ISO Registered Company

MODEL 6987
BACK PRESSURE / RELIEF REGULATOR

SECTION I

I. DESCRIPTION AND SCOPE

The Model 6987 is a back pressure relief regulator used to control upstream (inlet or P_1) pressure. Sizes are 1/2" and 3/4" (DN15 and 20). With proper trim utilization, the unit is suitable for air, inert gases, water, fuel oil and chemicals. The Model 6987 is not normally utilized in steam service. Refer to Technical Bulletin 6987-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

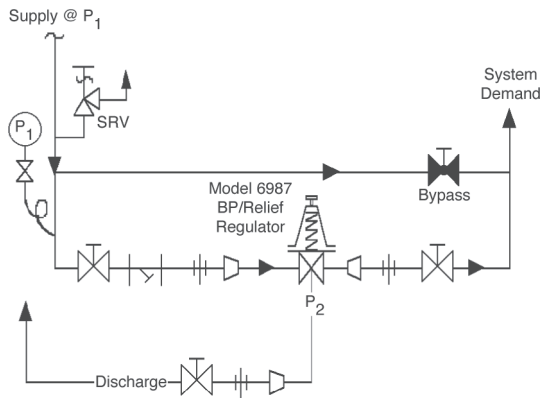
⚠ CAUTION

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.

⚠ 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/Relief Station

6. Clean the piping of all foreign material including chips, welding scale, oil, grease and dirt before installing the valve. 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 valve upon startup.
8. Flow Direction: Install so the flow direction matches the arrow cast on the body. The body has an angle configuration with a side inlet and bottom outlet.
9. Regulator may be installed in a vertical or horizontal pipe.

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

11. Regulators are not to be direct buried underground.

12. For insulated piping systems, recommendation is to not insulate regulator.

⚠ 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.)

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 may cause the valve to fail closed.

SECTION IV

IV. STARTUP

1. 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.

2. 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.

3. 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. Closely monitor inlet (upstream) pressure, via gauge, to assure 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.*

4. Crack open the inlet (upstream) block valve.

5. 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.

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

7. 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.

8. 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.

9. 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.

10. 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.

11. 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. 50 - 100 psig (3.4 - 6.9 Barg) range spring, at maximum flow the inlet pressure should not exceed 1.5 x 100 psig (6.9 Barg), or 150 psig (10.3 Barg). If it does, consult factory.)

12. Increase flow to maximum level if possible. Inlet (upstream or P_1) pressure should fall off. 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

VI. MAINTENANCE

⚠ 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.

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 2 for basic regulator parts.

B. Diaphragm Replacement:

⚠ 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.

1. For regulators with NPT end connections only, fabricate the special tool described in Figure 1. Rotate the No. 10-32 bolt CW to collapse the piston spring (20). This will hold the renewal unit (17) in place during disassembly. For all other end connection options, proceed with Step 2.

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

3. Loosen the adjusting screw lock nut (5) and rotate the adjusting screw (17) CCW until removed from the spring chamber (2).

4. Draw or embed a match mark on the body (1) and spring chamber (2) flanges.

5. If the special tool in Figure 1 is <u>not</u> being used, the piston spring (20) is always under tension. Therefore remove all flange bolts (13) <u>except two</u> located on opposite sides. Turn remaining two flange bolts (13) CCW using even increments. The piston spring (20) will force the body (1) and spring chamber (2) to separate.

6. Remove spring chamber (2), spring buttons (4), range spring (6), ball bearing (9), pressure plate (8), diaphragms (10), and diaphragm gasket (11).

7. Inspect pressure plate (8) for deformation due to over-pressurization. If deformed, replace.

8. Clean all parts to be reused according to owner's procedures. ***NOTE:*** On regulators originally supplied as “special cleaned”, Option-55, maintenance must include a level of cleanliness equal to Cashco’s cleaning standard #S-1134. On regulators originally supplied as “special cleaned”, Option-56, maintenance must include a level of cleanliness equal to Cashco’s cleaning standard #S-1542. Contact factory for details.

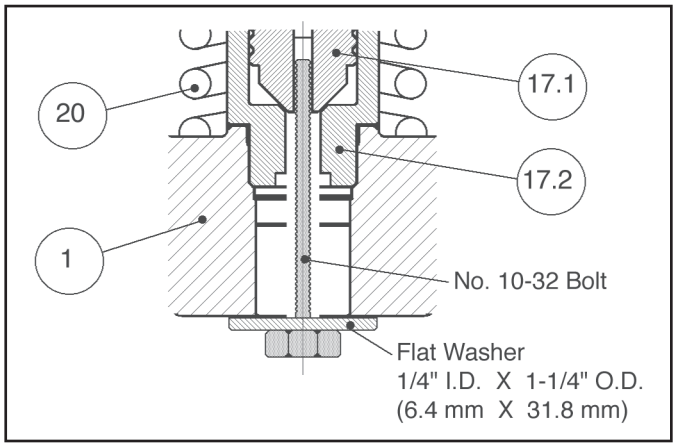


Figure 1: Special tool for collapsing piston spring (20).

9. If available, collapse the piston spring (20) using the special tool from Figure 1. If no special tool is available, proceed to Step 10.

10. Place new diaphragm gasket (11) and diaphragms (10) onto body (1).

11. Place multi-purpose, high temperature grease into depression of the pressure plate (8) and spring buttons (4) where the ball bearing (9) and adjusting screw (3) bears. In the center of the diaphragms (10), place the pressure plate (8), ball bearing (9), spring buttons (4), and range spring (6). Ensure spring buttons (4) are laying flat.

12. Aligning the matchmarks, place spring chamber (2) over the above stacked parts. Install flange bolts (13). Mechanically tighten flange bolts (13) in a cross pattern that allows the spring chamber (2) to be pulled down evenly. Tighten all flange bolts (13) to the following torque value: **All Sizes: 45–50 Ft-lbs (61–68 Nm).**

    NOTE: *Never replace bolting (13) with just any bolting if lost. Bolt heads and nuts are marked with specification identification markings. Use only proper grades as replacements.*

13. Reinstall adjusting screw (3) with locknut (5).

14. Spray liquid leak detector to test around flange bolts (13) and body (1) / spring chamber (2) connection for leakage. Ensure that an inlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 50-100 psig (3.4 - 6.9 Barg) range spring, 75 psig (5.2 Barg) test pressure minimum.

C. Renewal Unit Maintenance:

1. Refer to previous procedures, Section VI.B. steps 1–7 to remove all parts above the renewal unit (17).

2. Remove the piston spring button (17.3), piston (17.1) with piston o-ring (19), and the piston spring (20).

3. Remove the cylinder (17.2) by turning CCW.

4. Inspect seating surfaces of the piston (17.1) and cylinder (17.2). If necessary, relap the seating surface or replace renewal unit (17).

5. Clean all parts to be reused according to owner's procedures. ***NOTE:*** *On regulators originally supplied as "special cleaned", Option-55, maintenance must include a level of cleanliness equal to Cashco's cleaning standard #S-1134. On regulators originally supplied as "special cleaned", Option-56, maintenance must include a level of cleanliness equal to Cashco's cleaning standard #S-1542. Contact factory for details.*

6. Lubricate the cylinder (17.2) threads lightly with thread sealant. Install the cylinder (17.2) into the body (1) and impact until approximately 100 Ft-lbs (136 Nm) torque value is reached. This is a metal to metal seal.

7. Install the piston spring (20) into the body (1) cavity. Place the piston o-ring (19) into groove of piston (17.1) and install along with the piston spring button (17.3) into the cylinder (17.2).

8. Refer to previous procedures, Section VI.B. steps 8–13 to replace all other parts.

9. Bench test unit for suitable operation. ***NOTE:*** *Regulators are not tight shutoff devices. Even if pressure falls below set point, a regulator may or may not develop bubble tight shutoff.*

10. Spray liquid leak detector to test around flange bolts (13) and body (1) / spring chamber (2) connection for leakage. Ensure that an inlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 50-100 psig (3.4 - 6.9 Barg) range spring, 75 psig (5.2 Barg) test pressure minimum.

SECTION VII

VII. TROUBLE SHOOTING GUIDE

1. Erratic Operation; chattering.

Possible Causes		Remedies	
A.	Oversized regulator.	A1. A2. A3. A4. A5.	Check actual flow conditions, resize regulator for minimum and maximum flow. Increase flow rate. Decrease regulator pressure drop; decrease inlet pressure by placing throttling orifice in inlet piping union. Install next step higher range spring. Contact factory Before replacing regulator, contact factory.
B.	Inadequate rangeability.	B1. B2. B3.	Increase flow rate. Decrease regulator pressure drop. Install next step higher range spring. Contact factory
C.	Worn piston/cylinder; inadequate guiding.	C.	Replace renewal unit.

2. Regulator inlet (upstream) pressure too high.

Possible Causes		Remedies	
A.	Regulator undersized.	A1. A2.	Confirm by opening bypass valve together with regulator. Check actual flow conditions, resize regulator; if regulator has inadequate capacity, replace with larger unit.
B.	Plugged renewal unit.	B.	Remove renewal unit 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. Contact factory.
D.	Too much proportional band (rise).	D1. D2.	Review P.B. (rise) expected. Contact factory.
E.	Restricted diaphragm movement.	E.	Ensure no moisture in spring chamber at temperatures below freezing. Ensure no dust or debris entering vent opening. If rainwater or debris can enter, re-orient spring chamber.

3. Leakage through the spring chamber vent hole.

Possible Causes		Remedies	
A.	Normal-life diaphragm failure.	A.	Replace diaphragms.
B.	Abnormal short-life diaphragm failure.	B1. B2. B3. B4.	Can be caused by excessive chattering. See No. 1 to remedy chatter. Can be caused by corrosive action. Consider alternate diaphragm material. For composition diaphragms, ensure not subjecting to over-temperature conditions. Upstream (inlet) pressure buildup occurring that overstresses diaphragms.

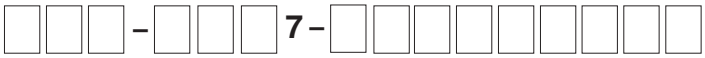
4. Sluggish Operation.

Possible Causes		Remedies	
A.	Plugged spring chamber vent.	A.	Clean vent opening.
B.	Plugged piston guides.	B.	Remove renewal unit and clean.
C.	Fluid too viscous	C.	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).



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.

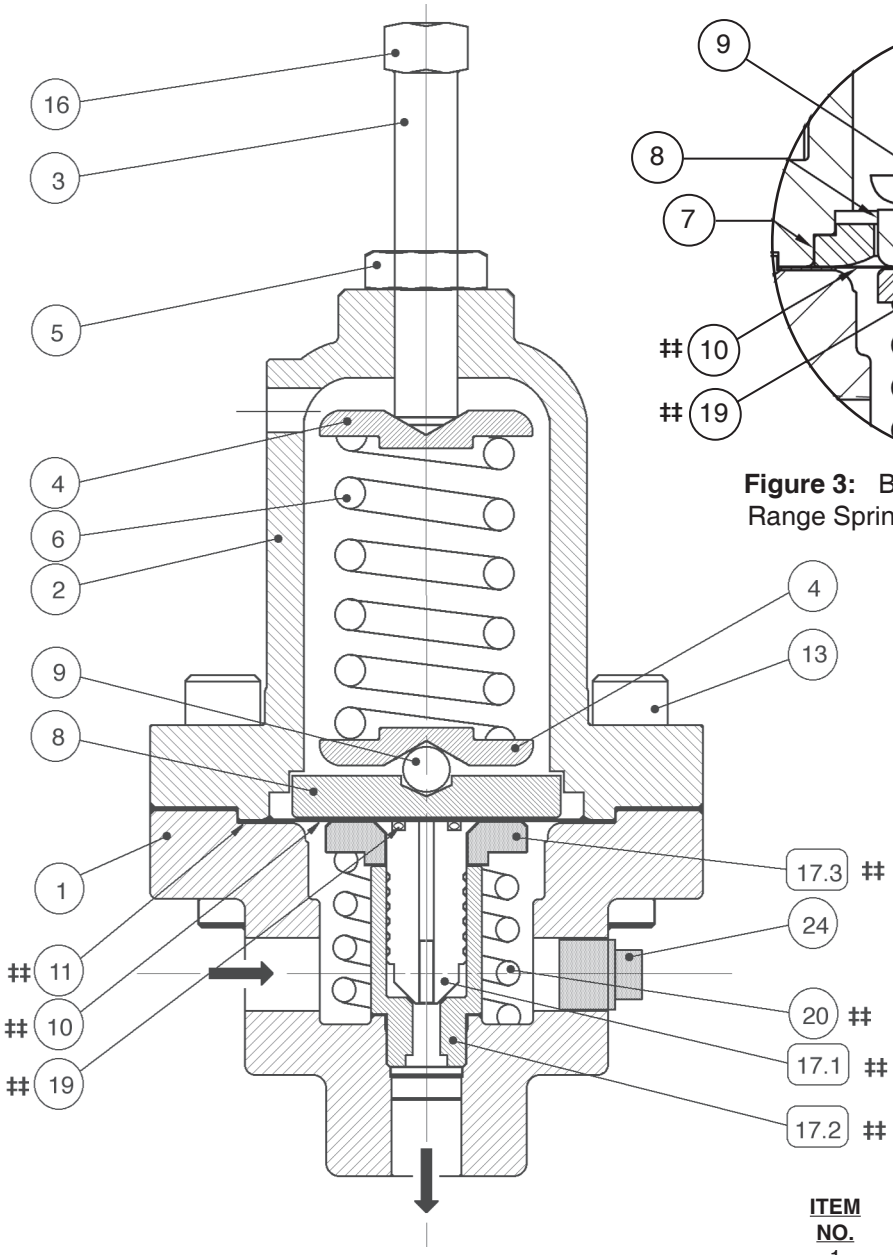


Figure 2: Basic Model 6987 - Metal Seat Range Springs from 50 psig to 200 psig.

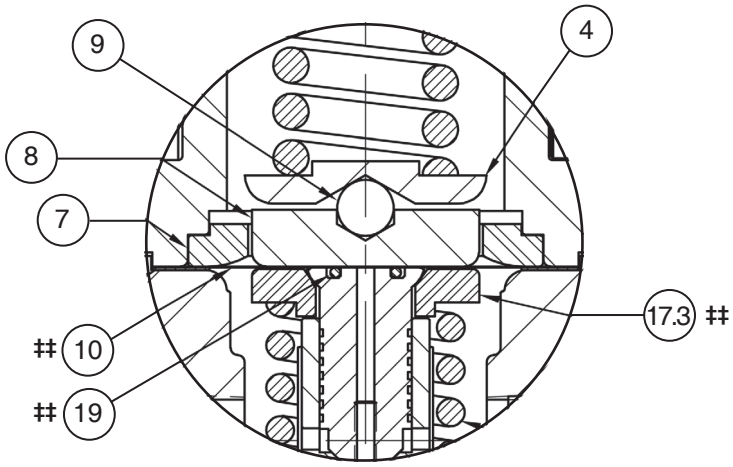


Figure 3: Basic Model 6987 - Metal Seat Range Springs from 200 psig to 800 psig.

ITEM NO.	DESCRIPTION	REPAIR PARTS Kit B
1	Body	
2	Spring chamber	
3	Adjusting Screw	
4	Spring Buttons (2)	
5	Adjusting Screw Lock Nut	
6	Range Spring	
7	Diaphragm Ring (upper range springs only. See Figure 3)	
8	Pressure Plate	
9	Ball Bearing	
10	Diaphragms	‡‡
11	Diaphragm Gasket	‡‡
13	Flange Bolts	
17	Renewal Unit	
17.1	Piston	‡‡
17.2	Cylinder	‡‡
17.3	Piston Spring Button	‡‡
19	Piston o-ring	‡‡
20	Piston Spring	‡‡
24	Pipe Plug	

ITEMS NOT SHOWN

16 Name Plate

IOM ADDENDUM:

ATEX DIRECTIVE 2014/34/EU and THE EQUIPMENT AND PROTECTIVE SYSTEMS INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES REGULATIONS 2016

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 and given in Schedule 1 of The Equipment and Protective Systems Indented for Use in Potentially Explosive Atmospheres Regulations 2016. 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:

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
REGULATORS	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
CONTROL VALVES	RANGER, 987, PREMIER
	964, 521, 988, 988-MB, 989
	2296/2296HF
	SCV-30, SCV-S
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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