

# MODEL P3

## TWO STAGE CYLINDER GAS PRESSURE REDUCING REGULATOR

### SECTION I

#### I. DESCRIPTION AND SCOPE

The Model P3 is a pressure reducing regulator used to control downstream (outlet or  $P_2$ ) pressure. Available in sizes 1/4" (DN8), 3/8" (DN10) and 1/2" (DN15). The unit is suitable for cylinder gaseous services. Refer to Technical Bulletin P3-TB for design conditions and selection recommendations.

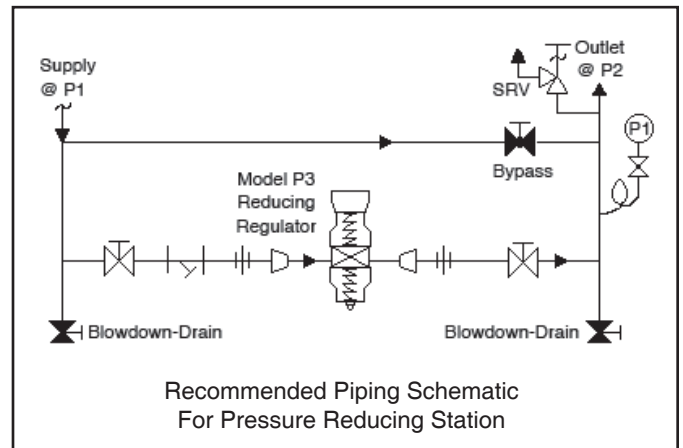
### SECTION II

#### II. INSTALLATION

 **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.**

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 outlet pressure gauge should be located approximately ten pipe diameters downstream, and within sight.
5. All installations should include a downstream relief device if the inlet pressure could exceed the pressure rating of any downstream equipment or the maximum outlet pressure rating of the unit.
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



8. removed and not allowed to enter the regulator upon startup.
8. Flow Direction: Install so the flow direction matches the inlet stamp on the main regulator body (1).
9. For best performance, install in well drained horizontal pipe.
10. Basic Regulator - (Refer to Figure 2, Model P3): Regulator may be rotated around the pipe axis 360°. Recommended position is with 2nd stage knob (4) vertical upwards.
11. Regulators are not to be buried underground.
12. For insulated piping systems, recommendation is to not insulate regulator.

## SECTION III

### III. PRINCIPLE OF OPERATION

1. Movement occurs as pressure variations register on the diaphragms (7.1). The registering pressure is the outlet,  $P_2$ , or downstream pressure. The range springs (15) oppose movement of the diaphragms. As outlet pressure drops,

the range springs push the diaphragms down, opening the ports; as outlet pressure increases, the diaphragms push up and the ports close.

2. A complete diaphragm failure will cause the regulator to fail open.

## SECTION IV

### IV. STARTUP



#### CAUTION

The maximum outlet pressure is stamped on the body as the upper range spring pressure level, and is the recommended “upper operative limit” for the sensing diaphragms (see Section IV. Startup, Step 7). Higher pressures could damage the diaphragms. (Field hydrostatic tests frequently destroy diaphragms. DO NOT HYDROSTATIC TEST THROUGH AN INSTALLED UNIT; ISOLATE FROM TEST.)

1. Start with the block valves closed. A bypass valve may be used to maintain outlet pressure in the downstream system without changing the following steps.
2. Relax 2nd stage range spring (15) by turning knob (4) counter clockwise (CCW) until rotation comes to a complete stop.
3. If it is a “hot” piping system, and equipped with a bypass valve, slowly open the bypass valve to preheat the system piping and to allow slow expansion of the piping. Closely monitor outlet (downstream) 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.*
4. Crack open the outlet (downstream) block valve.

5. Slowly open the inlet (upstream) block valve observing the outlet (downstream) pressure gauge. Determine if the regulator is flowing. If not, slowly rotate knob (4) clockwise (CW) until flow begins.
6. Continue to slowly open the inlet (upstream) block valve until fully open.
7. Continue to slowly open the outlet (downstream) block valve, especially when the downstream piping system isn't pressurized. If the outlet (downstream) pressure exceeds the desired pressure, close the block valve and go to Step 2, then return to Step 4.
8. When flow is established steady enough that the outlet (downstream) block valve is fully open, begin to slowly close the bypass valve if installed.
9. Develop system flow to a level near its expected normal rate, and reset the regulator set point by turning knob (4) CW to increase outlet pressure, or CCW to reduce outlet pressure.
10. Reduce system flow to a minimum level and observe set point. Outlet pressure will rise from the set point of Step 9. The maximum rise in outlet pressure on decreasing flow should not exceed the stated upper limit of the range spring by greater than 10%. Example with 2-100 psig (.14-6.9 Barg) range spring at low flow the outlet pressure should not exceed 110 psig (7.6 Barg), if it does, consult factory.

## 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 to both be shut down, 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 and Figure 1 for the diaphragm subassembly.



#### CAUTION

To prevent damage to body, use soft jaws when placing body in a vise.



#### WARNING

**SPRINGS UNDER COMPRESSION.** Prior to removing spring chambers, relieve range spring compression by turning 2nd stage knob (4) CCW until rotation comes to a complete stop. Failure to do so may result in flying parts that could cause personal injury.

#### B. 2nd Stage Diaphragm Replacement:

1. Securely install the body (1) in a vise with knob (4) directed upwards.
2. Relax 2nd stage range spring (15) by turning knob (4) CCW until rotation comes to a complete stop. **NOTE:** It is not necessary to remove knob (4) before removing spring chamber (6) from the body (1).
3. Remove the spring chamber (6) by grasping the flats and turning CCW. **NOTE:** Upon removal, the range spring (15), range spring clip (16), and spring button (5) should remain inside the spring chamber.
4. Remove 2nd stage diaphragm subassembly (7) consisting of the actuator nut (7.3), diaphragm (7.1), actuator post (7.2), actuator gasket (7.4), actuator o-ring (7.5). Remove diaphragm gasket (10).

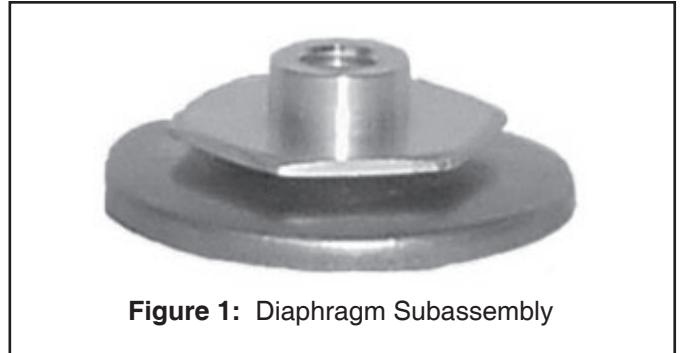


Figure 1: Diaphragm Subassembly

#### C. 1st Stage Diaphragm Replacement:

1. Invert the body and securely install in a vise with acron nut (4) directed upwards.
2. Rotate nut CCW and remove. Measure the height of the exposed adjusting screw and record that value here. \_\_\_\_\_.
3. Relax 1st stage range spring (15) by turning adjusting screw (2) CCW until spring compression is released. **NOTE:** It is not necessary to remove adjusting screw before removing the spring chamber (6) from the body (1).
4. Remove the spring chamber (6) by grasping the flats and turning CCW. **NOTE:** Upon removal, the range spring (15), range spring clip (16), and spring button (5) should remain inside the spring chamber.
5. Remove 1st stage diaphragm subassembly (7) consisting of the actuator nut (7.3), diaphragm (7.1), actuator post (7.2), actuator gasket (7.4), actuator o-ring (7.5). Remove diaphragm gasket (10).

**NOTE:** The following Steps 6 through 9 apply to both the first and second stage diaphragm subassemblies (7).

6. Remove actuator nut (7.3) and separate all parts of the diaphragm subassembly (7.).
7. Clean body (1) diaphragm flange surfaces and all reusable parts according to owner's procedures. **Do not scratch diaphragm gasket seating surface.** **NOTE:** On regulators originally supplied as "oxygen clean", Option-M, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1134. Contact factory for details.

8. Inspect and replace any necessary parts. **NOTE:** Use only parts manufactured and supplied by Cashco, Inc. for these products. See Section VIII.
9. Reassemble diaphragm subassembly (7) by placing the actuator gasket (7.4), diaphragm (7.1), and actuator o-ring (7.5) over the threads of the actuator post (7.2). **NOTE:** Use the **thickest** of the two diaphragms (7.1) for 1st Stage diaphragm subassembly (7). Place a thread sealant compound on the threads of the actuator post (7.2) prior to installing the actuator nut (7.3). Install actuator nut (7.3) and tighten to the following torque value: 15 Ft-lbs (20 Nm).
10. Place the 1st stage diaphragm gasket (10) onto the body (1) diaphragm flange area. Place 1st stage diaphragm subassembly (7) on top of the gasket (10).
11. Lubricate the threads of the body (1) with a lightweight grease that is compatible with service use. Rotate the spring chamber (6) CW by hand onto the threaded portion of the body (1) until firmly seated against the diaphragm gasket (10). Tighten to the following torque value: 65–70 Ft lbs (88–95 Nm).
12. Recalling height value of C.2, rotate adjusting screw (2) CW to compress spring (15) to factory established pressure set point. Hand tighten acron nut (4) on adjusting screw (2).
12. Invert the body (1). Repeat Steps 9 through 11 for 2nd stage diaphragm subassembly (7).
13. Pressurize with air and spray liquid leak detector around body (1) and spring chambers (6) to test for leakage. Ensure that an outlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 2-100 psig (.14-6.9 Barg) range spring, 51 psig (3.5 Barg) test pressure minimum.

#### D. Trim (Seat) Replacement:

1. Remove spring chamber subassemblies and diaphragm subassemblies per Section VI. Steps B and C.
2. Remove seat retainers (13) by rotating seat CCW.
3. Remove poppets (8) and poppet springs (9).
4. Clean debris from within the body (1) cavity. Clean all parts to be reused according to owner's procedures.

**NOTE:** On regulators originally supplied as “oxygen clean”, Option-M, maintenance must include a level of cleanliness equal to Cashco's cleaning standard #S-1134. Contact factory for details.

5. Inspect all parts for damage and replace if necessary. **NOTE:** Use only parts manufactured and supplied by Cashco, Inc. for these products. See Section VIII.
6. Place the 1st stage poppet spring (9) into body (1) cavity.
7. Place poppet (8) inside the poppet spring (9). **NOTE:** The angled seating surface of the poppet (8) must face up toward the seat (12).
8. Install new seat retainer (13) with seat (12) into body (1) cavity with the seat facing downward toward the angled seating surface of the poppet (8). Tighten seat retainer (13) to the following torque value: 6.25 Ft-lbs (8.47 Nm).
9. Reinstall the 1st stage diaphragm subassembly (7) and spring chamber subassembly(2) per Section VI, Steps B and C.
- 9.5. The 1st stage of this regulator should be set at 200 psig over the top of the spring range. This is done by attaching the appropriate guage to the P3 1st Stage Test Fitting (003-80-6-01310-00) and threading it into the 2nd stage body (1) cavity. Supply 1500 psig to the inlet of the regulator or the maximum range for the pressure guage. Using a screwdriver, screw the adjusting screw (2) CW down to 200 psig over the maximum outlet pressure of the range spring.
10. Invert the body (1) and repeat Steps 6 through 9 for the 2nd stage reassembly.
11. Bench test unit for suitable operation. **NOTE:** Regulators are not tight shutoff devices. Even if pressure builds up beyond set point, a regulator may or may not develop bubble tight shutoff.
12. Pressurize with air and spray liquid leak detector around body (1) and spring chambers (2.1) to test for leakage. Ensure that an outlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 2-100 psig (.14-6.9 Barg) range spring, 51 psig (3.5 Barg) test pressure minimum.

## SECTION VII

### VII. TROUBLE SHOOTING GUIDE

#### 1. Erratic operation; chattering.

Possible Causes	Remedies
A. Oversized regulator; inadequate rangeability.	A1. Check actual flow conditions, re-size regulator for minimum and maximum flow. 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 poppet; inadequate guiding.	B. Replace trim ( possible body replacement).
C. Weakened/broken poppet spring.	C. Replace poppet spring. Determine if corrosion is causing the failure.

#### 2. Regulator can't pass sufficient flow.

Possible Causes	Remedies
A. Regulator undersized.	A1. Confirm by opening bypass valve together with regulator. A2. Check actual flow conditions, re-size regulator; if regulator has inadequate capacity, replace with larger unit.
B. Incorrect range spring (adjusting aluminum knob CW does not raise pressure to proper level).	B. Replace range spring with proper higher range.
C. Too much droop.	C1. Review droop expected. C2. Contact factory.

#### 3. Sluggish operation.

Possible Causes	Remedies
A. Fluid too viscous.	A. Heat fluid. Contact factory.

#### 4. Excessive pressure downstream.

Possible Causes	Remedies
A. Regulator not closing tightly.	A. Inspect the seating. Clean and lap metal seat surfaces; replace if lapping does not remedy. If composition seats are depressed, nicked or embedded with debris, replace trim.
B. Downstream block.	B. Check system; isolate (block) flow at regulator inlet - not outlet. Relocate regulator if necessary.
C. No pressure relief protection.	C. Install safety relief valve, or rupture disc.
D. Restricted diaphragm movement.	D. Ensure no moisture in spring chamber at temperatures below freeze point.

## 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).

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#### 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.

#### 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.

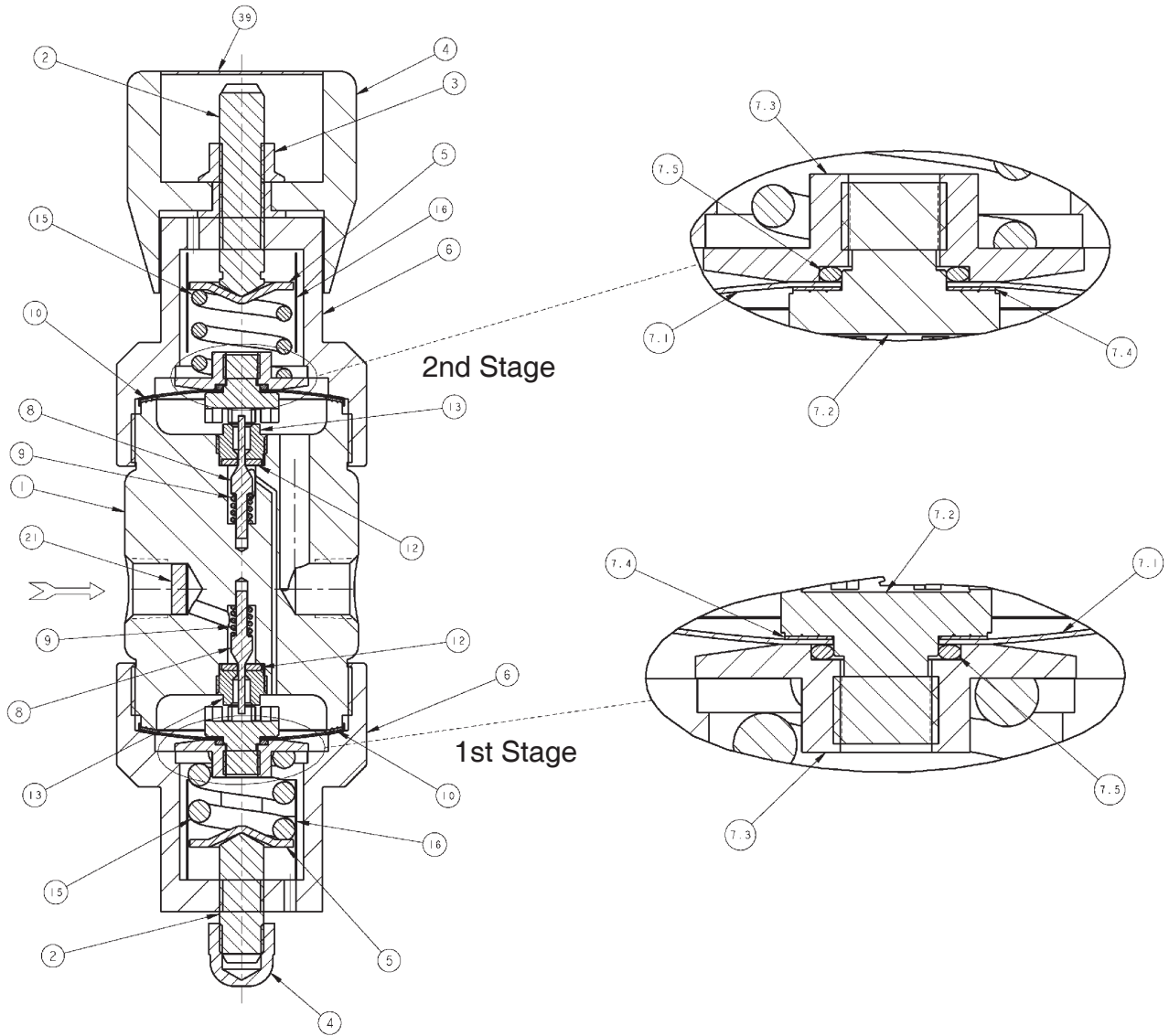


#### **CAUTION**

**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.**

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**Figure 2:**

\* 2nd stage pressure spring with range 5 to 500 psig, uses stack of Belleville washers in place of 1st stage spring.

Item No.	Description	Repair Parts Kit B
1	Body	
2	Adjusting Screw	
3	Knob Nut	
4	Knob 2nd stage / Acron nut 1st stage	
5	Spring Button	
6	Spring Chamber	
7	Diaphragm Subassembly	
7.1	Diaphragm -----	∓
7.2	Actuator Post	
7.3	Actuator Nut	
7.4	Actuator Gasket -----	∓
7.5	Actuator O-ring -----	∓
8	Poppet -----	∓
9	Poppet Spring -----	∓
10	Diaphragm Gasket -----	∓
12	Seat -----	∓
13	Seat Retainer -----	∓
15	Range Spring *	
16	Spring Clip	
21	Inline Filter -----	∓
39	Snap in cover	
∓	Recommended Spare Part	

## 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 Ex 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  $1G\Omega$ , 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  $<1\text{m/s}$  ( $<3.3\text{ ft/s}$ ) 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
<b>REGULATORS</b>	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	
<b>CONTROL VALVES</b>	RANGER, 987, PREMIER
	964, 521, 988, 988-MB, 989
	2296/2296HF
	SCV-30, SCV-S
	FL800/FL200
<b>TANK BLANKETING</b>	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
<b>MISC</b>	764P/PD, 764-37, 764T

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