

Type Y696 Vapor Recovery Regulator



W5996

Figure 1. Type Y696 Vapor Recovery Regulator

Features

- **Simplicity**—Direct-operated, straight forward stem and lever design minimizes the number of parts while providing excellent regulation of pressure.
- **Precision Control**—Large diaphragm area provides very accurate throttling control at low set pressures.
- **Rugged Construction**—Heavy duty castings and internal parts are designed to lessen vibration and shock.
- **Ease of Inspection and Maintenance**—The union nut connection permits maintenance or inspection of critical parts without removing the body from the line.
- **Variety of Construction Materials**—Body and lower casing are available in cast iron, steel, stainless steel or Hastelloy® C. Spring case is available in cast iron, steel or stainless steel. Trim is available in stainless steel or Hastelloy® C.

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Introduction

The Accu-Pressure™ Type Y696 is a direct-operated vapor recovery regulator. Type Y696 is available in two configurations, internal registration and external registration which requires control line. This regulator is used to sense an increase vessel pressure and vent excessive internal tank pressure to an appropriate vapor recovery disposal or reclamation system. However, inlet pressures, outlet pressures and other performance characteristics vary according to construction.



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Specifications

This section lists the specifications for the Type Y696 regulator. Factory specifications are stamped on the nameplate fastened on the regulator at the factory.

<p>Body Size and End Connection Style⁽¹⁾ See Table 1</p> <p>Maximum Allowable Inlet and Outlet Pressure⁽²⁾ 15 psig / 1.0 bar</p> <p>Orifice Diameter 1 in. / 25 mm</p> <p>Control Pressure Ranges See Table 2</p> <p>Flow Capacities See Table 7</p> <p>Wide-Open Flow Coefficients C_v: 14.7 C_g: 515 C_i: 35</p> <p>Pressure Registration Internal or External</p> <p>Vent Connections 1/4 NPT</p> <p>Spring Case Connection 1/4 NPT</p> <p>Common Services and Material Compatibility See Tables 3 and 4</p>	<p>Temperature Capabilities⁽²⁾ Nitrile (NBR): -20 to 180°F / -29 to 82°C Fluorocarbon (FKM): 40 to 300°F / 4 to 149°C Perfluoroelastomer (FFKM): 0 to 300°F / -18 to 149°C Ethylenepropylene (EPDM): -20 to 275°F / -29 to 135°C</p> <p>Approximate Weight Cast iron: 45 lbs / 20 kg Steel and Stainless Steel: 57 lbs / 26 kg</p> <p>Construction Materials Body and Union Nut: Cast iron, Steel, CF8M Stainless steel or Hastelloy® C Spring Case: Cast iron, Steel or CF8M Stainless steel Diaphragm Case Assembly: Cast iron, Steel, CF8M Stainless steel or Hastelloy® C Control Spring, Control Spring Seat and Diaphragm Plate: Plated Steel Diaphragm: Nitrile (NBR) (standard), Fluorocarbon (FKM) or Ethylenepropylene (EPDM) Disk Assembly: 303 Stainless steel disk holder with Nitrile (NBR) or Ethylenepropylene (EPDM) disk; 316 Stainless steel disk holder with Nitrile (NBR), Fluorocarbon (FKM), Perfluoroelastomer (FFKM) or Polytetrafluoroethylene (PTFE) disk; or Hastelloy® C disk holder with PTFE disk Orifice, Pusher Post, Lever Assembly, Stem and Cotter Pin: 303 Stainless steel, 316 Stainless steel or Hastelloy® C Gaskets: Composition</p>
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1. End connections for other than U.S. standard can usually be provided, consult your local Sales Office.

2. The pressure/temperature limits in this Bulletin or any applicable standard limitation should not be exceeded.

Table 1. Body Sizes and End Connection Style

BODY SIZE, NPS / DN	BODY MATERIAL			
	Cast Iron	Steel	Stainless Steel	Hastelloy® C
1-1/2 and 2 / 40 and 50	NPT	NPT, SWE, CL150 RF, CL300 RF, PN 16/25/40	NPT, SWE, CL150 RF, CL300 RF, PN 16/25/40	CL150 RF

Table 2. Control Pressure Ranges

CONTROL PRESSURE RANGE		SPRING PART NUMBER	SPRING COLOR	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
In. w.c.	mbar			In.	mm	In.	mm
2 to 5 ⁽¹⁾⁽²⁾	5 to 12 ⁽¹⁾⁽²⁾	1A200127022	Red	0.135	3.43	5.38	137
5 to 15 ⁽¹⁾⁽²⁾	12 to 37 ⁽¹⁾⁽²⁾	1B766627062	Gray	0.156	3.96	6.63	168
8 in. w.c. to 1 psig	20 to 69	0B019427052	Dark Green	0.187	4.75	6.00	152
1 to 2.8 psig	69 mbar to 0.19 bar	0A081127202	Orange	0.250	6.35	6.00	152
2 to 3.5 psig	0.14 to 0.24 bar	0Y066427022	Green stripe	0.363	9.22	6.00	152
4 to 7 psig	0.28 to 0.48 bar	1H802427032	Red	0.406	10.3	6.00	152

1. Spring ranges based on spring case installed pointed down. When installed pointed up, spring range increases 2 in. w.c. / 5 mbar.

2. Do not use Fluorocarbon (FKM) diaphragm with these springs at diaphragm temperatures lower than 60°F / 16°C.

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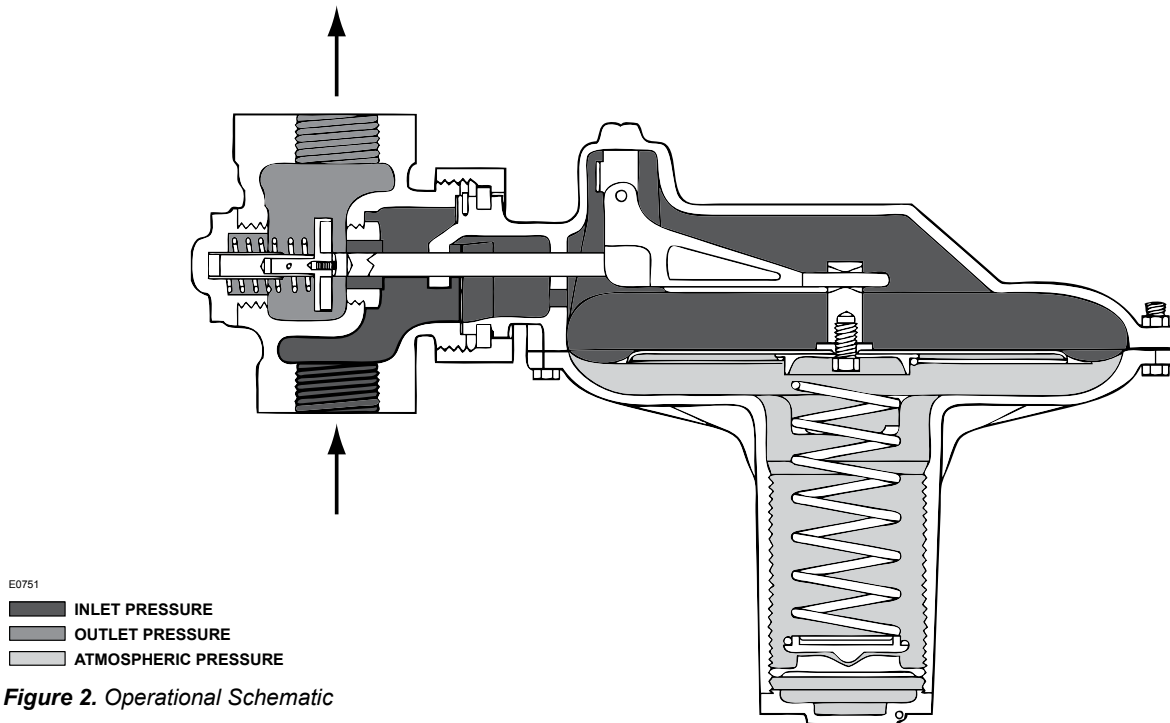


Figure 2. Operational Schematic

Principle of Operation

The Type Y696 vapor recovery regulator is used to maintain a constant blanket (inlet) pressure or vessel pressure with the outlet flowing to a system whose pressure is lower than that at the inlet.

When vessel pressure increases above the setpoint of the regulator due to pumping in or thermal heating, the force of the control spring is overcome by pressure acting on the diaphragm. This moves the disk away from the orifice allowing gas to flow from the vessel to the vapor recovery system.

As vessel pressure is reduced, the force of the control spring causes the disk to move toward the orifice decreasing the flow of gas out of the vessel. As vessel pressure drops below the setpoint of the regulator, the disk will seat against the orifice shutting off the flow of gas.

Sizing Vapor Recovery Systems

To determine the capacity required, you must consider the amount of blanketing gas that must be displaced from the tank when either filling the vessel with liquid (pump-in) or the expansion of tank vapors during atmospheric thermal heating.

Using the established procedures from American Petroleum Institute Standard 2000 (API 2000), determine the required flow rate for outbreathing.

1. Determine the flow rate of blanketing gas displaced when liquid is being pumped in (see Table 6).
2. Determine the gas flow rate due to “outbreathing” caused by atmospheric thermal heating (see Table 5).

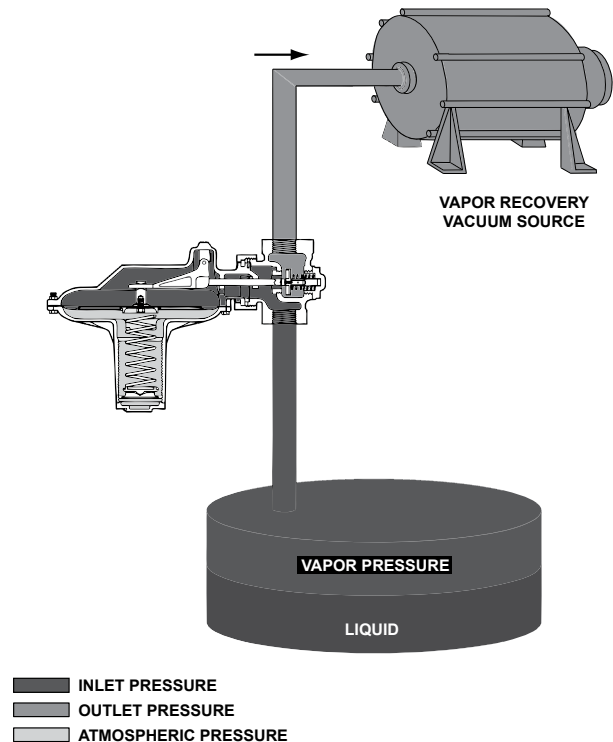


Figure 3. Type Y696 Operational Schematic

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Table 3. Fluid Compatibility of Metals

FLUID	MATERIAL				FLUID	MATERIAL			
	Carbon Steel	Cast Iron	316 Stainless Steel	Hastelloy® C		Carbon Steel	Cast Iron	316 Stainless Steel	Hastelloy® C
Acetaldehyde	A	A	A	A	Hydrochloric Acid, Aerated	C	C	C	B
Acetic Acid, Air Free	C	C	B	A	Hydrochloric Acid, Air free	C	C	C	B
Acetic Acid, Aerated	C	C	A	A	Hydrofluoric Acid, Aerated	B	C	B	A
Acetic Acid Vapors	C	C	A	A	Hydrofluoric Acid, Air free	A	C	B	A
Acetone	A	A	A	A	Hydrogen	A	A	A	A
Acetylene	A	A	A	A	Hydrogen Peroxide	IL	A	A	B
Alcohols	A	A	A	A	Hydrogen Sulfide, Liquid	C	C	A	A
Aluminum Sulfate	C	C	A	A	Magnesium Hydroxide	A	A	A	A
Ammonia	A	A	A	A	Mercury	A	A	A	A
Ammonium Chloride	C	C	B	A	Methanol	A	A	A	A
Ammonium Nitrate	A	C	A	A	Methyl Ethyl Ketone	A	A	A	A
Ammonium Phosphate	C	C	A	A	Milk	C	C	A	A
Ammonium Sulfate	C	C	A	A	Natural Gas	A	A	A	A
Ammonium Sulfite	C	C	A	A	Nitric Acid	C	C	B	B
Aniline	C	C	A	A	Oleic Acid	C	C	A	A
Asphalt	A	A	A	A	Oxalic Acid	C	C	B	A
Beer	B	B	A	A	Oxygen	A	A	A	A
Benzene (Benzol)	A	A	A	A	Petroleum Oils, Refined	A	A	A	A
Benzoic Acid	C	C	A	A	Phosphoric Acid, Aerated	C	C	A	A
Boric Acid	C	C	A	A	Phosphoric Acid, Air Free	C	C	A	A
Butane	A	A	A	A	Phosphoric Acid Vapors	C	C	B	IL
Calcium Chloride (Alkaline)	B	B	B	A	Picric Acid	C	C	A	A
Calcium Hypochlorite	C	C	B	A	Potassium Chloride	B	B	A	A
Carbolic Acid	B	B	A	A	Potassium Hydroxide	B	B	A	A
Carbon Dioxide, Dry	A	A	A	A	Propane	A	A	A	A
Carbon Dioxide, Wet	C	C	A	A	Rosin	B	B	A	A
Carbon Disulfide	A	A	A	A	Silver Nitrate	C	C	A	A
Carbon Tetrachloride	B	B	B	A	Sodium Acetate	A	A	A	A
Carbonic Acid	C	C	B	A	Sodium Carbonate	A	A	A	A
Chlorine Gas, Dry	A	A	B	A	Sodium Chloride	C	C	B	A
Chlorine Gas, Wet	C	C	C	B	Sodium Chromate	A	A	A	A
Chlorine, Liquid	C	C	C	A	Sodium Hydroxide	A	A	A	A
Chromic Acid	C	C	B	A	Sodium Hypochlorite	C	C	C	A
Citric Acid	IL	C	A	A	Sodium Thiosulfate	C	C	A	A
Coke Oven Gas	A	A	A	A	Stannous Chloride	B	B	A	A
Copper Sulfate	C	C	B	A	Stearic Acid	A	C	A	A
Cottonseed Oil	A	A	A	A	Sulfate Liquor (Black)	A	A	A	A
Creosote	A	A	A	A	Sulfur	A	A	A	A
Ethane	A	A	A	A	Sulfur Dioxide, Dry	A	A	A	A
Ether	B	B	A	A	Sulfur Trioxide, Dry	A	A	A	A
Ethyl Chloride	C	C	A	A	Sulfuric Acid (Aerated)	C	C	C	A
Ethylene	A	A	A	A	Sulfuric Acid (Air Free)	C	C	C	A
Ethylene Glycol	A	A	A	IL	Sulfurous Acid	C	C	B	A
Ferric Chloride	C	C	C	B	Trichloroethylene	B	B	A	A
Formaldehyde	B	B	A	A	Turpentine	B	B	A	A
Formic Acid	IL	C	B	A	Vinegar	C	C	A	A
Freon, Wet	B	B	A	A	Water, Boiler Feed	B	C	A	A
Freon, Dry	B	B	A	A	Water, Distilled	A	A	A	A
Furfural	A	A	A	A	Water, Sea	B	B	B	A
Gasoline, Refined	A	A	A	A	Zinc Chloride	C	C	C	A
Glucose	A	A	A	A	Zinc Sulfate/illed	C	C	A	A

A - Recommended
 B - Minor to moderate effect. Proceed with caution.
 C - Unsatisfactory
 IL - Information lacking

3. Add the requirements of 1 and 2 and select a vapor recovery regulator size based on total capacity required from Table 7.

Sample sizing problem:

Vessel Capacity 168,000 gal. / 636,000 liters
Pump In Capacity 50 GPM / 189 l/min
Desired Vapor Recovery 2 in. w.c. / 5 mbar
Vapor Recovery Vacuum Source 5 in. Hg

- From Table 6 the desired air flow rate due to pump in equals 50 GPM / 189 l/min x 8.01 = 400 SCFH / 10.7 Nm³/h air.
- From Table 5 the desired air flow rate = 4000 SCFH / 107 Nm³/h air due to thermal heating.
- Total required flow rate = 4400 SCFH / 118 Nm³/h air. 4400 SCFH / 118 Nm³/h converts to 4500 SCFH / 121 Nm³/h nitrogen.
- From Table 7, with a 2 in. w.c. / 5 mbar and an outlet pressure of 5 in. Hg, an NPS 1-1/2 or 2 / DN 40 or 50 body size would flow 5130 SCFH / 137 Nm³/h nitrogen. This would satisfy the desired flow rate of 4500 SCFH / 121 Nm³/h nitrogen.

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Table 4. Fluid Compatibility of Elastomers

FLUID	MATERIAL				
	Neoprene (CR)	Nitrile (NBR)	Fluorocarbon (FKM)	Ethylenepropylene (EPDM)	Perfluoroelastomer (FFKM)
Acetic Acid (30%)	B	C	C	A	A
Acetone	C	C	C	A	A
Air, Ambient	A	A	A	A	A
Air, Hot (200°F / 93°C)	C	B	A	A	A
Alcohol (Ethyl)	A	C	C	A	A
Alcohol (Methyl)	A	A	C	A	A
Ammonia (Anhydrous)(Cold)	A	A	C	A	A
Ammonia (Gas, Hot)	B	C	C	B	A
Beer	A	A	A	A	A
Benzene	C	C	B	C	A
Brine (Calcium Chloride)	A	A	B	A	A
Butadiene Gas	C	C	B	C	A
Butane (Gas)	A	A	A	C	A
Butane (Liquid)	C	A	A	C	A
Carbon Tetrachloride	C	C	A	C	A
Chlorine (Dry)	C	C	A	C	A
Chlorine (Wet)	C	C	B	C	A
Coke Oven Gas	C	C	A	C	A
Ethyl Acetate	C	C	C	B	A
Ethylene Glycol	A	A	A	A	A
Freon 11	C	B	A	C	A
Freon 12	A	A	B	B	A
Freon 22	A	C	C	A	A
Freon 114	A	A	B	A	A
Gasoline (Automotive)	C	B	A	C	A
Hydrogen Gas	A	A	A	A	A
Hydrogen Sulfide (Dry)	A	A ⁽¹⁾	C	A	A
Hydrogen Sulfide (Wet)	B	C	C	A	A
Jet Fuel (JP-4)	B	A	A	C	A
Methyl Ethyl Ketone (MEK)	C	C	C	A	A
MTBE	C	C	C	C	A
Natural Gas	A	A	A	C	A
Nitric Acid (50 to 100%)	C	C	B	C	A
Nitrogen	A	A	A	A	A
Oil (Fuel)	C	A	A	C	A
Propane	B	A	A	C	A
Sulfur Dioxide	A	C	A	A	A
Sulfuric Acid (up to 50%)	B	C	A	B	A
Sulfuric Acid (50 to 100%)	C	C	A	B	A
Water (Ambient)	A	A	A	A	A
Water [at 200°F (93°C)]	C	B	B	A	A

1. Performance worsens with hot temperatures.
A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory
N/A - Information not available

Capacity Information

Table 7 gives typical nitrogen regulating capacities at selected inlet pressures and outlet pressure settings. Flows are in SCFH (at 60°F and 14.7 psia) and Nm³/h (at 0°C and 1.01325 bar) of 0.97 specific gravity nitrogen. For gases of other specific gravities, multiply the given SCFH capacity of nitrogen by 0.985 and divide by the square root of the appropriate specific gravity of the gas required. Then, if capacity is desired in Nm³/h, multiply SCFH by 0.0268.

To determine regulating capacities at pressure settings not given or to determine wide-open flow capacities, use the following formula:

$$Q = \sqrt{\frac{520}{GT}} C_g P_1 \text{SIN} \left(\frac{3417}{C_1} \sqrt{\frac{\Delta P}{P_1}} \right) \text{DEG}$$

where:

- Q = gas flow rate, SCFH
- C_g = gas sizing coefficient
- P₁ = absolute inlet pressure, psia
- G = specific gravity of the gas
- T = absolute temperature of gas at inlet, °Rankine
- C₁ = flow coefficient
- ΔP = pressure drop across the regulator, psi

Installation

Install the regulator using a straight run of pipe the same size as or larger than the regulator body. Flow through the regulator body is indicated by the flow arrow cast, stamped or riveted on the body. If a block valve is required, install a full flow valve between the regulator and the blanketed vessel. For proper operation at low setpoint ranges, the Type Y696 regulators should be installed with the spring case barrel pointed down.

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Table 5. Gas Flow Required for Thermal Heating (Outbreathing) per API 2000 (Interpolate for Intermediate Sizes)

TANK CAPACITY, BARRELS	TANK CAPACITY, GALLONS	OUTBREATHING (FLASH POINT < 100°F OR NORMAL BOILING POINT < 300°F), SCFH AIR	TANK CAPACITY, m ³	OUTBREATHING (FLASH POINT < 38°C OR NORMAL BOILING POINT < 149°C), Nm ³ /h AIR
60	2500	60	10	1.6
100	4200	100	20	2.7
500	21,000	500	100	13.4
1000	42,000	1000	200	26.8
2000	84,000	2000	300	53.6
3000	126,000	3000	500	80.4
4000	168,000	4000	700	107
5000	210,000	5000	1000	134
10,000	420,000	10,000	1500	268
15,000	630,000	15,000	2000	402
20,000	840,000	20,000	3000	536
25,000	1,050,000	24,000	3180	643
30,000	1,260,000	28,000	4000	750
35,000	1,470,000	31,000	5000	831
40,000	1,680,000	34,000	6000	911
45,000	1,890,000	37,000	7000	992
50,000	2,100,000	40,000	8000	1072
60,000	2,520,000	44,000	9000	1179
70,000	2,940,000	48,000	10,000	1286
80,000	3,360,000	52,000	12,000	1394
90,000	3,780,000	56,000	14,000	1501
100,000	4,200,000	60,000	16,000	1608
120,000	5,040,000	68,000	18,000	1822
140,000	5,880,000	75,000	20,000	2010
160,000	6,720,000	82,000	25,000	2198
180,000	7,560,000	90,000	30,000	2412

Table 6. Flow Rate Conversion⁽¹⁾

MULTIPLY MAXIMUM PUMP RATE OUT:	BY	TO OBTAIN ⁽¹⁾ :
U.S. GPM	8.021	SCFH
U.S. GPH	0.1337	SCFH
m ³ /hr	1.01	Nm ³ /h
Barrels/hour	5.615	SCFH
Barrels/day	0.2340	SCFH

1. Gas flow of blanketing gas to replace liquid pumped out.

Table 7. Capacities

OUTLET PRESSURE RANGE, SPRING PART NUMBER AND COLOR	SET PRESSURE		BUILDUP TO OBTAIN WIDE-OPEN TRAVEL		OUTLET PRESSURE VACUUM		CAPACITIES IN SCFH / Nm ³ /h OF 0.97 SPECIFIC GRAVITY NITROGEN	
	In. w.c.	mbar	In. w.c.	mbar	psig	bar	SCFH	Nm ³ /h
2 to 5 in. w.c. / 5 to 12 mbar 1A200127022 Red	2	5	2.6	6	0	0	1420	38.1
					2.5	0.17	5130	137
					5	0.34	6560	176
5 to 15 in. w.c. / 12 to 37 mbar 1B766627062 Gray	15	37	3.9	10	0	0	2810	75.3
					2.5	0.17	5580	150
					5	0.34	6850	184
8 in. w.c. to 1 psig / 20 to 69 mbar 0B019427052 Dark Green	21	52	7.7	19	0	0	3510	94.1
					2.5	0.17	5950	159
					5	0.34	7160	192
1 to 2.8 psig / 69 mbar to 0.19 bar 0A081127202 Orange	2 psig	0.14 bar	23	57	0	0	5820	156
					2.5	0.17	7410	199
					5	0.34	8340	224
2 to 3.5 psig / 0.14 to 0.24 bar 0Y066427022 Green Stripe	3 psig	0.21 bar	3.2 psig	0.22 bar	0	0	8790	236
					2.5	0.17	9770	262
					5	0.34	10,400	279
4 to 7 psig / 0.28 to 0.48 bar 1H802427032 Red	5 psig	0.34 bar	5.87 psig	0.41 bar	0	0	12,000	322
					2.5	0.17	12,700	340
					5	0.34	13,100	351

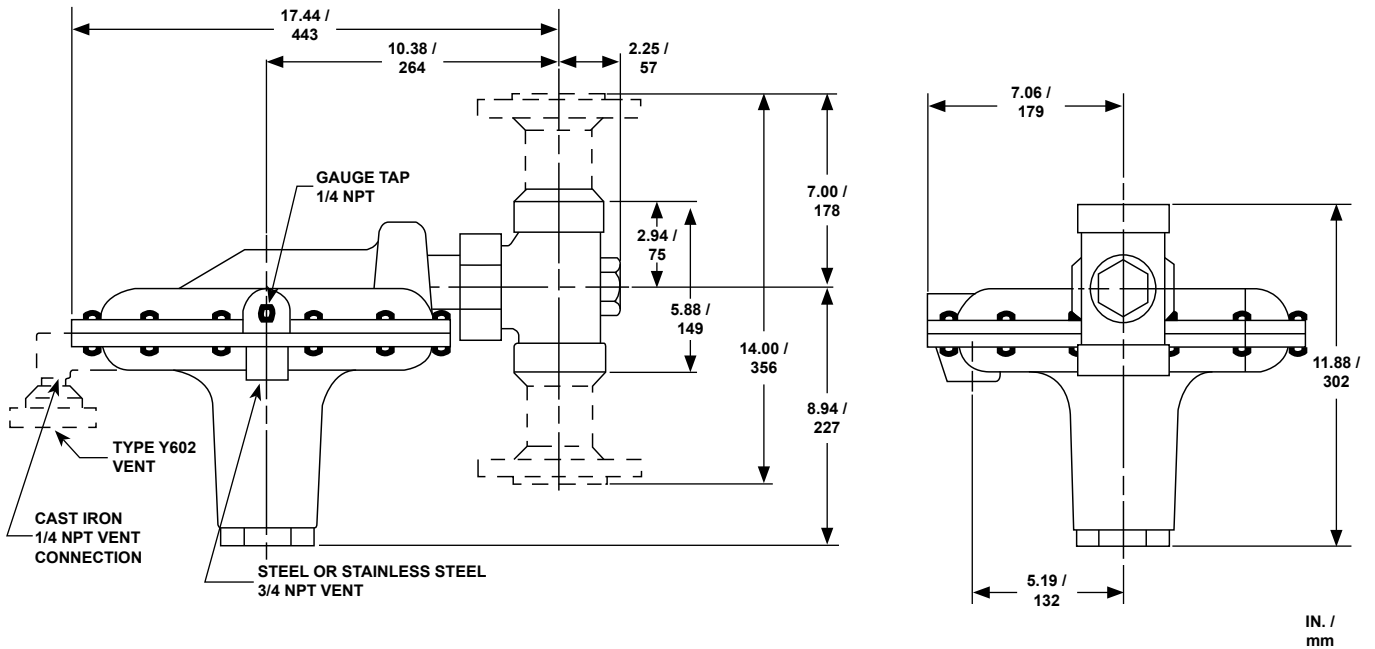


Figure 4. Dimensions

Ordering Information

Carefully review each specification and complete the Ordering Guide. To ensure ordering accuracy, please complete the Specifications Worksheet on the last page.

Ordering Guide

Body Size (Select One)

- NPS 1-1/2 / DN 40
- NPS 2 / DN 50

Body Material and End Connection Style (Select One)

Cast Iron

- NPT***

WCC Steel

- NPT***
- CL150 RF**
- CL300 RF**
- PN 16/25/40*

Hastelloy® C

- NPT*
- CL150 RF*
- CL300 RF*

CF8M Stainless Steel

- NPT**
- CL150 RF**
- CL300 RF**
- PN 16/25/40*

Spring Case Material (Select One)

- Cast iron***
- WCC Steel***
- CF8M Stainless steel**

Diaphragm Case Material (Select One)

- Cast iron***
- WCC Steel***
- CF8M Stainless steel**
- Hastelloy® C*

Trim Material (Select One)

- 303 Stainless steel***
- 316 Stainless steel (not available with Ethylenepropylene (EPDM))**
- Hastelloy® C (only available with PTFE)*

Diaphragm Material (Select One)

- Nitrile (NBR) (standard)***
- Fluorocarbon (FKM)**
- Nitrile (NBR) with PTFE Protector**

Disk Material (Select One)

- Nitrile (NBR) (standard)***
- Fluorocarbon (FKM)***
- Perfluoroelastomer (FFKM)*
- Ethylenepropylene (EPDM)*
- PTFE*

- continued -

Ordering Guide (continued)

Outlet Pressure Range (Select One)

- 2 to 5 in. w.c. / 5 to 12 mbar, Red***
- 5 to 15 in. w.c. / 12 to 37 mbar, Gray***
- 8 in. w.c. to 1 psig / 20 to 69 mbar, Dark Green***
- 1 to 2.8 psig / 69 mbar to 0.19 bar, Orange***
- 2 to 3.5 psig / 0.14 to 0.24 bar, Green Stripe***
- 4 to 7 psig / 0.28 to 0.48 bar, Red***

Pressure Registration

- Internal
- External

Replacement Parts Kit (Optional)

- Yes, send one parts kit to match this order.

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Regulators Quick Order Guide	
***	Standard - Readily Available for Shipment
**	Non-Standard - Allow Additional Time for Shipment
*	Special Order, Constructed from Non-Stocked Parts. Consult your local Sales Office for Availability.
Availability of the product being ordered is determined by the component with the longest shipping time for the requested construction.	

Vapor Recovery Specification Worksheet

Application Specifications:

Tank Size _____
 Pump In Rate _____
 Pump Out Rate _____
 Blanketing Gas (Type and Specific Gravity) _____

Pressure Requirements:

Control Pressure Setting _____
 Downstream Pressure _____
 Maximum Flow (Q_{max}) _____

Build-up Limitations:

- 0.25 in. w.c. / 0.6 mbar
- 0.5 in. w.c. / 1 mbar
- 1 in. w.c. / 2 mbar
- 2 in. w.c. / 5 mbar
- Others _____

Other Specifications:

Is a tank blanketing regulator required? Yes No
 Special Material Requirements: Ductile Iron Steel
 Stainless Steel Hastelloy® C Other _____
 Other Requirements: _____

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