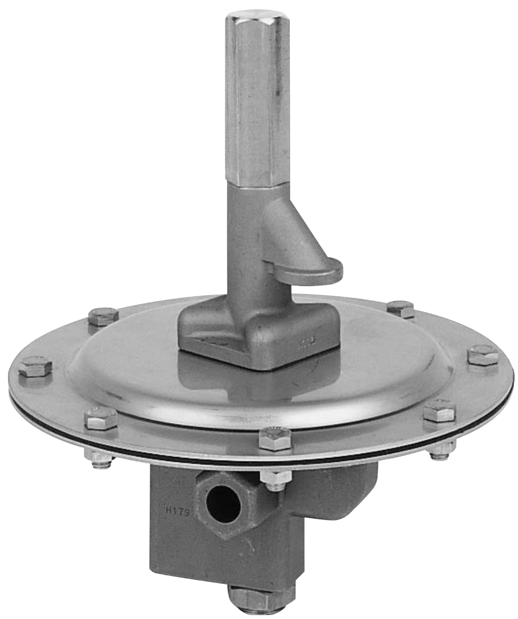
USER GUIDE / Series 30

PROTECTOSEAL SERIES NO. 30 TANK BLANKETING VALVE

Series No. 30 Tank Blanketing Valve
Specifically Designed for Low Flow Requirements



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

PROTECTOSEAL®

ISO 9001 : 2000 CERTIFIED

SAFETY WITHOUT COMPROMISE

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Product Overview

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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.

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

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 fitting installed at the valve inlet port to reduce the flow of gas through the valve.

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

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

Poppet: The component in the 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 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 30 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:

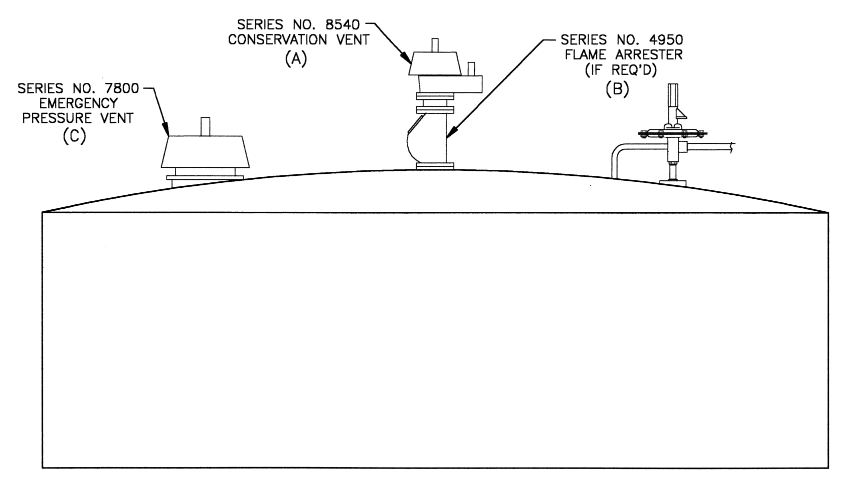
1. Maintains the vapor space of the storage tank at an allowable vacuum during emptying or thermal contraction.
2. Keeps the vapor space non-flammable by keeping out oxygen-rich air.
3. Minimizes evaporation and, thus, product loss.
4. Reduces product degradation and tank corrosion by keeping contaminants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

Fig. 1



Blanketing Valve Operation

The Protectoseal Series No. 30 Blanketing Valve consists of a direct acting main valve assembly (see Fig. 2 and Fig. 3) (A) with a moveable poppet (B), whose opening and closing is controlled by movement of the sense diaphragm (C) in the pressure sensing chamber (D). Unseating of the poppet allows a flow of inert gas into the tank.

In the preferred configuration, three external connections are required for the operation of the Protectoseal Series No. 30 Blanketing Valve. The remote sense line (E) runs from the tank to the sense port of the valve. This line provides the controlling pressure to the sensing chamber. It is connected to the tank at a distance far enough from the blanketing valve outlet to insure that it will not be affected by the flow stream of inert gas into the tank. The second line (F) comes from the inert gas supply and connects to the valve inlet. The third external connection (G) joins the valve outlet port to the tank.

The pressure in the tank's vapor space is transmitted through the sense line (E) to the underside of the sense diaphragm (C). This pressure pushes upwards against the combined downward forces of atmospheric pressure (I) on the top side of the sense diaphragm and the setting spring (J). When the pressure in the tank's vapor space is greater than the set point of the valve which is determined by the compression of the set spring (J), the sense diaphragm is pushed upward and the valve poppet (B) remains in its closed position (no flow of inert gas into the tank). A decrease in the tank's vapor space pressure results in a corresponding reduced pressure in the sensing chamber (D). Tank pressure less than the valve set point allows downward movement of the sense diaphragm. The stop (K) connected to the diaphragm pushes down on the poppet, causing it to unseat and allowing a flow of inert gas into the tank.

As the tank pressure increases, the sense chamber pressure works to push the diaphragm upwards and the valve poppet is allowed to return to its closed position aided by the biasing spring (L) under the poppet, stopping the flow of inert gas into the tank.

Fig. 2

Blanketing Valve in Closed Position

(Tank pressure above set point pressure)

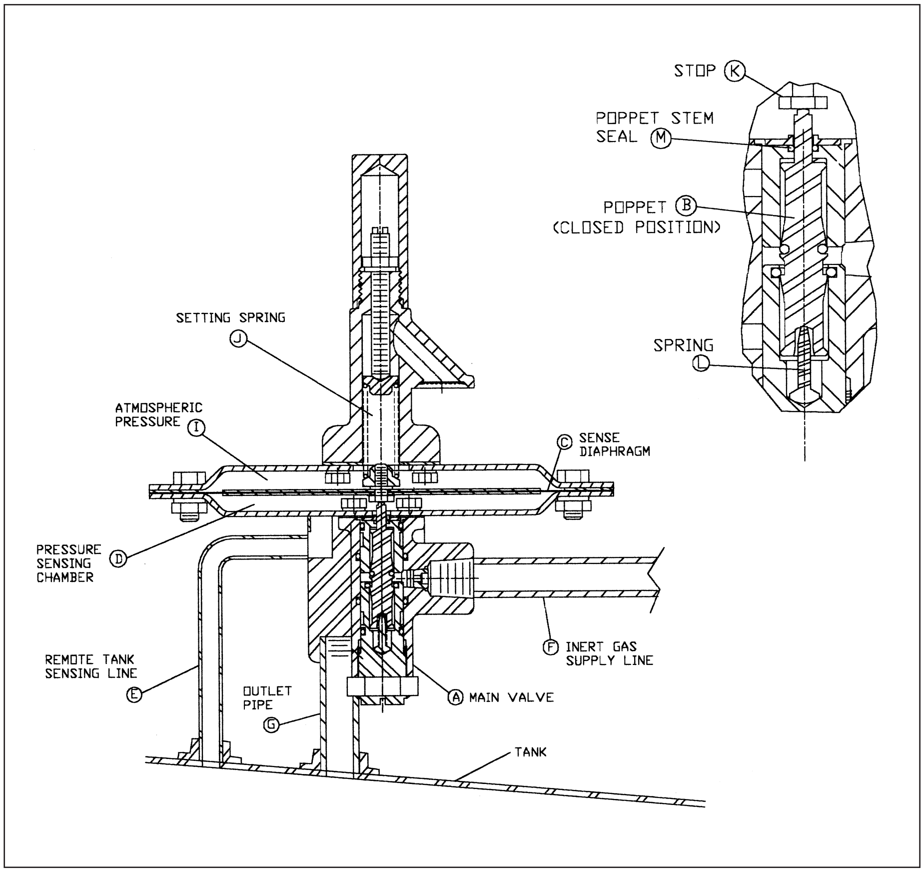
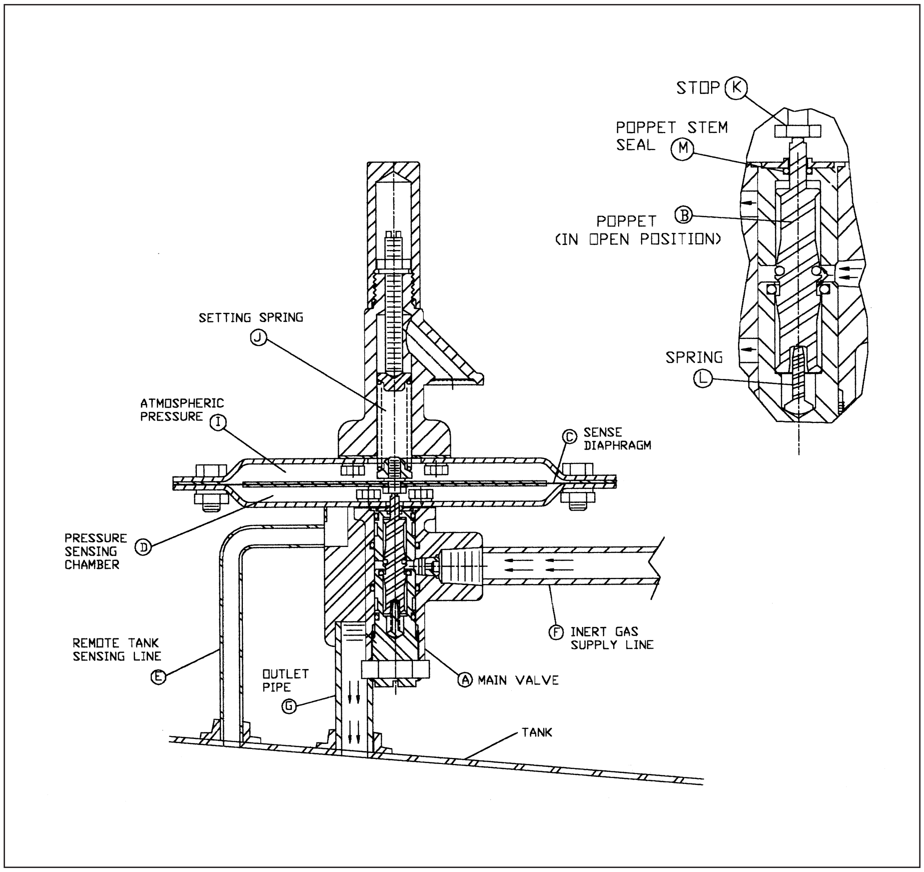


Fig. 3

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 is 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. Nm^3/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. The flows stated in Table 3 will be achieved by a pressure of 1 1/2" W.C. below the set point of the Protectoseal Series No. 30 Blanketing Valve (no flow plugs). Optional flow plugs can be used to restrict flow to 75%, 50% or 25% of the flows listed below.

Table 3
Flows Through Protectoseal Blanketing Valve

Supply Pressure			Air		Nitrogen		Natural Gas	
PSIG	kPa (g)	kg/cm² (g)	SCFH	Nm³/h	SCFH	Nm³/h	SCFH	Nm³/h
10	69	0.7	246	6.8	250	6.9	317	8.7
20	138	1.4	345	9.5	351	9.6	445	12.2
40	276	2.8	543	14.9	552	15.2	701	19.3
60	414	4.2	742	20.4	754	20.7	958	26.4
80	552	5.6	941	25.9	957	26.3	1,215	33.4
100	690	7.0	1,140	31.4	1,159	31.9	1,472	40.5
120	827	8.4	1,339	36.9	1,361	37.5	1,728	47.6
140	965	9.8	1,537	42.3	1,563	43.0	1,984	54.6
160	1,103	11.2	1,736	47.8	1,765	48.6	2,241	61.7
180	1,241	12.7	1,935	53.3	1,968	54.2	2,498	68.8
200	1,379	14.1	2,134	58.8	2,170	59.8	2,755	75.9

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 30 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).

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. Refer to Fig. 4 on page 8 for "Relative Set Points of the Blanketing Valve and Conservation Vents".

Conservation Vents

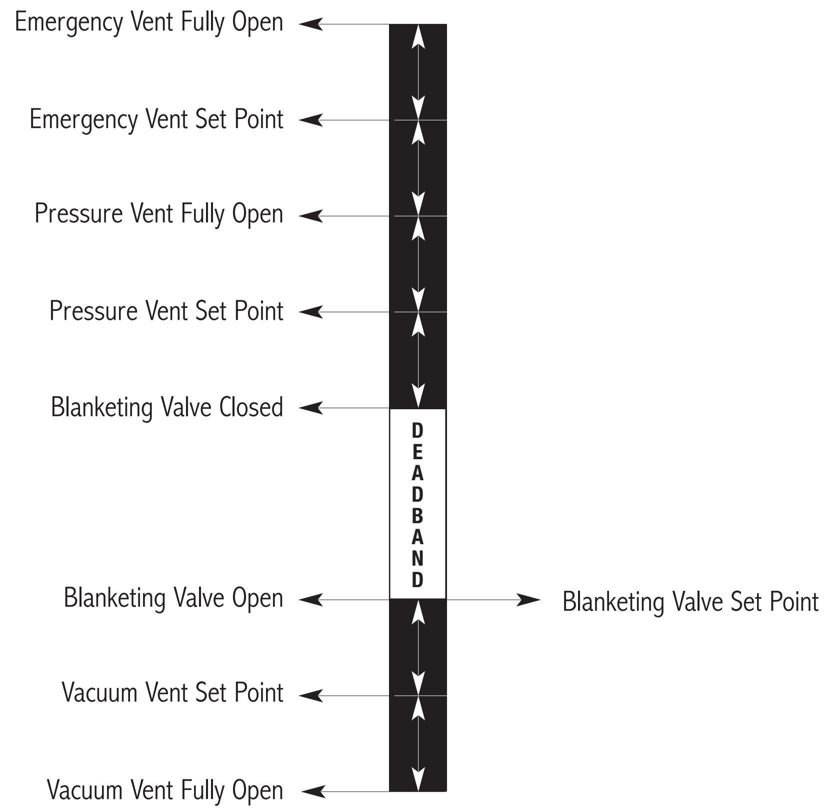


Fig. 4
Relative Set Points of the Blanketing Valve and Conservation Vents

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	1.5 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]

NOTE[1] Set point ranges may be varied. Contact factory for specific applications outside the stated guidelines.
NOTE[2] For Blanketing Valve set points BELOW 1.0 gauge, set Vacuum Vent at least 1.5 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 30 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 in which it operates. The standard metal for the Series 30 Blanketing Valve is stainless steel 316 which offers good resistance to most chemicals. The sense diaphragm and gasket are made from FEP Film which offers the best possible chemical resistance. The O-rings and other gaskets are available in a range of materials, as shown in Table 5 below. An optional supply line filter 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, polyethylene and Viton® is also available. The use of a supply line filter is 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 resistant 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 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 30 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)

* Sense diaphragm and gasket only.

Note: Viton® and Kalrez® are registered trademarks of E. I. DuPont de Nemours Co., Inc. Chemraz® is a registered trademark of Green, Tweed & Co., Inc.

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)
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 30 Numbering System

Most of the digits of the twelve-digit Series 30 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
Standard:	F	3	0	B	A	A	A	A	0	0	0	0

EXAMPLE:

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

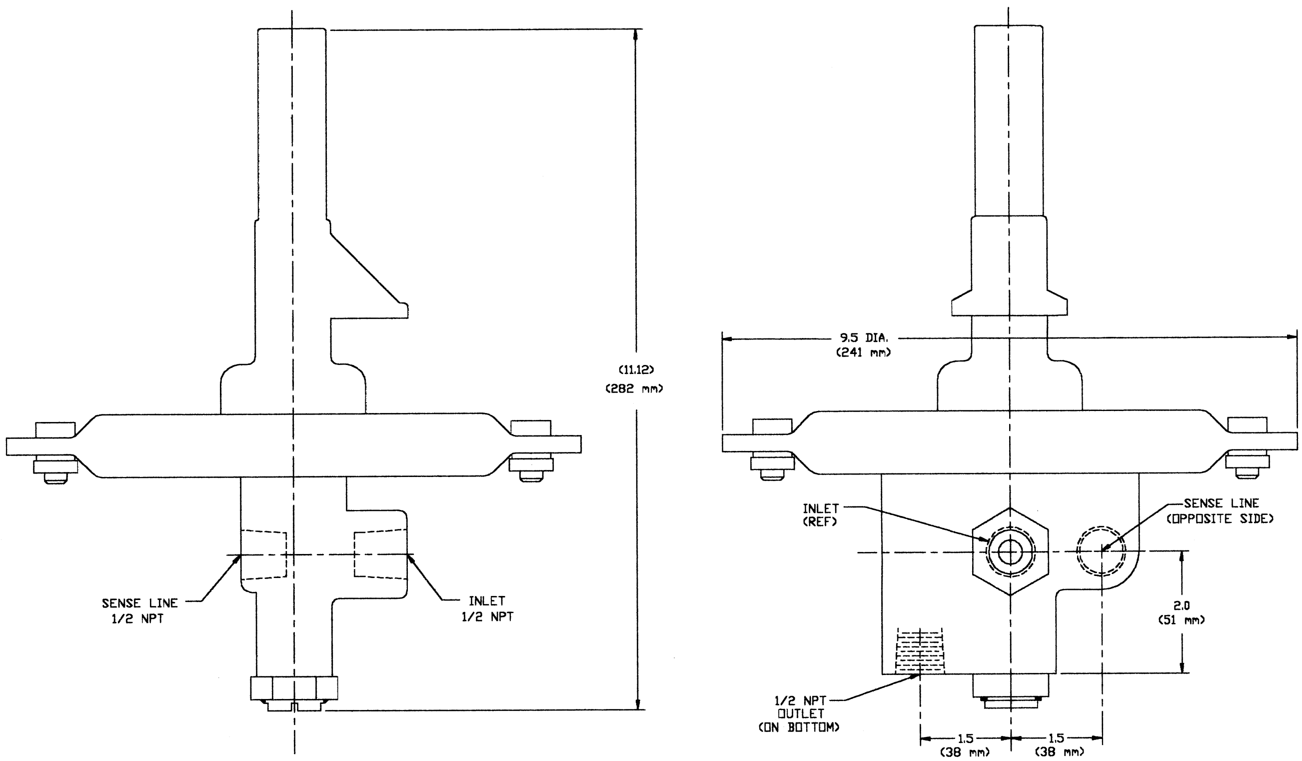
1	MATERIAL	F: Stainless Steel 316 K: Same as above with cleaning/packaging to Pure-Tech specifications
2-3	SERIES NO.	30
4	HOUSING DESIGN	B: Investment Cast Body
5	CONNECTIONS: (INLET / OUTLET)	A: ½" FNPT / FNPT B: ½" FNPT / 150# flange C: ½" FNPT / 300# flange D: ½" 150# flange / 150# flange E: ½" 300# flange / 300# flange
6	SET POINT PRESSURE RANGE (in inches W.C.)	A: -0.1" including 3.0" B: Above 3.0" including 7.0" C: Above 7.0" including 25.0" D: Above 25.0" including 69.2"
7	SOFT GOOD MATERIALS SEALS & GASKETS*	A: Buna-N B: Neoprene C: Viton® D: EPDM E: Kalrez® F: Chemraz®
8	FLOW CAPACITY	A: 100% (NO PLUG) B: 75% C: 50% D: 25%
9	FILTER OPTION (Filters not assembled to valve)	0: No filter 1: ½" FNPT aluminum filter 2: ½" FNPT stainless steel filter
10	PRESSURE GAGE OPTION	0: No gages 1: Supply line gage only 2: Sense line gage only 3: Sense line & supply line gages
11	INTEGRAL PURGE OPTION	0: No purge 1: Outlet line purge only 2: Sense line purge only 3: Outlet line and sense line purge
12	FIELD TEST OPTION	0: Not included 1: Included** 2: Included with 3-way valve for outlet line** 3: Included with shut-off valve for sense line** 4: Included with 3-way valve for outlet line & shut-off valve for sense line**

*For all soft goods options, the poppet stem seal (Item M, Fig. Nos. 2 & 3 on page 3) will be Teflon® coated Buna-N. On units with Kalrez® or Chemraz® seals and gaskets (option code E or F), the sense diaphragm gasket (Item C) will be Buna-N.

**Sense line and supply line gages included. Digit #10 should be option 3.

Dimensions

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



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