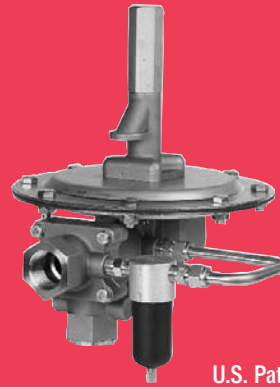




- 1" NPT inlet and outlet standard
- Pilot operated design provides tight operating band
- Optional inlet and outlet connections available
- Inlet gas pressures from 20 PSIG to 200 PSIG
- Set points from -0.5 in.W.C. to 69.2 in.W.C.
- Optional flow plugs to meet specific flow requirements
- Fully field serviceable
- Optional pilot and sense line gauges
- System purge and field test capability available
- Conforms with European ATEX Directive 94/9/EC



U.S. Patent No. 5,660,204

Tank Blanketing is an effective means of preventing fires in flammable liquid storage tanks by controlling the formation of explosive vapor / air mixtures. Blanketing minimizes evaporation of the stored product, thus reducing emission levels and product loss. Protection from external sources of contamination that may adversely affect the tank's contents is also provided.

The principle involved is quite simple: a blanket or pad of inert gas in the tank's vapor space prevents atmospheric air from entering the tank. The inert gas, usually Nitrogen, is injected, as necessary, into the vapor space in order to maintain a non-flammable atmosphere. The blanketing pressure is usually very low (less than 1 PSI). Outside air, which contains oxygen, moisture and other contaminants is not permitted to enter the tank. For those applications where the purity of stored product is a major concern, Protectoseal offers optional Pure-Tech cleaning and packaging specifications for the blanketing valves.

This inert gas is admitted only during inbreathing cycles (vacuum cycles). An inbreathing cycle occurs when liquid is being withdrawn from a tank, or when vapors condense in a tank due to a decrease in temperature.

The amount of inert gas required for a specific application is based on the maximum inbreathing demand under conditions of sudden cooling caused by a rain or hail-storm PLUS the maximum emptying rate.

Although Nitrogen is most commonly used for inerting, other gases, including natural gas, may be used in some applications.

Depending upon the specific application, the selection of an inert gas for a particular process is based upon one or more of the following characteristics:

1. Non-flammable in the atmosphere being protected
2. Non-contaminating
3. Chemically inactive
4. Non-toxic
5. Availability for large quantity use
6. Cost

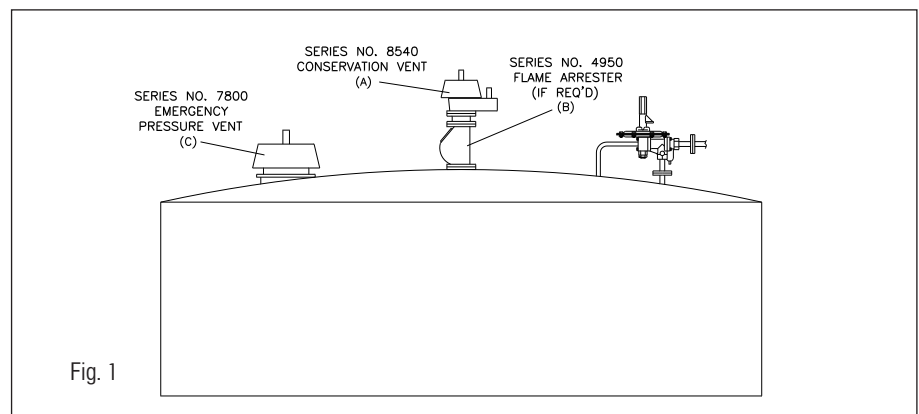
A typical tank blanketing installation is shown in Fig. 1.

The conservation vent (A) is sized to take care of overpressure and vacuum conditions brought about by unforeseen conditions or equipment failures. The pressure setting of the vent is set at a slightly higher setting than the blanketing pressure in the tank but below the maximum pressure the tank can withstand. Similarly, the vacuum pallet is set at a higher vacuum setting than normal operating conditions bring about and below the maximum vacuum pressure the tank could withstand.

Note the placement of the flame arrester (B) to provide additional protection in the event of inert gas failure. An emergency relief vent (C) is placed on the tank, the pressure setting being slightly above the conservation vent pressure setting.

In designing a tank blanketing system, several important considerations should be evaluated:

1. Inert gas or tank blanketing equipment must be completely reliable and capable of maintaining an adequate supply of inert gas at all times. Equipment breakdown or equipment that is inadequately sized for the job will result in a higher oxygen concentration in the vapor space of the storage tank which would mix with the vapors resulting in the development of a flammable mixture.
2. The inert gas should be introduced into the tank in such a manner that it can be distributed effectively.
3. Contamination of the inert gas from any source must be guarded against. Any inerting system should have suitable devices to hold moisture to an absolute minimum.



## PRINCIPLES OF OPERATION

A blanketing valve is used in tank blanketing applications to regulate the pressure of the inert gas layer on top of a tank's stored liquid. The valve senses the pressure of the tank blanket and opens to flow in more inert gas when pressure drops below the set pressure. The valve closes and stops flow when pressure builds back up to the set pressure. See Fig. 2 and Fig. 3.

The Protectoseal Series 20 Blanketing Valve essentially consists of two separate valves operating in tandem. 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 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.

## OPERATING CHARACTERISTICS

The set pressure of the Protectoseal Series 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.

## FEATURES & BENEFITS OF THE PROTECTOSEAL BLANKETING VALVE

- Designed specifically for tank blanketing
- Pilot-operated design provides very tight operating band
- Most compact design and fewest external connections of any pilot-operated valve on the market
- Field serviceable
- Pressure balanced pilot provides consistent opening pressure over the range of possible supply pressures
- A range of flow plug sizes provides the opportunity to tailor flow capacity to individual requirements
- A comprehensive range of materials are offered:
  - Metal parts in 316 Stainless Steel
  - Seals & gaskets in Buna-N, Neoprene, Viton®, EPDM, Chemraz® or Kalrez®
- Protectoseal Pure-Tech High Purity Blanketing Valves are available for applications involving high purity products.

*NOTE: On units with Kalrez® or Chemraz® seals and gaskets, the diaphragm case gasket is Buna-N.*

*Viton® and Kalrez® are registered Trademarks of E.I. DuPont de Nemours & Co., Inc.*

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

## MATERIALS OF CONSTRUCTION

<b>Valve Bodies &amp; Components:</b>	STANDARD	316 Stainless
	CUSTOM	Others
<b>Fittings &amp; Hardware:</b>	STANDARD	316 Stainless
	CUSTOM	Others
<b>Springs:</b>		302 Stainless
<b>Seals &amp; Gaskets:</b>	OPTIONS	Buna-N Neoprene, Viton®, EPDM, Chemraz®, Kalrez® & Others
<b>Diaphragm:</b>		FEP Film
<b>Filter:</b>	OPTIONS	Aluminum / Zinc / Polypropylene / Buna-N / Acetal Stainless Steel / Polypropylene/ Viton® / Acetal

## PRIMARY OPTIONS

<b>Connections:</b>	OPTIONS	FNPT inlet & outlet 150# or 300# welded ANSI flanges on inlet / outlet or outlet only Adapters for connection to 1/2" or 3/4" lines
<b>Flow Plugs:</b>	OPTIONS	No flow plug (100% of maximum flow) Flow plugs for 80%, 60%, 40%, 20%, or 10% of maximum flow

<b>Other Options:</b>		<ul style="list-style-type: none"> <li>■ Pressure gauges on pilot inlet and / or sense line</li> <li>■ Integral purge on main and / or sense line</li> <li>■ Check valve between pilot inlet and main supply line</li> <li>■ Field test accessories</li> <li>■ Supply line filter</li> <li>■ Single port sensing (see page 6)</li> <li>■ Status port option (see page 6)</li> </ul>
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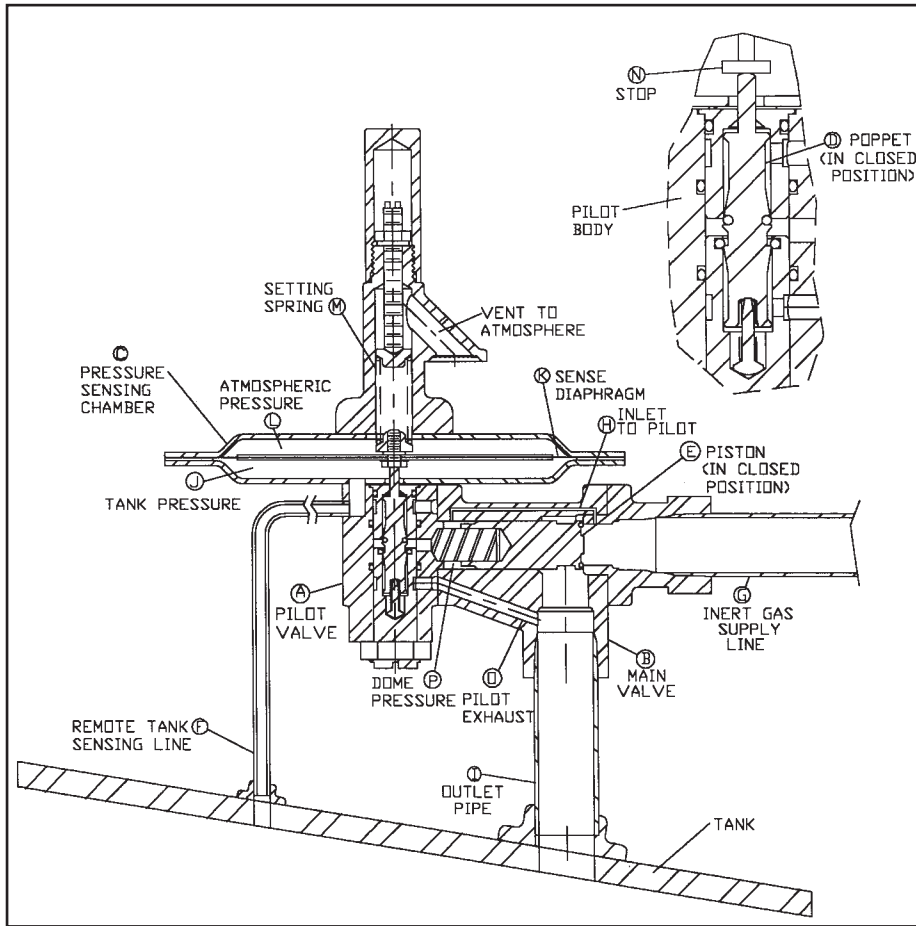


Fig. 2

Blanketing Valve In Closed Position  
(Tank Pressure Above Set Point Pressure)

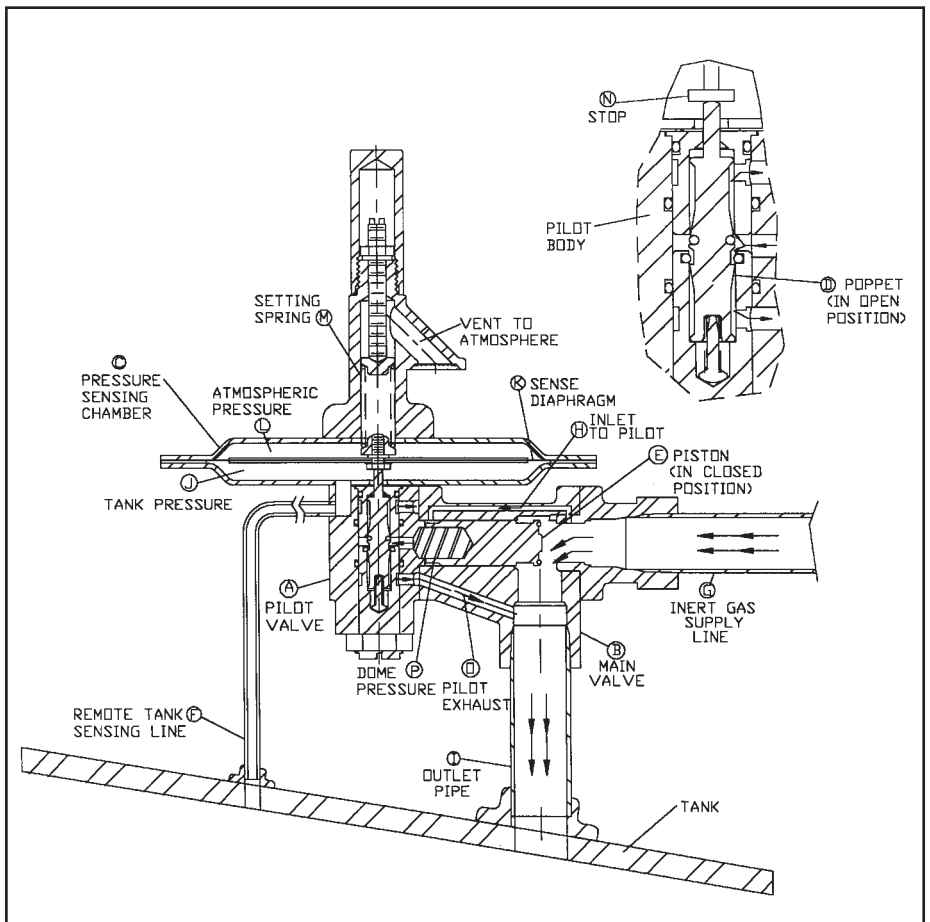


Fig. 3

Blanketing Valve Open and Flowing  
(Tank Pressure Below Set Point Pressure)

## VALVE SIZING TO MEET FLOW REQUIREMENTS

Blanketing valve flow requirements are based upon two factors: 1) the maximum possible emptying rate out of the tank, and 2) the possible effects of cooling during atmospheric changes. Using the total required flow determined from these two factors, the necessary specifications for the blanketing valve can be determined. Follow the three steps below. Steps 1 and 2 are based upon API 2000 recommendations.

### 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 N m <sup>3</sup> /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 <sup>3</sup> /h	35.22	1.00

SCFH is at 60°F and 14.7 psia. Nm<sup>3</sup>/h is at 0°C and 101.3 kPA (absolute).

### 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**

Barrels	Tank Capacity		Inbreathing Required	
	Gallons	m <sup>3</sup>	SCFH	N m <sup>3</sup> /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.

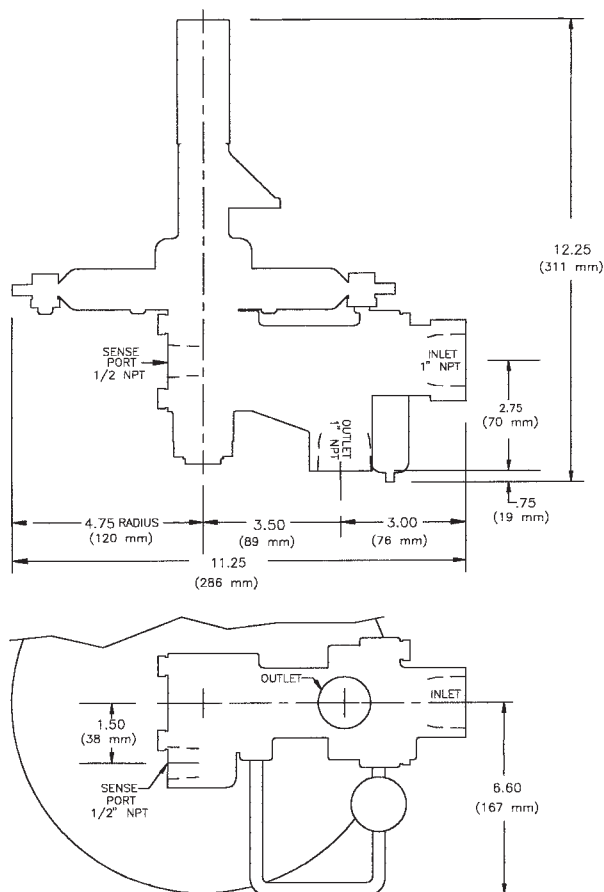
**STEP 3:**

Add the values from Step 1 and Step 2 to determine the total flow requirement. Check Table 3 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 in Table 3.

**Table 3 – Maximum Flows Through Protectoseal Blanketing Valve**

psig	Supply Pressure		Air		Nitrogen		0.6g Natural Gas	
	kPa (g)	kg/cm <sup>2</sup> (g)	SCFH	N m <sup>3</sup> /h	SCFH	N m <sup>3</sup> /h	SCFH	N m <sup>3</sup> /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

NOTES: Estimated flow values. Interpolate between values as necessary. SCFH is at 60° F and 14.7 psia. N m<sup>3</sup>/h is at 0° C and 101.3 kPa (absolute).



**DIMENSIONS**

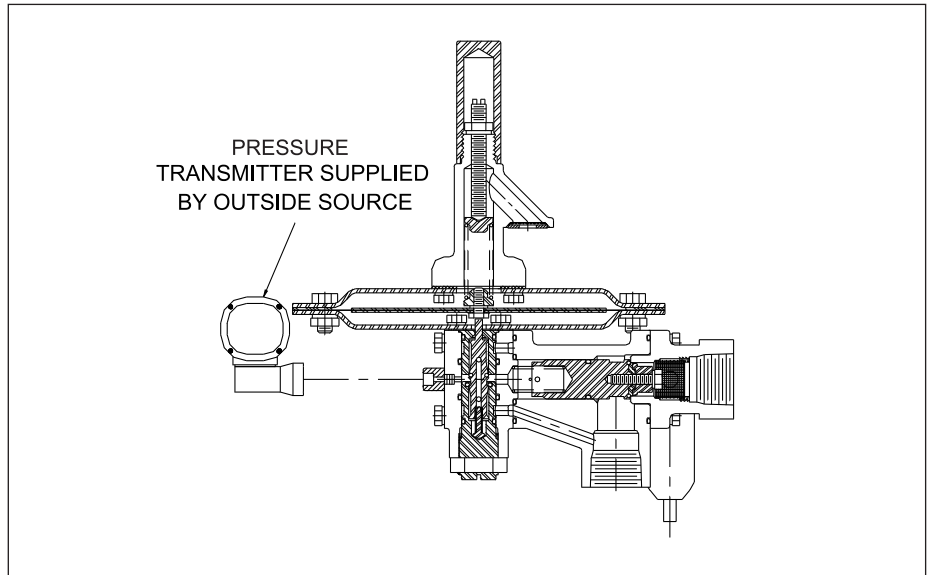
(Dimensions shown are for reference only. Contact Factory for certified drawings.)

## STATUS PORT OPTION

- Provides indication of open vs. closed valve status
- Offers remote monitoring via pressure transmitter
- Allows alarm when blanketing gas flow is excessive
- Reduces operating costs by allowing monitoring of blanketing gas usage

The Status Port Option for Protectoseal Series 20 Pilot-Operated Tank Blanketing Valves consists of a 1/4" NPT threaded port connection in the valve body. This allows the addition of a pressure transmitter (provided by other source) to provide a continuous signal to remote monitoring equipment, distributed control system, alarm system, etc. This signal indicates if the valve is open (flowing) or closed (non-flowing).

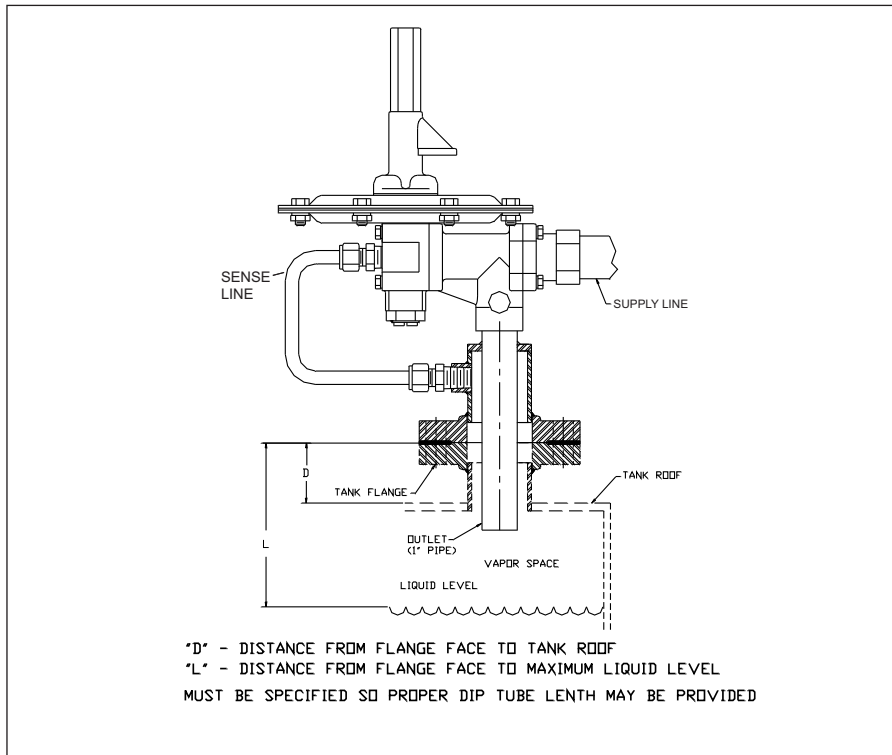
When the blanketing valve is closed, the pressure in the dome is the same as the supply pressure. When the valve is open, the pressure in the dome drops and is significantly lower than the supply pressure.



The tank's monitoring instrumentation would be calibrated to indicate an alarm condition if the open signal continues beyond a predetermined time required for tank repressurization. Action can then be taken to address the problem and preclude the loss of blanketing gas, usually Nitrogen).

Please contact the Protectoseal factory for assistance with tank blanketing valve selection and for information on Protectoseal's full range of Vapor Control Products.

## SINGLE PORT SENSING



- Single connection mounting
- Eliminates need for separate sense line connection to tank
- Efficient control of tank pressure

If the preferred independent sense line configuration cannot be accommodated, the single port design allows for mounting the blanketing valve with only one tank connection. Tank vapor space pressure sensing and blanketing gas supply are accomplished through a common tank fitting. Outlet tube directs blanketing gas flow past the pressure sensing location in the connection to minimize vapor space pressure sensing errors. A minimum 1 1/2" pipe size connection is required. Consult factory for details.



**PROTECTOSEAL MODEL NO. 20 BLANKETING VALVE NUMBERING SYSTEM**

**EXAMPLE:**

DIGIT:	1	2	3	4	5	6	7	8	9	10	11	12	13
<b>PART NO. CODE:</b>	F	2	0	T	D	B	A	A	A	0	0	0	0
1 MATERIAL	F: 316 Stainless Steel 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: 316 Stainless Steel						
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					10 CHECK VALVE OPTION	0: Not Included 1: Included						
7 MATERIALS SEALS & GASKETS *	A: Buna-N B: Neoprene C: Viton® D: EPDM E: Kalrez® F: Chemraz®					11 PRESSURE GAUGE OPTION ***	0: No gauges 1: Supply line gauge only 2: Sense line gauge only 3: Sense line & supply line gauges						
						12 INTEGRAL PURGE OPTION	0: No purge 1: Outlet line purge only 2: Sense line purge only 3: Outlet line and sense line purge						
						13 FIELD TEST OPTION ****	0: Not included 1: Included 2: Included with 3-way valve for outlet line 3: Included with 3-way valve for sense line 4: Included with 3-way valves for outlet & sense lines						

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

\*\* Supply line filters available (sold separately - consult factory).

\*\*\* Stainless steel gauge available (consult factory).

\*\*\*\* Sense line and supply line gauges included. Digit #11 should be option 3.

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225 Foster Ave., Bensenville, IL 60106-1690  
P 630.595.0800 F 630.595.8059  
info@protectoseal.com www.protectoseal.com