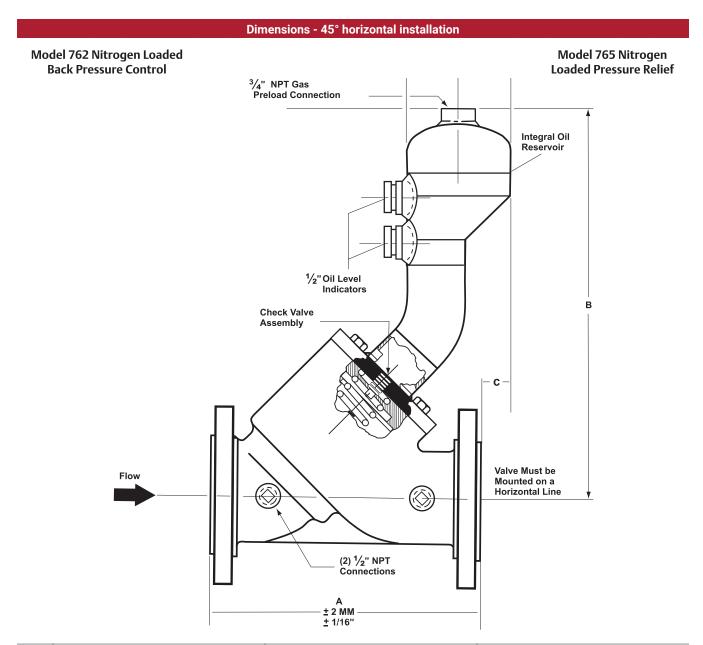
| Flange Connections / Ratings (DIN) | | | | | | | | | | | |
|------------------------------------|--------------------------|--------------------------|--------------------------|--|--|---------------------------|--|--|--|--|--|
| Valve Size | DIN PN16 MWP at 120°C | DIN PN25 MWP at 120°C | DIN PN40 MWP at 120°C | DIN PN64 (300 ANSI) MWP at 120°C | DIN PN64 (600 ANSI) MWP at 120°C | DIN PN100 MWP at 120°C | | | | | |
| DN50 - DN400 | 16 bar | 25 bar | 40 bar | 51 bar | 64 bar | 100 bar | | | | | |
| MWP: Maximum | Working Pressure | | | | | | | | | | |

⁽¹⁾ Temperature range is dependent on o-ring material Tmin and Tmax.

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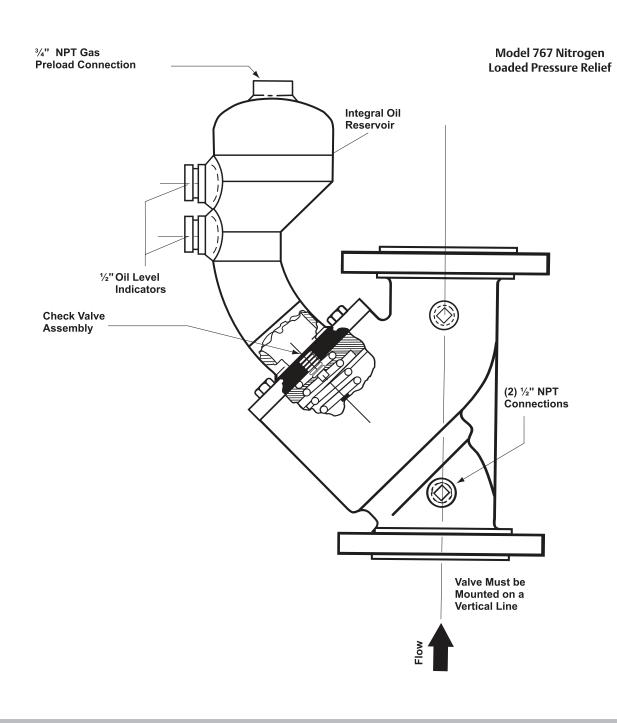


| | C | DIMENSION A (ANSI Flanges) | | | | | | | DIMENSION B (ANSI Flanges) | | | | | | | DIMENSION C (ANSI Flanges) | | | | | |
|---------------|--------|----------------------------|--------|-------|--------|-------|--------|-------|----------------------------|-------|--------|-------|--------|-----|--------|----------------------------|--------|-----|--|--|--|
| Valve Size | 150 | | 300 | | 600 | | 150 | | 300 | | 600 | | 150 | | 300 | | 600 | | | | |
| 0120 | In | mm | In | mm | In | mm | In | mm | In | mm | In | mm | In | mm | In | mm | In | mm | | | |
| 2" | 10 1/4 | 260 | 10 1/2 | 267 | 11 1/2 | 292 | 15 1/2 | 394 | 15 1/2 | 394 | 16 1/8 | 410 | 5 1/2 | 140 | 5 3/8 | 137 | 5 3/4 | 146 | | | |
| 3" | 11 | 279 | 13 1/8 | 333 | 14 | 356 | 18 5/8 | 473 | 20 1/4 | 514 | 20 1/4 | 514 | 5 3/8 | 137 | 6 1/4 | 159 | 7 1/8 | 181 | | | |
| 4" | 13 | 330 | 14 1/2 | 368 | 17 | 432 | 19 1/4 | 487 | 19 1/4 | 502 | 27 1/2 | 699 | 6 3/4 | 171 | 7 1/4 | 184 | 8 5/8 | 219 | | | |
| 6" | 17 | 432 | 17 7/8 | 454 | 22 | 559 | 25 5/8 | 151 | 25 7/8 | 657 | 27 3/4 | 705 | 8 5/8 | 219 | 8 3/4 | 222 | 10 1/2 | 267 | | | |
| 8" | 22 1/4 | 565 | 23 1/4 | 591 | 26 | 660 | 29 7/8 | 759 | 30 1/4 | 768 | 32 3/4 | 832 | 10 | 254 | 11 1/4 | 286 | 12 5/8 | 321 | | | |
| 10" | 26 1/2 | 673 | 27 7/8 | 708 | 31 | 787 | 35 1/4 | 895 | 36 1/4 | 921 | 39 | 991 | 12 | 305 | 13 3/8 | 340 | 7 1/2 | 445 | | | |
| 12" | 30 7/8 | 784 | 33 5/8 | 854 | 36 1/2 | 927 | 42 3/4 | 1,086 | 43 5/8 | 1,108 | 45 1/2 | 1,156 | 15 1/2 | 394 | 16 3/4 | 425 | 18 | 457 | | | |
| 16" | 41 3/8 | 1,051 | 43 1/2 | 1,105 | 46 | 1,168 | 58 | 1,473 | 58 3/4 | 1,492 | 56 1/4 | 1,429 | 20 3/4 | 527 | 21 3/4 | 552 | 23 3/4 | 603 | | | |



| | DIMENSION A (ANSI Flanges) | | | | | | | DIMENSION B (ANSI Flanges) | | | | | | | DIMENSION C (ANSI Flanges) | | | | | |
|---------------|----------------------------|-------|--------|-------|--------|-------|--------|----------------------------|--------|-------|--------|-------|-------|-----|----------------------------|----|-------|----|--|--|
| Valve Size | 150 | | 30 | 300 | | 600 | | 150 | | 300 | | 600 | | 50 | 300 | | 600 | | | |
| 5120 | In | mm | In | mm | In | mm | In | mm | In | mm | In | mm | In | mm | In | mm | In | mm | | |
| 2" | 10 1/4 | 260 | 10 1/2 | 267 | 11 1/2 | 292 | 14 1/8 | 359 | 14 1/8 | 359 | 14 1/2 | 368 | 5/8 | 16 | 3/4 | 19 | 1/2 | 13 | | |
| 3" | 11 | 279 | 13 1/8 | 333 | 14 | 356 | 16 3/4 | 425 | 17 1/4 | 438 | 18 3/8 | 467 | 2 3/8 | 60 | 1 1/2 | 38 | 1 1/2 | 38 | | |
| 4" | 13 | 330 | 14 1/2 | 368 | 17 | 432 | 17 5/8 | 448 | 17 5/8 | 470 | 19 3/8 | 492 | 1 1/4 | 32 | 1/2 | 13 | 1/2 | 13 | | |
| 6" | 17 | 432 | 17 7/8 | 454 | 22 | 559 | 23 3/8 | 594 | 23 3/8 | 606 | 24 3/8 | 619 | 2 3/8 | 60 | 2 | 51 | 1/4 | 6 | | |
| 8" | 22 1/4 | 565 | 23 1/4 | 591 | 26 | 660 | 27 | 686 | 27 | 714 | 28 1/8 | 714 | 3 3/8 | 86 | 1 5/8 | 41 | 3/4 | 19 | | |
| 10" | 26 1/2 | 673 | 27 7/8 | 708 | 31 | 787 | 32 1/2 | 806 | 31 3/4 | 806 | 34 3/4 | 883 | 4 | 102 | 1 1/2 | 38 | 1/2 | 13 | | |
| 12" | 30 7/8 | 784 | 33 5/8 | 854 | 36 1/2 | 927 | 38 3/4 | 984 | 38 3/4 | 1,000 | 41 | 1,041 | 3 5/8 | 92 | 2 1/8 | 54 | 1 1/8 | 29 | | |
| 16" | 41 3/8 | 1,051 | 43 1/2 | 1,105 | 46 | 1,168 | 52 1/4 | 1,327 | 52 1/4 | 1,327 | 49 | 1,245 | 3 1/4 | 83 | 2 1/8 | 54 | CF | CF | | |

Vertical installation



For certified dimension prints of the Model 767, please consult the factory.

| | Approximate Shipping Weight and Volume | | | | | | | | | | | | |
|------------|--|---------|------------|--------------|----------|-----------|-----------------|--------------|--|--|--|--|--|
| | | 150 - 3 | 00 ANSI | | 600 ANSI | | | | | | | | |
| Valve Size | Shipping | Weights | Shippin | g Volume | Shipping | y Weights | Shipping Volume | | | | | | |
| | lbs | Kgs | Cubic Feet | Cubic Meters | lbs | Kgs | Cubic Feet | Cubic Meters | | | | | |
| 2" | 63 | 29 | 1.26 | 0.036 | 103 | 47 | 1.43 | 0.04 | | | | | |
| 3" | 113 | 51 | 2.11 | 0.06 | 158 | 72 | 2.25 | 0.063 | | | | | |
| 4" | 148 | 67 | 2.66 | 0.075 | 213 | 97 | 4.23 | 0.12 | | | | | |
| 6" | 268 | 122 | 5.12 | 0.145 | 363 | 165 | 7.19 | 0.204 | | | | | |
| 8" | 493 | 224 | 9.84 | 0.279 | 423 | 192 | 11.84 | 0.335 | | | | | |
| 10" | 743 | 337 | 16.32 | 0.462 | 1,225 | 556 | 20.45 | 0.579 | | | | | |
| 12" | 1,278 | 580 | 26.83 | 0.76 | 1,883 | 854 | 33.29 | 0.943 | | | | | |
| 16" | CF | CF | CF | CF | CF | CF | CF | CF | | | | | |

Purchase Specifications

These valves are normally closed and only open when line pressure exceeds the gas loaded bias pressure applied to the integral reservoir of the valve. The gas loaded bias pressure must be equal to the desired set point. There are no unbalanced forces. The integral oil reservoir includes two (2) sight gauges for visual indication of the oil level. Opening and closing speeds are factory set with no external adjustments. The basic valve is a balanced piston design with linear control characteristics. It is a single seated valve with 45° body construction. A major benefit of our valve design is that all internal parts, including cylinder, piston and seat ring are removed as a cartridge assembly which keeps your line connections intact.

Required Ordering Information

- Size
- Product, product viscosity, product specific gravity
- Minimum and maximum operating temperature
- Minimum and maximum flow rate
- Minimum, normal and maximum operating pressure
- · Control functions to be performed
- Flange connections (150, 300, 600 ANSI Class)
- O-ring material
- Type of installation (45° in-line, horizontal or vertical)
- Main valve piston material
- Optional equipment

DANIEL 7NL NITROGEN LOADED CONTROL VALVE SELECTION MATRIX

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В

| | v | XXX | XX | XX | K | X | x x |
|---|----|----------------------|----------------------------------|--------------------------------------|---|---------------|-------------|
| Device Control Valve | .v | | T | | | | |
| Basic Type / Primary Function Nitrogen Loaded Back Pressure Control - Horizontal Nitrogen Loaded Back Pressure Control - Horizontal | | .762 .762 .762 | | | | | |
| Line Size 2" DN50 | | | 03 04 06 08 10 12 | | | | |
| Flange Rating / Maxiumum Working Pressure 150# ANSI 285 PSI MWP 1,965 kPa MWP. 300# ANSI 740 PSI MWP 5,102 kPa MWP. 600# ANSI 1,480 PSI MWP 10,204 kPa MWP. PN16 DIN 2526 Form C 16 BAR MWP. PN16 DIN 2526 Form C 25 BAR MWP. PN16 DIN 2526 Form C 40 BAR MWP. PN16 DIN 2526 Form C 64 BAR MWP. PN16 DIN 2526 Form C 100 BAR MWP. | | | | . C . D . H . K L . N | | | |
| Materials of Construction | | | | | | | |
| Valve Body Carbon Steel Low Temp Carbon Steel Nickel Coated Carbon Steel | | | | (| С | | |
| Piston Stainless Steel | | | | | | ↓ B | |
| Main Valve Construction | | | | | | , | Ļ |
| Standard Aggressive Product | | | | | | | |
| Main Valve Elastomer | | | | | | | |
| Viton Viton GFLT Viton V1289-75 Viton for LPG Service | | | | | | | C D E |
| All EPR All Neoprene All Nitrile Teflon Dynamic/ Low Swell Nitrile Static Kalrez® O-rings | | | | | | | G H |
| NACE No Yes | | | | | | | |

With over 90 years of experience, Daniel is the only manufacturer that has the knowledge and experience to engineer and offer superior products that are trusted to provide the most reliable and accurate measurements in the global oil and gas industry.

Contact Us Email: info@daniel.com Phone: (346) 509-3700

