

MODEL BQ

BACK PRESSURE / RELIEF REGULATOR

SECTION I

I. DESCRIPTION AND SCOPE

The Model BQ is a back pressure relief regulator used to control upstream (inlet or P₁) pressure. Side inlet and flow-through connections are 1/4", 3/8", and 1/2" NPT (DN8, DN10, DN15); outlet (bottom discharge) connection is always 1/2" NPT (DN15). With proper trim utilization, the unit is suitable for liquid, gaseous, or steam service. Refer to Technical Bulletin BQ-TB for design conditions and selection recommendations.



CAUTION

This is not a safety device and must not be substituted for a code approved pressure safety relief valve or a rupture disc.

SECTION II

II. INSTALLATION



CAUTION

For welded installations, all internal trim parts, seals and diaphragm(s) must be removed from regulator body prior to welding into pipeline. The heat of fusion welding will damage non-metallic parts if not removed. NOTE: This does not apply to units equipped with extended pipe nipples.

1. An inlet block valve should always be installed.
2. If service application is continuous such that shutdown is not readily accomplished, it is recommended that an inlet block valve, outlet block valve, and a manual bypass valve be installed.
3. Pipe unions should be installed to allow removal from piping.
4. An inlet pressure gauge should be located approximately ten pipe diameters upstream and within sight. An outlet pressure gauge is optional.
5. All installations should include an upstream relief device if the inlet pressure could exceed the pressure rating of any equipment or the maximum inlet pressure rating of the unit.



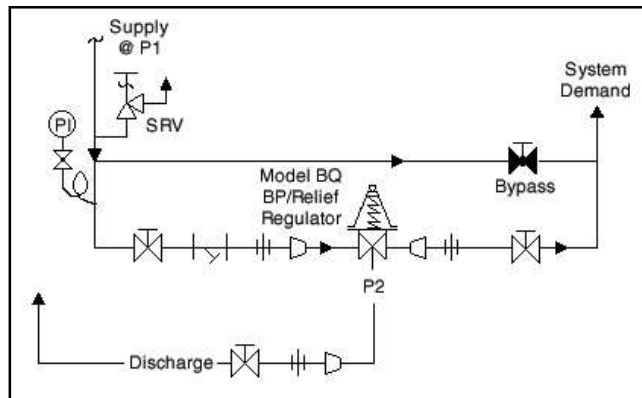
WARNING

The maximum inlet pressure is equal to 1.5 times the larger number of the stated range spring on the nameplate, and is the recommended "upper operative limit" for the sensing diaphragm. Higher pressures could damage the diaphragm. (Field hydrostatic tests frequently destroy diaphragms. DO NOT HYDROSTATIC TEST THROUGH AN INSTALLED UNIT; ISOLATE FROM TEST.)



CAUTION

Installation of adequate overpressure protection is recommended to protect the regulator from overpressure and all downstream equipment from damage in the event of regulator failure.



Recommended piping schematic for Back Pressure Regulator

6. Clean the piping of all foreign material including chips, welding scale, oil, grease and dirt before installing the regulator. Strainers are recommended.
7. In placing thread sealant on pipe ends prior to engagement, ensure that excess material is removed and not allowed to enter the regulator upon startup.
8. Flow Direction: Install so the flow direction matches the arrow cast on the body. Connect the inlet pressure to the body side connection(s). Fluid will relieve out of the bottom connection. The double inlet connections are for in-line installation (plug one side connection if in-line installation is not required).
9. Regulator may be installed in a vertical or horizontal pipe. If it is a steam system, ensure the piping is properly trapped and vented.

10a. Basic Regulator - (Refer to Figure 1): Regulator may be rotated around the pipe axis 360°. Recommended positions are with the spring chamber vertical upwards, or horizontal. Orient such that the spring chamber vent hole does not collect rainwater or debris.

10b. Cryogenic Regulator - Option -5 or -36 (Figure 2):

- a. Recommended installation is with spring chamber hanging directly below the body in a vertical downwards orientation. Allow water to drain; i.e. melting frost, rain water.
- b. Recommend inert purge gas to spring chamber through vent hole and out drain hole.

10c. Differential Regulator - Option -1+6 (Refer to Figure 3).

- a. Recommended installation is with the spring chamber directed upwards.
- b. No corrosive fluid should be utilized for spring chamber loading.
- c. System operation should ensure that loading pressure (P_{LOAD}) not exceed inlet pressure (P_1); internal diaphragm damage may occur if this operational mode occurs.

11. Regulators are not to be direct buried underground. For insulated piping systems, recommendation is to not insulate regulator.

12. Spring Chamber Vent Tap - Option -25: Pipe spring chamber vent opening to remote location. Orient so as not to take on rainwater.

SECTION III

III. PRINCIPLE OF OPERATION

1. Movement occurs as pressure variations register on the diaphragm. The registering pressure is the inlet, P_1 or upstream pressure. The range spring opposes diaphragm movement. As inlet pressure drops, the

range spring pushes the diaphragm down, closing the port; as inlet pressure increases, the diaphragm pushes up and the port opens.

2. A complete diaphragm failure will cause the outlet process fluid to mix with the loading fluid.

SECTION IV

IV. STARTUP

* **NOTE:** Systems sequencing operations at startup, normal operation, failure mode(s), and shutdown must assure that the pressure (P_{LOAD}) on the spring chamber does not exceed the pressure registering on the wetted side of the diaphragm. Should this "pressure reversal" occur, particularly to metal diaphragms, the diaphragm may be permanently damaged and cause improper operation.

$$P_1 > P_{LOAD}$$

Pressure reversal is normally caused by the inlet pressure to a regulator being interrupted (automatically or manually).

1. Ensure the proper range spring is indicated to be within the regulator by inspection of the unit's nameplate. Apply setpoint pressures that are only within the stated range.
2. When stating direction of rotation of the adjustment screw, the view is with respect to looking down towards the adjusting screw or its normal location.
3. Start with the block valves closed. A bypass valve may be used to maintain inlet pressure in the upstream system without changing the following steps.
4. Remove closing cap, if installed. Relax the range spring by turning the adjusting screw counterclockwise (CCW) a minimum of three (3) full revolutions. This reduces the inlet (upstream) pressure setpoint.
5. If it is a "hot" piping system, and equipped with a bypass valve, slowly open the bypass valve to pre-heat the system piping and to allow slow expansion of the piping. Ensure proper steam trap operation if installed. Closely monitor inlet (upstream) pressure, via gauge, to ensure not over-pressurizing. **NOTE:** If no bypass valve is installed, extra caution should be used in starting up a cold system; i.e. do everything slowly.
6. Crack open the inlet (upstream) block valve.

7. Slowly open the outlet (downstream) block valve observing the inlet (upstream) pressure gauge. Determine if the regulator is flowing. If not, slowly rotate the regulator adjusting screw counterclockwise (CCW) until flow begins.

8. Continue to slowly open the outlet (downstream) block valve until fully open.

9. Observing the inlet (upstream) pressure gauge, rotate the adjusting screw clockwise (CW) slowly until the inlet pressure begins to rise. Rotate CW until the desired setpoint is reached.

10. Continue to slowly open the inlet (upstream) block valve. If the inlet (upstream) pressure exceeds the desired setpoint pressure, rotate the adjusting screw (CCW) until the pressure decreases.

11. When flow is established steady enough that both the outlet and inlet block valves are fully open, begin to slowly close the bypass valve if installed.

12. Develop system flow to a level near its expected normal rate, and reset the regulator setpoint by turning the adjusting screw CW to increase inlet pressure, or CCW to reduce inlet pressure.

13. Reduce system flow to a minimum level and observe setpoint. Inlet pressure will rise from the setpoint of Step 9. (Ensure that this rise does not exceed the stated upper limit of the range spring by greater than 50% i.e. 30-80 psig (2.07 - 5.52 Barg) range spring, at maximum flow the inlet pressure should not exceed 1.5 x 80 (5.6 Barg) or 120 psig (8.3 Barg). If it does, consult factory.)

14. Increase flow to maximum level if possible. Inlet (upstream or P_1) pressure should rise. Readjust setpoint as necessary at the normal flow rate.

SECTION V

V. SHUTDOWN

1. On systems with a bypass valve, and where system pressure is to be maintained as the regulator is shut down, slowly open the bypass valve while closing the inlet (upstream) block valve. Fully close the inlet (upstream) block valve. When on bypass, the system pressure must be constantly observed and manually regulated. Close the outlet (downstream) block valve.



CAUTION

Do not walk away and leave a bypassed regulator unattended!

2. If the regulator and system are both to be shutdown, slowly close the inlet (upstream) block valve. Close the outlet (downstream) valve only if regulator removal is required.

SECTION VI



WARNING

SYSTEM UNDER PRESSURE. Prior to performing any maintenance, isolate the regulator from the system and relieve all pressure. Failure to do so could result in personal injury.

VI. MAINTENANCE

A. General:

1. Maintenance procedures hereinafter are based upon removal of the regulator unit from the pipeline where installed.
2. Owner should refer to owner's procedures for removal, handling, cleaning and disposal of nonreusable parts, i.e. gaskets, etc.
3. Refer to Figure 1 for basic construction, Figure 3 for differential construction and Figure 2 for cryogenic construction. For a blow-up of the composition seat trim, see Figure 4.
4. When counter clockwise (CCW) or clockwise (CW) rotations are indicated, they are with respect to:
 - a. Spring Chamber - as viewed from above looking down towards the closing cap or its normal location.
 - b. Body - as viewed looking into the body cavity with the spring chamber removed.

B. Diaphragm Replacement:

1. Securely install the body (1) in a vise with the spring chamber (2) directed upwards.

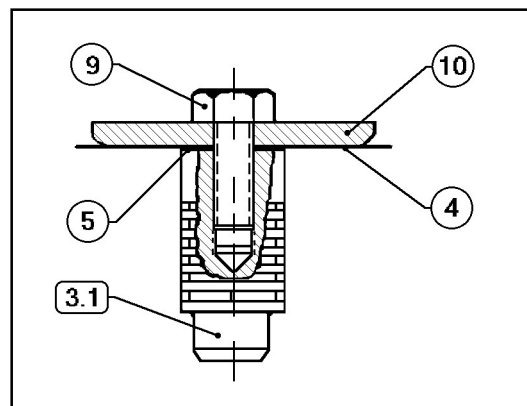


WARNING

SPRING UNDER COMPRESSION. Prior to removing flange bolts, relieve spring compression by backing out the adjusting screw. Failure to do so may result in flying parts that could cause personal injury.

2. Relax range spring (11) by turning adjusting screw (13) CCW until removed from spring chamber (2).

3. Draw or embed a match mark between body casting (1) and spring chamber casting (2) along flanged area.
4. Remove all flange nuts (8) and flange bolts (7).
5. Remove spring chamber (2), range spring (11) and spring button (12).
6. Remove the diaphragm subassembly consisting of the piston cap screw (9), pressure plate (10), diaphragm(s) (4), piston (3.1) and piston gasket (5). **NOTE:** Refer to the quantity of diaphragm(s) (4) incorporated in the bill of materials listing. Depending on inlet pressure level, multiple metal diaphragms may be "stacked".



Diaphragm Subassembly

7. To disassemble the diaphragm subassembly, place piston (3.1) in a vise and rotate piston cap screw (9) CCW. **NOTE:** Recommend using lead jaws when placing the piston in a vise, so as not to damage the piston grooves.
8. Separate all parts (3.1, 4, 5, 9 and 10) and clean piston gasket (5) surface on piston (3.1) if piston is to be reused. **NOTE:** No piston gasket (5) utilized for composition diaphragm.
9. Inspect pressure plate (10) to ensure no deformation due to over-pressurization. If deformed, replace.
10. Remove diaphragm gasket (6) for metal diaphragm. **NOTE:** No diaphragm gasket (6) utilized for composition diaphragm.

11. Clean body (1) and diaphragm flange. **NOTE:** *On regulators originally supplied as "cleaned for oxygen service", Option -5, -36 or -55, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1134. Contact factory for details.*
12. Place diaphragm gasket (6) on body (1) flange, if required.
13. Reassemble diaphragm subassembly by placing piston (3.1) in a vise (recommend using lead jaws with vise). Assemble parts on piston cap screw (9) as follows: pressure plate (10), diaphragm(s) (4), and piston gasket (5), if required. **NOTE 1:** *Apply a light coat of gasket sealant to gasket.* **NOTE 2:** *Ensure the pressure plate is placed with curved outer rim down next to the diaphragm (4) surface.*
14. Apply thread sealant compound to the threads of the piston cap screw (9) and thread into piston (3.1). Rotate piston cap screw (9) CW and tighten to the following torques.

DIAPHRAGM TYPE	TORQUE
Metal	15 ft-lb (20 N-m)
Composition	12 ft-lb (16 N-m)

15. Insert the diaphragm subassembly into the body (1). Rotate the assembly to ensure that the piston is not binding in the cylinder. If necessary, buff piston with Scotch-Brite® or equivalent.
16. Place range spring (11) on the pressure plate (10).
17. Place multipurpose, high temperature grease into depression of spring button (12) where adjusting screw bears. Set spring button (12) onto range spring (11); ensure spring button (12) is laying flat.
18. Aligning the matchmarks, place spring chamber (2) over the above stacked parts. Install all bolts (7) and nuts (8) by hand tightening. Mechanically tighten bolting (7) (8) in a cross pattern that allows spring chamber (2) to be pulled down evenly. Recommended torques are as follows:

REGULATOR SIZE	BOLT SIZE	METAL DIAPHRAGM	COMP. DIAPHRAGM
ALL	5/16"	15 ft-lb (20 N-m)	12 ft-lb (16 N-m)

NOTE: *Never replace bolting (7)(8) with just any bolting, if lost. Bolt heads and nuts are marked with specification identification numbers. Use only proper grades as replacements.*

19. Reinstall adjusting screw (13) with locknut (14).
20. Soap solution test around bolting (7) (8), body (1) and spring chamber (2) flanges for leakage. Ensure that an inlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 20-75 psig range spring, 50 psig test pressure minimum.

C. Special Instructions for Diaphragm Replacement:

1. For the Option -1+6 Differential Construction, reassemble the diaphragm subassembly in Sub-Section B. Step 12 as follows: assemble parts on piston cap screw (9), pressure plate (10), piston gasket (5), diaphragm(s) (4), piston gasket (5), and pusher plate (23). Refer back to Step 13 for "NOTES".
2. For metal diaphragm(s) (4) only, install a second diaphragm gasket (6) on the top side of the diaphragm. **NOTE:** *Clean the diaphragm flange area of the spring chamber (2) thoroughly before assembly.*
3. Utilize a new lock nut seal (22) when installing the adjusting screw (13) and locknut (14).
4. Install new closing cap gasket (21), reinstall closing cap (20).

D. Trim Replacement:

1. Trim removal requires that diaphragm subassembly be removed. Refer to previous procedure Section VI.B.
2. Using a deep socket with a 24 inch (600mm) lever length, place the socket over the cylinder (3.2) hex surfaces. Rotate CCW to remove the cylinder (3.2).
3. Inspect inside surface of cylinder (3.2) at three points:
 - a. Seat ring for erosion/wear on seating surfaces.
 - b. At metal-to-metal surface between body and cylinder (3.2). If wear exists here, consult factory.
 - c. Where the piston (3.1) ribbed guides bear (guide zone).

If wear is significant at any of these points, replace the piston/cylinder assembly (3).

4. Clean the body (1) cavity. Clean all parts to be reused. **NOTE:** *On regulators originally supplied with Option -55, "special cleaned", maintenance must include a level of cleanliness equal to Cashco Specification #S-1134. Contact factory for details.*
5. Use special care cleaning the flat mating surfaces of the body (1) and cylinder (3.2) shoulder, as this pressurized joint is metal-to-metal without a gasket.
6. Lubricate the cylinder (3.2) threads lightly with thread sealant, insert the cylinder (3.2) into the body (1) and screw CW until tightly seated. Reinstall diaphragm subassembly per Section VI.B., Diaphragm Replacement.
7. Bench test unit for suitable operation. **NOTE:** *Regulators are not tight shutoff devices. Even if*

pressure falls below setpoint, regulator may or may not develop bubble tight shutoff. In general, tighter shutoff can be expected with a composition seat.

8. Soap solution test around body (1) flange for leakage. Test pressure should be the maximum allowed by the range spring at the inlet.

SECTION VII

VII. TROUBLE SHOOTING GUIDE

1. Erratic Operation; chattering

Possible Causes	Remedies
A. Oversized regulator; inadequate rangeability.	A1. Check actual flow conditions, resize regulator for minimum and maximum flow. Tighten flange bolting. A2. Increase flow rate. A3. Decrease regulator pressure drop; decrease inlet pressure by placing a throttling orifice in inlet piping union. A4. Install next step higher range spring. A5. Before replacing regulator, contact factory.
B. Worn piston/cylinder; inadequate guiding.	B1. Replace trim.

2. Regulator inlet (upstream) pressure too high:

Possible Causes	Remedies
A. Regulator undersized.	A1. Confirm by opening bypass valve together with regulator. A2. Check actual flow conditions, resize regulator; if regulator has inadequate capacity, replace with larger unit.
B. Plugged trim.	B. Remove trim and check for plugged holes in cylinder.
C. Incorrect range spring (screwing out CCW of adjusting screw does not allow bringing pressure level to a stable and proper level).	C. Replace range spring with proper lower range.
D. Too much build (rise).	D1. Review rise (build) expected. D2. Contact factory. D3. If -1+6 differential, ensure that pressure reversal has not permanently deformed the metal diaphragm.
E. Restricted diaphragm movement.	E. Ensure no moisture in spring chamber at temperatures below freeze point. Ensure no dust or debris entering vent opening. If rainwater or debris can enter, reorient spring chamber.

3. Leakage through the spring chamber vent hole.

Possible Causes	Remedies
A. Normal-life diaphragm failure.	A. Replace diaphragm.
B. Abnormal short-life diaphragm failure.	B1. Can be caused by excessive chattering. See No. 1 to remedy chatter. B2. Can be caused by corrosive action. Consider alternate diaphragm material. B3. Upstream (inlet) pressure buildup occurring that overstresses diaphragms. Relocate regulator or protect with safety relief valve.

4. Sluggish operation.

Possible Causes	Remedies
A. Plugged spring chamber vent.	A. Clean vent opening.
B. Fluid too viscous.	B. Heat fluid. Contact factory.

SECTION VIII

VIII. ORDERING INFORMATION: NEW REPLACEMENT UNIT vs PARTS "KIT" FOR FIELD REPAIR

To obtain a quotation or place an order, please retrieve the Serial Number and Product Code that was stamped on the metal name plate and attached to the unit. This information can also be found on the Bill of Material ("BOM"), a parts list that was provided when unit was originally shipped. (Serial Number typically 6 digits). Product Code typical format as follows: (last digit is alpha character that reflects revision level for the product).

□□□-□□□7-□□□□□□□□□□

NEW REPLACEMENT UNIT:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. With this information they can provide a quotation for a new unit including a complete description, price and availability.



CAUTION

Do not attempt to alter the original construction of any unit without assistance and approval from the factory. All purposed changes will require a new name plate with appropriate ratings and new product code to accommodate the recommended part(s) changes.

PARTS "KIT" for FIELD REPAIR:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. Identify the parts and the quantity required to repair the unit from the "BOM" sheet that was provided when unit was originally shipped.

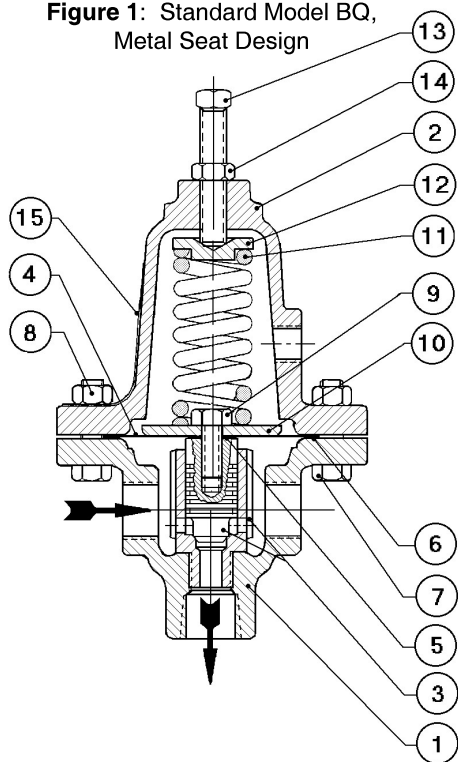
NOTE: *Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".*

If the "BOM" is not available, refer to the cross-sectional drawings included in this manual for part identification and selection.

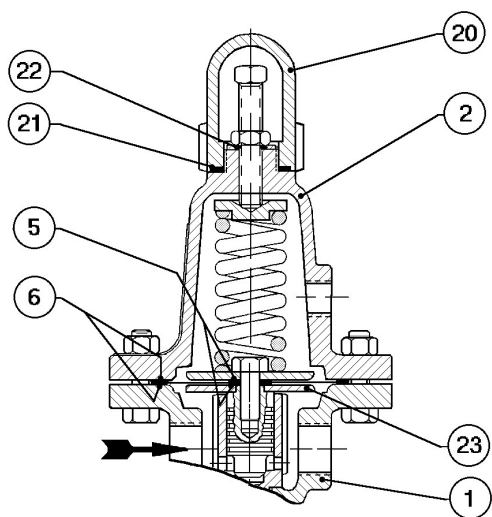
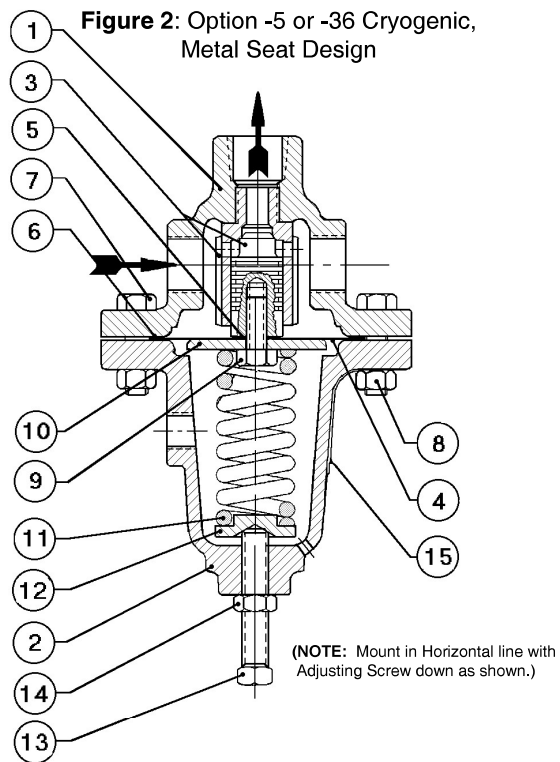
A Local Sales Representative will provide quotation for appropriate Kit Number, Price and Availability.

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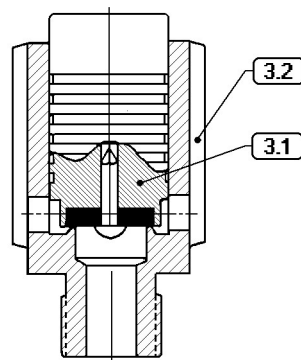
**Figure 1: Standard Model BQ,
Metal Seat Design**



**Figure 2: Option -5 or -36 Cryogenic,
Metal Seat Design**



**Figure 3: Option -1+6 Differential,
Metal Seat Design (includes
Option -1 Closing Cap)**



**Figure 4:
Composition Seat**

Item No.	Description
1	Body
2	Spring Chamber
3	Trim (Cylinder/Piston/Seat)
3.1	Piston
3.2	Cylinder
4	Diaphragm
5	Piston Gasket
6	Diaphragm Gasket
7	Hex. head Cap Screw (Flange Bolting)
8	Nut (Flange Bolting)
9	Piston Cap Screw
10	Pressure Plate
11	Range Spring
12	Spring Button
13	Adjusting Screw
14	Adjusting Screw Lock Nut
15	Nameplate
20	Closing Cap
21	Closing Cap Gasket
22	Lock Nut Seal
23	Differential Pusher Plate

ATEX 2014/34/EU: Explosive Atmospheres and Cashco Inc. Products



Cashco, Inc. declares that the products listed in the table below has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II of the ATEX Directive 2014/34/EU. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN ISO 80079-36:2016 and EN ISO 80079-37:2016. The product will be marked as follows:

CE  II 2 G
Ex h IIB T6... T1 Gb
1000ATEXR1 X

The 'X' placed after the technical file number indicates that the product is subject to specific conditions of use as follows:

1. The maximum surface temperature depends entirely on the operating conditions and not the equipment itself. The combination of the maximum ambient and the maximum process medium temperature shall be used to determine the maximum surface temperature and corresponding temperature classification, considering the safety margins described prescribed in EN ISO 80079-36:2016, Clause 8.2. Additionally, the system designer and users must take precautions to prevent rapid system pressurization which may raise the surface temperature of system components and tubing due to adiabatic compression of the system gas. Furthermore, the Joule-Thomson effect may cause process gases to rise in temperature as they expand going through a regulator. This could raise the external surface temperature of the regulator body and the downstream piping creating a potential source of ignition. Whether the Joule-Thomson effect leads to heating or cooling of the process gas depends on the process gas and the inlet and outlet pressures. The system designer is responsible for determining whether the process gas temperature may raise under any operating conditions.
2. Where the process medium is a liquid or semi-solid material with a surface resistance in excess of 1GΩ, special precautions shall be taken to ensure the process does not generate electrostatic discharge.
3. Special consideration shall be made regarding the filtration of the process medium if there is a potential for the process medium to contain solid particles. Where particles are present, the process flow shall be <1m/s (<3.3 ft/s) in order to prevent friction between the process medium and internal surfaces.
4. Effective earthing (grounding) of the product shall be ensured during installation.
5. The valve body/housing shall be regularly cleaned to prevent build up of dust deposits.
6. Regulators must be ordered with the non-relieving option (instead of the self-relieving option) if the process gas they are to be used with is hazardous (flammable, toxic, etc.). The self-relieving option vents process gas through the regulator cap directly into the atmosphere while the non-relieving option does not. Using regulators with the self-relieving option in a flammable gas system could create an explosive atmosphere in the vicinity of the regulator.
7. Tied diaphragm regulators with outlet ranges greater than 7 barg (100 psig) should be preset to minimize the risk that improper operation might lead to an outboard leak and a potentially explosive atmosphere.
8. All equipment must only be fitted with manufacturer's original spare parts.
9. Ensure that only non-sparking tools are used, as per EN 1127-1, Annex A.

	PRODUCT
	31-B, 31-N
	1164, 1164(OPT-45)
	1171, 1171(OPT-45), 1171(CRYO)
	2171, 2171(OPT-45), 2171(CRYO), 3171
	1465, 3381, 3381(OPT-45), 3381(OPT-40)
	4381, 4381(OPT-37), 4381(CRYO), 4381(OPT-45), 5381
	MPRV-H, MPRV-L
	PBE, PBE-L, PBE-H
	CA-1, CA-2
	CA1, SA1, CA4, SA4, CA5, SA5
	DA2, DA4, DA5, DA6, DA8
	DA0, DA1, DAP, SAP
	SLR-1, SLR-2, PTR-1
	ALR-1, ULR-1, PGR-1
	BQ, BQ(OPT-45), BQ(CRYO)
	123, 123(CRYO), 123(OPT-45), 123(OPT-46G)
	123-1+6, 123-1+6(OPT-45), 123-1+6(OPT-46G), 123-1+6+S, 123-1+6+S(OPT-40)
	1000HP, 1000HP(OPT-37), 1000HP(OPT-45), 1000HP(OPT-45G), 1000HP(CRYO)
	1000HP-1+6, 1000HP-1+8, 1000LP, 1000LP(OPT-45), 1000LP(OPT-46G)
	6987
	8310HP, 8310HP-1+6, 8310HP-1+8, 8310LP, 8311HP, 8311LP
	345, 345(OPT-45)
	BA1/BL1, PA1/PL1
	C-BPV, C-PRV, C-CS
	D, D(CRYO), D(OPT-37), D(OPT-20), D(OPT-45)
	DL, DL(LCC), DL(OPT-45)
	BR, BR(CRYO)
	HP, HP(LCC), HP(OPT-45), HP(OPT46G), HP-1+6+S(OPT-40), HP-1+6+S
	P1, P2, P3, P4, P5, P7
	B2, B7
	POSR-1, POSR-2
	5200P, 5300P
	135
	NW-PL, NW-SO
	CG-PILOT
	FG1
REGULATORS	RANGER, 987, PREMIER
	964, 521, 988, 988-MB, 989
	2296/2296HF
	SCV-30, SCV-S
	FL800/FL200
TANK BLANKETING	8700, 8910, 8920, 8930, 8940
	2100, 2199
	3100, 3200, 3300, 3400, 3500, 3600, 3700
	1078, 1088, 1100, 1049
	5100, 5200, 5400, 5500
	4100, 4200, 4300, 4400, 4500, 4600
MISC	764P/PD, 764-37, 764T

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