

Definition of Terms

---Some of the terms used in this manual are defined below:

Conservation Vent: A device which is connected to a storage tank and regulates the pressure therein. Conservation vents may provide pressure relief, vacuum relief, or both. Pallets move in direct response to tank pressure allowing flow out of or into the tank. Pallet movement may be controlled by weight-loading, spring-loading, or a pilot valve.

Deadband: The total pressure difference between the blanketing valve opening pressure (or set point) and resealing pressure. This applies to the main valve; some leakage through the pilot will occur above the main valve resealing pressure

Diaphragm Chamber: The portion of the pilot valve which contains the sense diaphragm.

Dome Pressure: The pressure in the dome volume.

Dome Volume: The chamber between the poppet in the pilot valve and the piston in the main valve.

Emergency Vent: A conservation vent which provides additional pressure relief to accommodate extraordinary conditions such as fire exposure to a tank or full-open failure of a blanketing valve.

Flow Plug: A small cylinder which may be connected to the end of the piston to partially block flow past the inlet seat of the main valve. This is used to reduce the blanketing valve's flow capacity.

Inlet Port: The connection to the blanketing valve coming from the gas supply line.

Main Valve: The portion of the blanketing valve through which the supply gas flows into the storage tank.

Orifice: A small diameter passage in the line between the inlet port and the dome volume.

Outlet Port: The connection to the blanketing valve leading to the storage tank.

Pilot Valve: The portion of the blanketing valve which senses the tank pressure and controls the dome pressure.

Piston: The component in the main valve which moves open from a normally seated position to allow flow of blanketing gas through the valve.

Piston Spring: The spring which biases the piston towards the seated position.

Poppet: The component in the pilot valve which can move open from a normally seated position to allow flow through the valve.

Poppet Spring: The spring which biases the poppet towards the seated position.

Purge: A very low flow of supply gas directed past the sense line and/or the outlet in order to keep corrosive vapors away from the blanketing valve.

Sense Chamber: The space below the diaphragm chamber to which the pressure from the sense line is directed. The pressure in the sense chamber controls the opening and closing of the pilot and blanketing valve.

Sense Diaphragm: A thin, non-metallic disc in the diaphragm chamber which flexes in response to changes in tank pressure acting upon it.

Sense Line: A line running from the storage tank to the sense port of the blanketing valve. It feeds tank pressure to the underside of the sense diaphragm.

Sense Port: The connection to the blanketing valve coming from the sense line.

Set Point: The tank pressure (positive or negative) at which the blanketing valve opens.

Soft Goods: The elastomeric components of the blanketing valve including the o-rings, gaskets and diaphragm.

Stop: A bolt connected to the sense diaphragm which contacts the poppet to move it in response to movement of the sense diaphragm.

The Function of Blanketing Valves

The Series 20 Blanketing Valve uses a supply of high pressure gas to maintain a blanket of low pressure gas above the stored material in storage tanks. The blanket gas must be non-flammable and chemically non-reactive when mixed with the vapors of the stored material. The inert gas, usually Nitrogen, is injected, as necessary, into the vapor space in order to maintain an inert atmosphere. The blanket pressure is usually very low, less than 1 PSI.

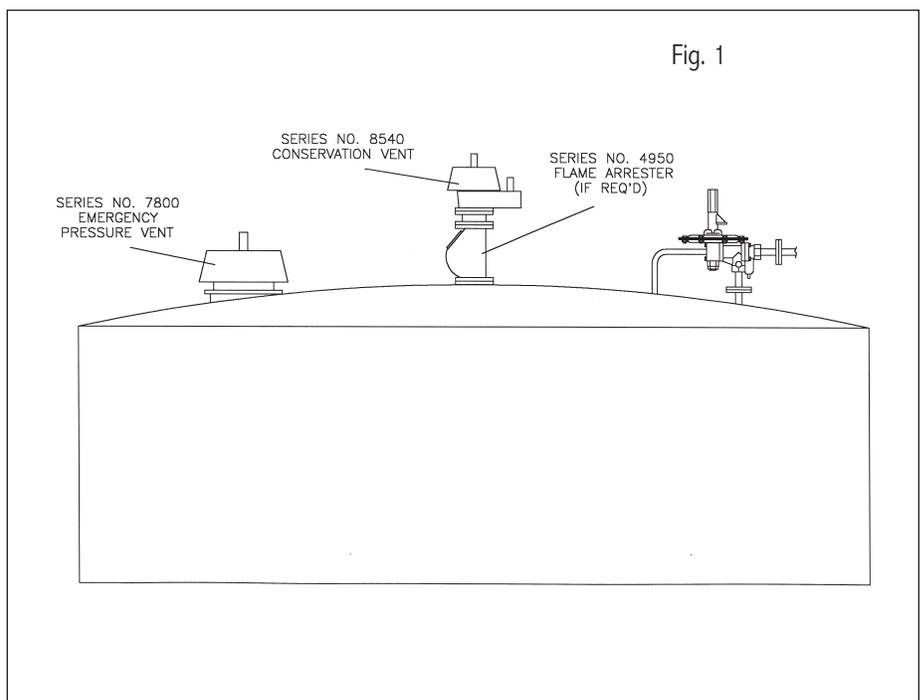
Tank blanketing serves several purposes:

1. Maintains the vapor space of the storage tank at an allowable vacuum during emptying or thermal contraction.
2. Keeps the vapor space non-flammable by keeping out oxygen-rich air.
3. Minimizes evaporation and, thus, product loss.
4. Reduces product degradation and tank corrosion by keeping contaminants and moisture from entering the tank.

Blanketing Valve Operation

A blanketing valve is typically located on top of a storage tank along with a pressure-vacuum conservation vent and an emergency pressure vent. Piping from the blanketing gas supply source is connected to the valve inlet, and the valve outlet is piped to the tank. A sense line runs from a remote location on the tank to the sense port thus supplying control pressure for the valve. The blanketing valve provides primary vacuum relief, opening to flow in blanketing gas when emptying the tank or thermal contraction lead to drop in pressure. The pressure conservation vent provides primary pressure relief, opening to relieve pressure build-up in the tank during filling or thermal expansion. The vacuum conservation vent and the emergency pressure vent furnish supplemental or emergency relief. Note the placement of the flame arrester for additional protection in the event of inert gas failure.

A typical tank blanketing installation is shown below in Fig. 1.



Blanketing Valve Operation

The Protectoseal Series 20 Blanketing Valve is pilot-operated. Pilot-operated valves open and close quickly resulting in tight operating bands as opposed to direct spring-operated valves which open and close gradually over a wider pressure range.

Pilot-operated blanketing valves essentially consist of two separate valves operating in tandem (see Fig 2 and Fig. 3). The pilot valve (A), which is controlled by the sensed tank pressure, in turn controls the opening and closing of the main valve (B) which provides flow into the tank from the inert gas supply. Main components of the pilot valve are a pressure sensing chamber (C) and a poppet (D) which can move up and down. The main valve has a piston (E) which can move to control flow into the tank.

Three external connections are required for operation of the blanketing valve. One line (F) runs from the tank into the pilot valve to provide the controlling pressure. The second line (G) comes from the inert gas supply and connects to the main valve inlet. This inlet gas supply also feeds a line (H) running out through an external filter (shown as internal line for clarity) and a small orifice to bleed inert gas into the dome volume between the main and pilot valves. The third external connection (I) is the main valve outlet which provides inert gas flow into the tank.

The sensed pressure in the pilot valves comes through a remote sensing line (F) which is connected to the tank at a distance far enough from the blanketing valve connection that it will not be affected by the flow stream of inert gas into the tank. The sensed tank pressure (J), channeled to the underside of the sense diaphragm (K), pushes up while atmospheric pressure (L) and the setting spring (M) push down on the top side. When tank pressure drops below the set pressure (which is fixed by initial compression of the setting spring), then the stop (N) connected to the sense diaphragm pushes down the poppet causing the pilot valve to open.

A small fraction of an inch of movement of the poppet vacates the dome volume by allowing flow past the two seats and out of the pilot exhaust (O). This causes the piston in the main valve to open to allow gas flow into the tank. The piston is normally held closed when the dome pressure (P) equals the inlet pressure because there is a larger area exposed to the dome pressure than to the inlet pressure. A significant pressure drop in the dome pressure, however, allows the piston to be pushed open by the inlet pressure.

When gas flow into the tank raises tank pressure above the set pressure, the sense diaphragm is pushed up allowing the stop and the poppet to raise up (due to the spring force under the poppet) until the poppet reseals. When the poppet reseals, the dome pressure is allowed to build back up to the inlet pressure and push the piston closed again - shutting off flow to the tank.

The set pressure of the Protectoseal Series No. 20 Blanketing Valve is specified as the pressure at which the main valve opens. Generally, the pilot valve will begin to leak at a pressure slightly above the set point. As the pressure moves down to the set point, the pilot opens fully causing the main valve to open. Gas flow into the tank raises the tank pressure which causes the main valve and pilot valve to reseal. The Protectoseal Blanketing Valve has a pressure-balanced poppet which provides for a consistent opening pressure over the allowable range of inlet gas supply pressures.

Fig. 2

Blanketing Valve in Closed Position

(Tank pressure above set point pressure)

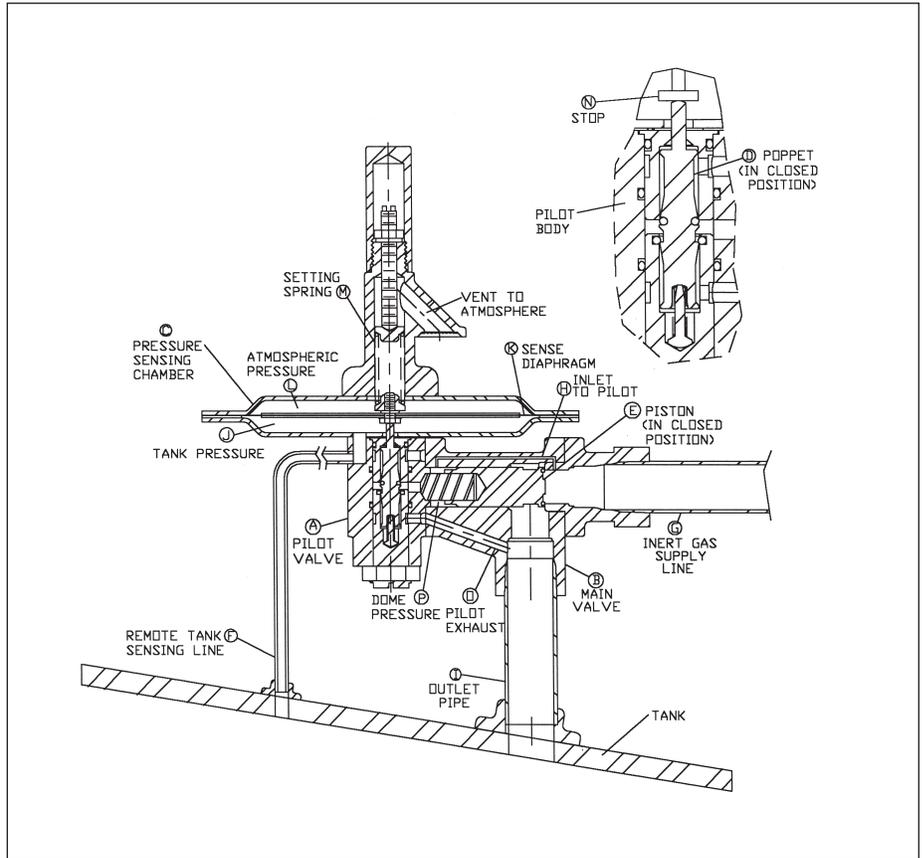
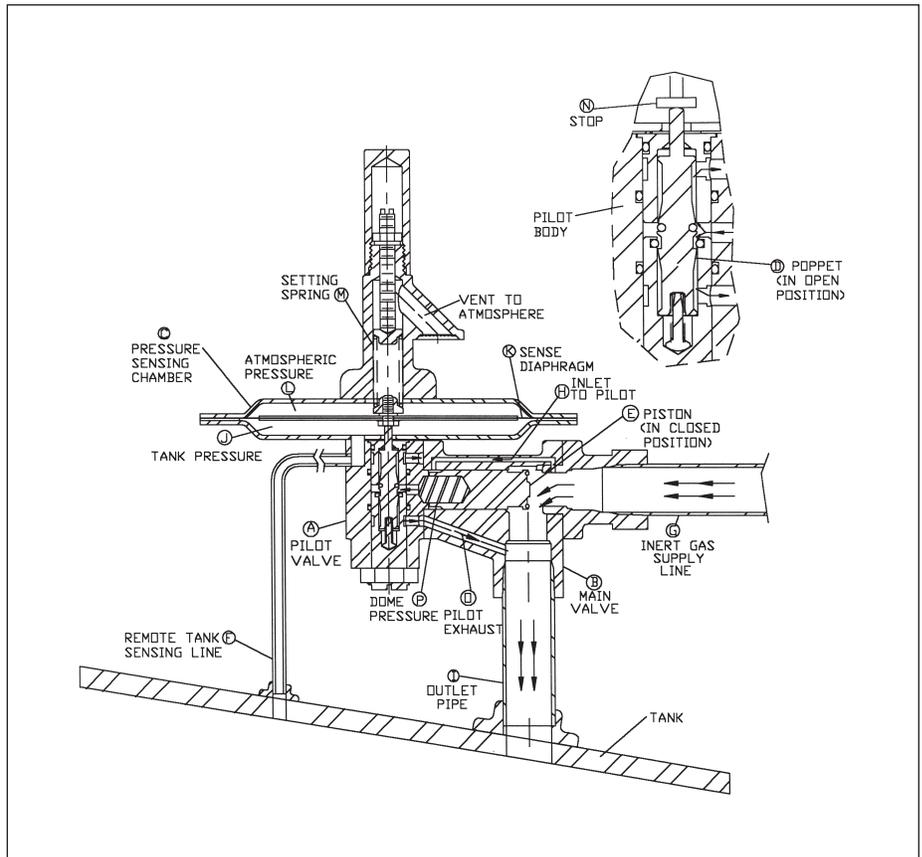


Fig. 3

Blanketing Valve Open and Flowing

(Tank pressure below set point pressure)



Flow Capacity Sizing

Flow capacity must be taken into consideration when specifying a blanketing valve for a tank storage system. Following steps outlined in API 2000, a standard published by the American Petroleum Institute, the minimum flow requirements for a blanketing valve can be determined. The minimum flow requirement is based upon two factors:

1. The maximum possible emptying rate out of the tank while product is being pumped out.
2. Thermal effects caused by atmospheric cooling (i.e. a downpour of rain or sudden drop in atmospheric temperature).

When the blanketing valve is sized, a combination of inlet pressure and flow plug size are selected which will lead to a flow somewhere above the required minimum. A safe rule of thumb is a flow up to 50% above the minimum required, but the acceptable range will depend upon the size of the tank and the required flow. If the blanketing valve is oversized, then it may overshoot the set point and possibly cause the conservation pressure vent to open. If, on the other hand, the blanketing valve is undersized, then pressure drop in the storage tank may lead to the conservation vacuum vent opening and flowing unwanted air into the tank.

Since the blanketing gas supply pressure directly affects the flow rate through the valve (increase in flow rate is approximately proportional to increase in supply pressure), this pressure should be monitored. If it differs significantly from that specified on the blanketing valve's label then there may be a problem with inadequate or excessive flow through the valve.

Follow the three steps indicated. Steps 1 and 2 are based upon API 2000.

STEP 1:

Use Table 1 below to determine the flow required to accommodate the maximum possible emptying rate:

Table 1
Flow Required to Accommodate Pumping Out

| For Maximum Liquid Emptying Rate in: | To obtain SCFH Air Required, multiply by: | To obtain Nm ₃ /h Air Required, multiply by: |
|--------------------------------------|---|---|
| US gpm | 8.00 | 0.227 |
| US gph | 0.133 | 0.00379 |
| barrels / hour | 5.600 | 0.159 |
| barrels / day | 0.233 | 0.00662 |
| m ³ / h | 35.22 | 1.00 |

SCFH is at 60°F and 14.7 psia. Nm³/h is at 0°C and 101.3 kPa (absolute).

Flow Capacity Sizing

STEP 2:

Use Table 2 below to determine the flow required to accommodate the possible effects of atmospheric cooling:

**Table 2
Flow Required to Accommodate Thermal Effects**

| Tank Capacity | | | Inbreathing Required | |
|---------------|-----------|----------------|----------------------|----------------------|
| Barrels | Gallons | m ³ | SCFH | N m ³ / h |
| 60 | 2,500 | 10 | 60 | 1.7 |
| 100 | 4,200 | 16 | 100 | 2.8 |
| 500 | 21,000 | 79 | 500 | 14 |
| 1,000 | 42,000 | 159 | 1,000 | 28 |
| 2,000 | 84,000 | 318 | 2,000 | 55 |
| 3,000 | 126,000 | 477 | 3,000 | 83 |
| 4,000 | 168,000 | 636 | 4,000 | 110 |
| 5,000 | 210,000 | 795 | 5,000 | 138 |
| 10,000 | 420,000 | 1,590 | 10,000 | 276 |
| 15,000 | 630,000 | 2,385 | 15,000 | 413 |
| 20,000 | 840,000 | 3,180 | 20,000 | 551 |
| 25,000 | 1,050,000 | 3,975 | 24,000 | 661 |
| 30,000 | 1,260,000 | 4,770 | 28,000 | 772 |
| 35,000 | 1,470,000 | 5,565 | 31,000 | 854 |
| 40,000 | 1,680,000 | 6,360 | 34,000 | 937 |
| 45,000 | 1,890,000 | 7,155 | 37,000 | 1,020 |
| 50,000 | 2,100,000 | 7,950 | 40,000 | 1,102 |
| 60,000 | 2,520,000 | 9,540 | 44,000 | 1,212 |
| 70,000 | 2,940,000 | 11,130 | 48,000 | 1,323 |
| 80,000 | 3,360,000 | 12,720 | 52,000 | 1,433 |
| 90,000 | 3,780,000 | 14,310 | 56,000 | 1,543 |
| 100,000 | 4,200,000 | 15,900 | 60,000 | 1,653 |
| 120,000 | 5,040,000 | 19,080 | 68,000 | 1,874 |
| 140,000 | 5,880,000 | 22,260 | 75,000 | 2,067 |
| 160,000 | 6,720,000 | 25,440 | 82,000 | 2,260 |
| 180,000 | 7,560,000 | 28,620 | 90,000 | 2,480 |

Interpolate between values as necessary.

Flow Capacity Sizing

STEP 3:

Add the values from Step 1 and Step 2 to determine the total flow requirement. Check Table 3 below to locate the required flow. Optional flow plugs can be used to restrict flow to 80%, 60%, 40%, 20% or 10% of the maximum flows listed.

Table 3
Maximum Flows Through Protectoseal Blanketing Valve

| Supply Pressure | | | Air | | Nitrogen | | Natural Gas | |
|-----------------|---------|------------------------|--------|--------------------|----------|--------------------|-------------|--------------------|
| PSIG | kPa (g) | kg/cm ² (g) | SCFH | Nm ³ /h | SCFH | Nm ³ /h | SCFH | Nm ³ /h |
| 20 | 138 | 1.4 | 13,209 | 364 | 13,432 | 370 | 17,053 | 470 |
| 30 | 207 | 2.1 | 17,016 | 469 | 17,303 | 477 | 21,967 | 605 |
| 40 | 276 | 2.8 | 20,822 | 574 | 21,174 | 584 | 26,881 | 741 |
| 50 | 345 | 3.5 | 24,629 | 679 | 25,045 | 690 | 31,796 | 876 |
| 60 | 414 | 4.2 | 28,436 | 784 | 28,916 | 797 | 36,710 | 1,012 |
| 70 | 483 | 4.9 | 32,242 | 889 | 32,786 | 904 | 41,624 | 1,147 |
| 80 | 552 | 5.6 | 36,049 | 993 | 36,657 | 1,010 | 46,539 | 1,283 |
| 90 | 621 | 6.3 | 39,855 | 1,098 | 40,528 | 1,117 | 51,453 | 1,418 |
| 100 | 690 | 7.0 | 43,662 | 1,203 | 44,399 | 1,224 | 56,367 | 1,553 |
| 110 | 758 | 7.7 | 47,469 | 1,308 | 48,270 | 1,330 | 61,281 | 1,689 |
| 120 | 827 | 8.4 | 51,275 | 1,413 | 52,141 | 1,337 | 66,196 | 1,824 |
| 130 | 896 | 9.1 | 55,082 | 1,518 | 56,012 | 1,544 | 71,110 | 1,960 |
| 140 | 965 | 9.8 | 58,889 | 1,623 | 59,883 | 1,650 | 76,024 | 2,095 |
| 150 | 1,034 | 10.5 | 62,695 | 1,728 | 63,753 | 1,757 | 80,939 | 2,231 |
| 160 | 1,103 | 11.2 | 66,502 | 1,833 | 67,624 | 1,864 | 85,853 | 2,366 |
| 170 | 1,172 | 12.0 | 70,308 | 1,938 | 71,495 | 1,970 | 90,767 | 2,502 |
| 180 | 1,241 | 12.7 | 74,115 | 2,043 | 75,366 | 2,077 | 95,682 | 2,637 |
| 190 | 1,310 | 13.4 | 77,922 | 2,148 | 79,237 | 2,184 | 100,596 | 2,772 |
| 200 | 1,379 | 14.1 | 81,728 | 2,252 | 83,108 | 2,290 | 105,510 | 2,908 |

Interpolate between values as necessary, SCFH is at 60°F and 14.7 psia. Nm³/h is at 0°C and 101.3 kPa (absolute).

Conservation Vents

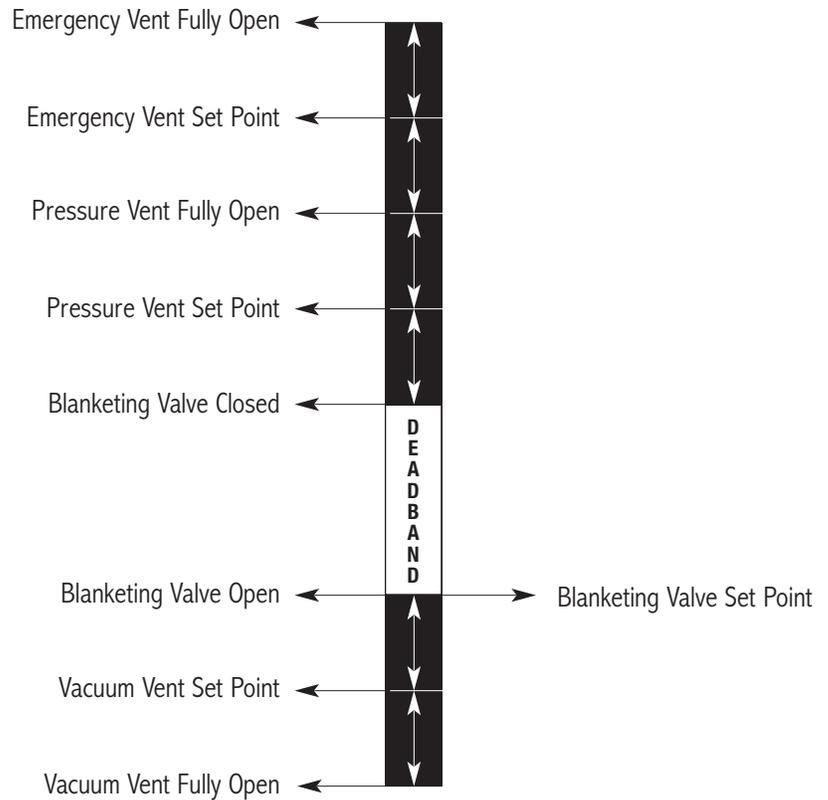
As previously mentioned, a blanketing valve must be used in conjunction with conservation vents or other relief devices. A blanketing valve should not be installed in a system that does not include properly specified conservation vents or equivalent relieving devices.

The purpose of the conservation vacuum vent is to provide emergency vacuum relief in the event that the blanketing valve does not open. The set point of the vacuum relief device should be set below that of the blanketing valve. The purpose of a conservation pressure vent is to provide normal venting (outflow of vapor) to accommodate either filling of the tank or expansion of the tank contents due to increase in atmospheric temperature. The set point of the conservation pressure vent should be above that of the blanketing valve. Since the set point of the Protectoseal Series 20 Blanketing Valve is specified as the pressure at which the valve opens, the set point of the pressure vent must be set high enough so that the pressure vent will not open before the blanketing valve closes. (see Fig. 4 and Table 4 on page 8).

Conservation Vents

The emergency vent provides pressure relief supplemental to the regular pressure vent in cases of emergency such as the tank being exposed to fire or the blanketing valve failing full open. Its set point is above the full open pressure of the conservation pressure vent. The total flow capacity of the two pressure vents, must be greater than the flow capacity of the blanketing valve to accommodate the possibility of full open failure of the blanketing valve.

Fig. 4
Relative Set Points of
the Blanketing Valve
and Conservation Vents



**Table 4
Guidelines for Blanketing Valve and Conservation Vent Set Points**

| Blanketing Valve Set Point (inches W.C.) | Minimum Recommended Pressure Vent Set Point (inches W.C.) | Minimum Recommended Vacuum Vent Set Point (inches W.C.) |
|--|---|---|
| -0.5 TO 10.0 | 2.0 ABOVE Valve Set Point | 0.5 BELOW Valve Set Point (gauge) |
| 10.1 to 20.0 | 4.0 ABOVE Valve Set Point | See Note ² |
| 20.1 to 30.0 | 6.0 ABOVE Valve Set Point | See Note ² |
| Above 30.0 | 8.0 ABOVE Valve Set Point | See Note ² |

NOTE¹ Set point ranges may be varied. Contact factory for specific applications outside the stated guidelines.

NOTE² For Blanketing Valve set points BELOW 0.5 gauge, set Vacuum Vent at least 0.5 gauge BELOW Valve set point.

Environment

It is important that the blanketing valve not be used in an environment for which it was not intended. Chemical compatibility as well as atmospheric conditions are key concerns. How well suited the Series 20 Blanketing Valve is for a given environment depends largely on the options chosen for the valve.

Chemical Compatibility

The materials selected for the blanketing valve will determine its compatibility with the chemical environment it operates in. The standard metal for the Series 20 Blanketing Valve is stainless steel 316 which offers good resistance to most chemicals. Other materials included in a basic valve (one with no accessories) which are made from rubber or FEP are O-rings, gaskets and a diaphragm. FEP offers the best possible chemical resistance, and so the diaphragm and gasket made from REP are not offered in other materials. The O-rings and other gaskets are, however, available in a range of materials. The basic filter included with the blanketing valve is constructed of aluminum, zinc and acetal resin with Buna-N seals, a polypropylene element and a brass drain plug. An alternate filter made of stainless steel 316, acetal resin, polypropylene and Viton is also available. The blanketing valve can be ordered without a filter, although this is not generally recommended. Refer to the guide on page 11, illustrating the numbering system, to determine the materials used in the basic components of your blanketing valve.

The accessories offered with the blanketing valve are comprised of various materials. Where components in stainless steel with chemically resistive seals are cost prohibitive or not available, other components have been used instead. Components made of alternate materials may be available in some cases. Consult the factory for assistance in determining what materials are included in your blanketing valve and for information regarding chemical compatibility.

Temperature

The materials selected for the blanketing valve will also determine the temperature range in which it can safely operate. Generally, the lower the end of this range will be limited by the rubber material chosen for the O-rings and gaskets. Following are operating temperature ranges for the various seal materials offered with the Series 20 Blanketing Valve:

Table 5
Operating Temperatures for Soft Goods

| Material | Low Temperature | High Temperature |
|-------------|-----------------|------------------|
| Buna-N | -65°F (-54°C) | 275°F (135°C) |
| Chemraz 505 | -20°F (-29°C) | 425°F (218°C) |
| EPDM | -65°F (-54°C) | 300°F (149°C) |
| Kalrez 1050 | 0°F (-18°C) | 500°F (260°C) |
| Neoprene | -65°F (-54°C) | 275°F (135°C) |
| FEP | -450°F (-268°C) | 400°F (204°C) |
| Viton | -31°F (-35°C) | 400°F (204°C) |

Temperature

For operation at temperatures which could drop below freezing, particular care should be taken so that moisture does not get into the blanketing valve through the supply gas line or the tank. The filter is also a limiting factor for the temperature range. Ice in the filter element could block flow and inhibit operation of the blanketing valve. Also, the filter is not recommended for service above 180°F (82°C). See Table 6 below for limiting temperature ranges for accessories:

**Table 6
Operating Temperatures for Accessories**

| Accessory | Low Temperature | High Temperature |
|------------------------|-----------------|------------------|
| Supply Line Gauge | 0°F (-18°C) | 140°F (60°C) |
| Sense Line Gauge | 0°F (-18°C) | 140°F (60°C) |
| Integral Purge | 32°F (0°C) | 250°F (121°C) |
| Check Valve | -65°F (-54°C) | 240°F (115°C) |
| Field Test (Fixed) | 20°F (-7°C) | 140°F (60°C) |
| Field Test (Removable) | 20°F (-7°C) | 120°F (49°C) |

Atmospheric Pressure

The blanketing valve pressure set point is measured as a gauge pressure. The correct opening gauge pressure should be realized at any atmospheric pressure.

The Series 20 Numbering System

Most of the digits of the thirteen-digit Series 20 model number represent codes for available options. If there is a question as to what material or options are part of your blanketing valve, you can refer to the guide in page 11 to decipher your model number on the label of your unit(s). For options or combinations of options not listed, please consult the factory to determine the correct part number.

Examples of possible model number:

| Digit: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|-----------|---|---|---|---|---|---|---|---|---|----|----|----|----|
| Standard: | F | 2 | 0 | T | A | A | A | A | A | 0 | 0 | 0 | 0 |

User Guide

Numbering System

PROTECTOSEAL SERIES NO. 20

TANK BLANKETING VALVE

Page 11

EXAMPLE:

| | | | | | | | | | | | | | |
|----------------|---|---|---|---|---|---|---|---|---|----|----|----|----|
| DIGIT: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| PART NO. CODE: | F | 2 | 0 | T | D | B | A | A | A | 0 | 0 | 0 | 0 |

| | | | | | |
|-----|-------------------------------|---|----|-------------------------------|---|
| --1 | MATERIAL | F: Stainless Steel 316 K: Same as above with cleaning/packaging to Pure-Tech specifications | 8 | FLOW CAPACITY REDUCTION PLUGS | A: 100% (NO PLUG) B: 80% C: 60% D: 40% E: 20% F: 10% |
| 2-3 | SERIES NO. | 20 | | | |
| 4 | REVISION LEVEL | T | | | |
| 5 | CONNECTIONS: (INLET / OUTLET) | A: 1" FNPT / FNPT B: 1" FNPT / 150# flange C: 1" FNPT / 300# flange D: 1" 150# flange / 150# flange E: 1" 300# flange / 300# flange F: 3/4" FNPT / FNPT G: 3/4" FNPT / 150# flange H: 3/4" FNPT / 300# flange I: 3/4" 150# flange / 150# flange J: 3/4" 300# flange / 300# flange K: 1/2" FNPT / FNPT L: 1/2" FNPT / 150# flange M: 1/2" FNPT / 300# flange N: 1/2" 150# flange / 150# flange P: 1/2" 300# flange / 300# flange | 9 | PILOT FILTER OPTION | A: Aluminum/Zinc B: Stainless Steel 316 |
| | | | 10 | CHECK VALVE OPTION | 0: Not Included 1: Included |
| | | | 11 | PRESSURE GAGE OPTION | 0: No gages 1: Supply line gage only 2: Sense line gage only 3: Sense line & supply line gages |
| | | | 12 | INTEGRAL PURGE OPTION | 0: No purge 1: Outlet line purge only 2: Sense line purge only 3: Outlet line and sense line purge |
| 6 | SET POINT PRESSURE RANGE | A: 0.0" WC to 2.0" WC B: 2.1" WC to 5.0" WC C: 5.1" WC to 15.0" WC D: 15.1" WC to 50.0" WC E: 50.1" WC to 69.2" WC F: -0.5" WC to -0.1" WC | 13 | FIELD TEST OPTION | 0: Not included 1: Included (Note 2) 2: Included with 3-way valve for outlet line (Note 2) 3: Included with 3-way valve for sense line (Note 2) 4: Included with 3-way valves for outlet & sense lines (Note 2) |
| 7 | MATERIALS SEALS & GASKETS | A: Buna-N B: Neoprene C: Viton® D: EPDM E: Kalrez® F: Chemraz® | | | |

Note 1: On units with Kalrez® or Chemraz® seals and gaskets, the diaphragm case gasket will be Buna-N.

Note 2: Contact factory regarding materials or options not listed.

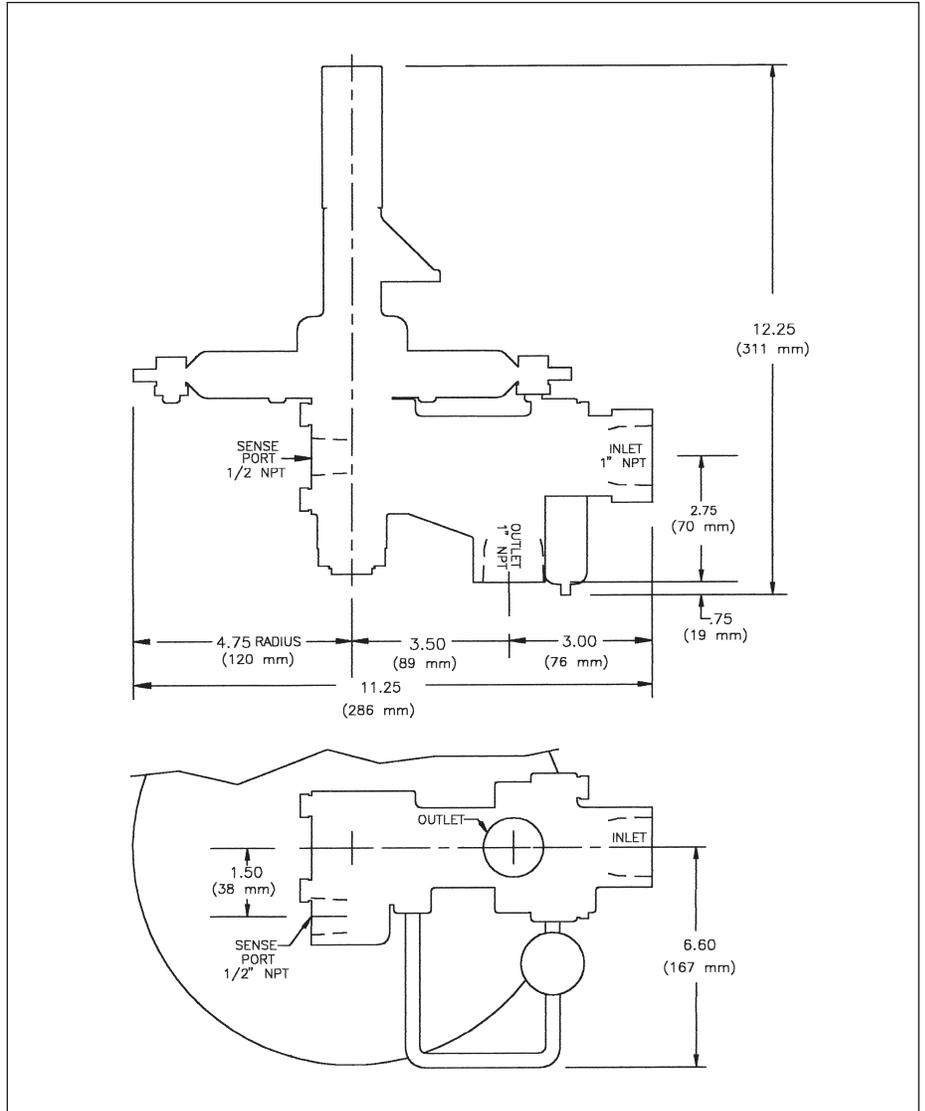
Note 3: Sense line and supply line gages included. Digit #11 should be option 3.

Note 4: Supply line filters available (sold separately - consult factory).

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Chemraz® is a registered Trademark of Green, Tweed & Co., Inc.

Dimensions

Dimensions shown are for reference only. Contact Factory for certified drawings.





THE PROTECTOSEAL COMPANY

ISO 9001 CERTIFIED

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