

MODELS CA-1 AND CA-2

BACK PRESSURE / RELIEF REGULATORS

SECTION I

I. DESCRIPTION AND SCOPE

Models CA-1 and CA-2 are back pressure/relief regulators used to control upstream (inlet or P_1) pressure. Sizes for CA-1 – 1/8" and 1/4" (DN6 and DN8); for CA-2 – 3/8" and 1/2" (DN10 and DN15). Both models are bronze bodied units. With proper trim utilization, both units are suitable for liquid and gaseous service. Refer to Technical Bulletin CA-TB for specific design conditions and selection recommendations.

The instructions in this manual will pertain to both models, unless otherwise stated.



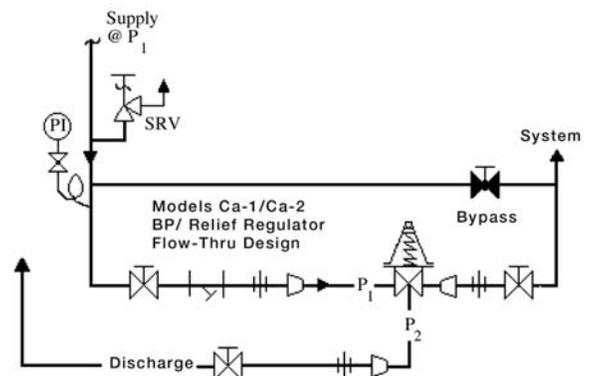
CAUTION

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

SECTION II

II. INSTALLATION

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 safety relief device if the inlet pressure could exceed the pressure rating of any equipment or the maximum inlet pressure rating of the unit.



Recommended Piping Schematic For Back Pressure/Relief Station

6. Clean 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 regulator upon startup.
8. Flow Direction: Install so the flow direction aligns with the word "IN" stamped on the body. Connect the inlet pressure to the body (1) side connection(s). Fluid will relieve out the bottom



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.)

connection for Angle or Flow-Thru design and out the other side connection for Globe design (side inlet-side outlet).

9. Regulator may be installed in a vertical or horizontal pipe.
- 10a. Basic Regulator - (Refer to Figure 1): Regulator may be rotated around the pipe axis 360°. Recommended position is with spring chamber vertical downwards. Orient such that the spring

chamber (2) vent hole does not collect rainwater.

- 10b. Cryogenic Regulator, Opt-5 – Recommended installation is in horizontal line with spring chamber (2) oriented downwards below the body (1).
11. Regulators are not to be direct buried underground.
12. For insulated piping systems, the recommendation is to not insulate the regulator.

SECTION III

III. PRINCIPLE OF OPERATION

1. Movement occurs as pressure variations register on the diaphragm (11). The registering pressure is the inlet, P_1 , or upstream pressure. The range spring (6) opposes diaphragm (11) movement. As inlet pressure drops, the range spring (6) pushes

the diaphragm (11) down, closing the port; as inlet pressure increases, the diaphragm (11) pushes up and the port opens.

2. A complete diaphragm (11) failure will cause the regulator to fail closed.

SECTION IV

IV. START-UP

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 (6) by turning the adjusting screw (3) counter clockwise (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 (3) clockwise (CW - viewed from spring chamber (2) top) until flow begins.
6. Continue to slowly open the outlet (downstream) block valve until fully open.

7. Observing the inlet (upstream) pressure gauge, simultaneously rotate the adjusting screw (3) clockwise (CW) slowly and begin to close the bypass valve, if installed, until the inlet pressure begins to rise. Rotate adjusting screw (3) 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 (3) CCW until the pressure decreases.
9. When flow is established steady enough that both the outlet and inlet block valves are fully open, ensure that the bypass valve is closed, if installed.
10. Develop system flow to a level near its expected normal rate, and reset the regulator setpoint by turning the adjusting screw (3) 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. (Assure that this rise does not exceed the stated upper limit of the range spring (6) by greater than 50% i.e. 40-90 psig (2.8 - 6.2 Barg) range spring (6), at maximum flow the inlet pressure should not exceed 1.5 x 90 psig (6.2 Barg), or 135 psig (9.3 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 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 1, Model CA-1 or CA-2 for the basic regulator. Blow-ups of options are included with each drawing.

B. Diaphragm Replacement



CAUTION

To prevent damage to body, use lead jaws when placing body in a vise. Position so that vise closes over inlet and outlet of the body.

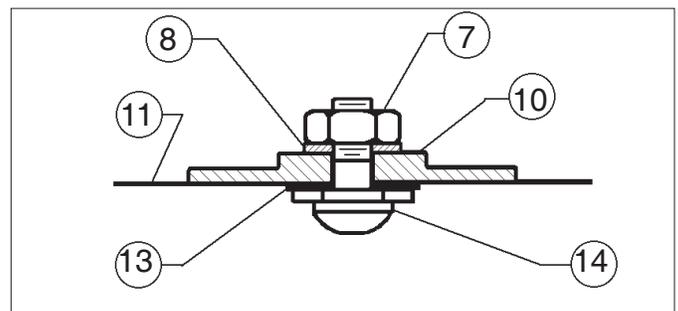
1. Securely install the body (1) in a vise with the spring chamber (2) directed upwards.



WARNING

SPRING UNDER COMPRESSION. Prior to removing spring chamber, 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 (6) by loosening the locknut (4) and turning adjusting screw (3) CCW until removed from spring chamber (2). **NOTE:** If the Option -2 handwheel is utilized, the adjusting screw (3) and lock nut (4) are replaced with a knob (18) and lock nut (4). With the Option-22 panel mounting w/handwheel, the adjusting screw (3) and lock nut (4) are replaced with a knob (18), lock nut (4) and a panel mounting nut (19).
3. Loosen spring chamber (2) by placing wrench on "flats" and rotating CCW.
4. Remove spring chamber (2), spring button (5) range spring (6), and diaphragm stop (9).
5. Remove the diaphragm subassembly consisting of the pressure plate nut (7), lock washer (8), pressure plate (10), diaphragm (11), plug gasket (13) and plug (14). **NOTE:** Refer to the quantity of diaphragms (11) incorporated per the bill of materials listing. Depending on inlet pressure level, multiple metal diaphragms (11) may be "stacked".



Model's CA-1/CA-2 Diaphragm Subassembly

6. Loosen pressure plate nut (7) and separate all parts (7, 8, 10, 11, 13 & 14) of the diaphragm subassembly.
7. Inspect pressure plate (10) to ensure no deformation due to over-pressurization. If deformed, replace.

8. Remove diaphragm gasket (12) for metal diaphragm (11). **NOTE:** *No diaphragm gasket (12) for composition diaphragm (11).*
9. Clean body (1) and diaphragm flange. **NOTE:** *On regulators originally supplied as "oxygen clean", Option -5 or Option -55, maintenance must include a level of cleanliness equal to Cashco's cleaning standard #S-1134. Contact factory for details.*
10. Reassemble diaphragm subassembly by placing plug gasket (13), diaphragm(s) (11), pressure plate (10) and lock washer (8) over threaded post of plug (14). Ensure the pressure plate (10) is placed with curved outer rim down next to the diaphragm (11) surface.

	CAUTION
Use only gaskets supplied by Cashco, Inc. for these products.	

Place a thread sealant compound similar to Loctite #271 on the threads of the plug's (14) post prior to tightening the pressure plate nut (7) to the following torque values:

Sizes	Diaphragm	Torque	
ALL	Metal	60 In-lbs.	6.8 N-m
	Composition	15 In-lbs.	1.7 N-m

11. Place diaphragm gasket (12) on body (1), then insert the diaphragm subassembly into the body (1).
12. Place diaphragm stop (9) and range spring (6) over the pressure plate nut (7) of the diaphragm subassembly.
13. Place multi-purpose, high temperature grease into depression of spring button (5) where adjusting screw (3) bears. Set spring button (5) onto range spring (6); ensure spring button (5) is laying flat.
14. Rotate the spring chamber (2) CW by hand into the threaded portion of the body (1) assuring not to cross thread. Continue hand rotating CW until firmly seated against the diaphragm stop (9). Wrench tighten securely to the following torque values:

Model	Torque	
CA-1	20-25 Ft-lbs.	27-34 N-m
CA-2	25-30 Ft-lbs.	34-40 N-m

15. Reinstall adjusting screw (3) with locknut (4) into the spring chamber (2).
16. Pressurize with air and spray liquid leak detector to inspect entire body (1) and spring chamber (2) for leakage. Ensure that an inlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 40-90 psig (2.8-6.2 Barg) range spring, 65 psig (4.5 Barg) test pressure minimum.

C. Trim Replacement

1. Trim inspection requires the diaphragm subassembly be removed. Refer to previous procedure, Section VI.B.
2. Inspect inside surface of seat ring (15) and seating surface of plug (14). If seating surface shows signs of erosion/wear, the seat ring (15) and plug (14) should be replaced.
3. Clean body (1) cavity. Clean all parts to be reused. **NOTE:** *On regulators originally supplied as "oxygen clean", Option -5 or Option -55, maintenance must include a level of cleanliness equal to Cashco's cleaning standard #S-1134. Contact factory for details.*
4. Inspect the surface in the body (1) cavity where seat ring (15) rests. If surface area of either mating part shows signs of erosion/wear, replace with new regulator.
5. Place seat ring (15) in center of body (1) cavity. Ensure that the shoulder on outer edge of seat ring (15) faces up towards the diaphragm (11).
6. Reinstall diaphragm subassembly per Section VI.B., Diaphragm Replacement.
7. Bench test unit for suitable operation. **NOTE:** *Regulators are not tight shut off devices. Even if pressure falls below setpoint, a regulator may or may not develop bubble tight shut off. In general, tighter shut off can be expected with composition seat.*
8. Pressurize with air and spray liquid leak detector to inspect entire body (1) and spring chamber (2) 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.	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. Contact factory. A5. Before replacing regulator, contact factory.
B. Worn plug.	B. Replace regulator.

2. Regulator inlet (upstream) too high:

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 (screwing in CW of adjusting screw does not allow bringing pressure level up to proper level.)	B. Replace range spring with proper lower range. Contact factory
C. Too much rise (build).	C1. Review rise (build) expected. C2. Contact factory.

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. For composition diaphragms, assure not subjecting to over-temperature conditions. B4. Upstream (inlet) pressure build-up 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).

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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.



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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MODEL CA-1

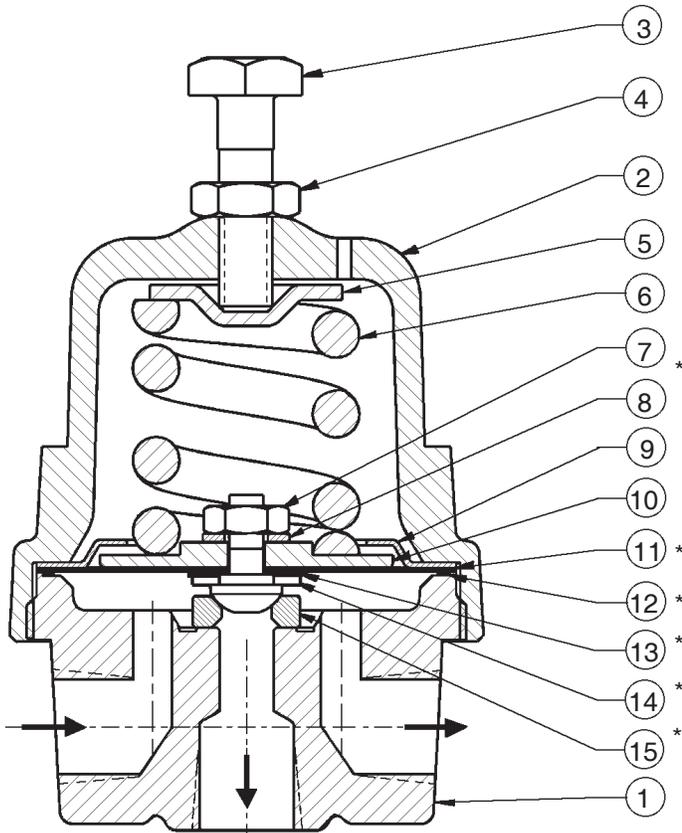
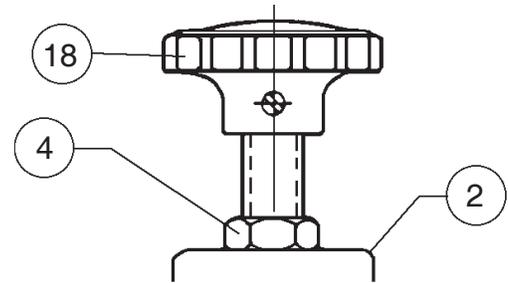


Figure 1:
Basic Model CA-1 with
3-Connection Flow-Thru Body



Option-2 Handwheel

Option-5 Cryogenic Construction
Installed in horizontal line with spring chamber oriented downwards below the body. Body and spring chamber Item Numbers are identical to Figure 1.

Item No.	Description	Repair Parts Kit B
1	Body	
2	Spring Chamber	
3	Adjusting Screw	
4	Lock Nut	
5	Spring Button	
6	Range Spring	
7	Pressure Plate Nut	*
8	Lock Washer	
9	Diaphragm Stop	
10	Pressure Plate	
11	Diaphragm	*
12	Diaphragm Gasket	*
13	Plug Gasket	*
14	Plug	*
15	Seat Ring	*
17	Nameplate	
18	Knob	

MODEL CA-2

Option-5 Cryogenic Construction

Installed in horizontal line with spring chamber oriented downwards below the body. Body and spring chamber Item Numbers are identical to Figure 1.

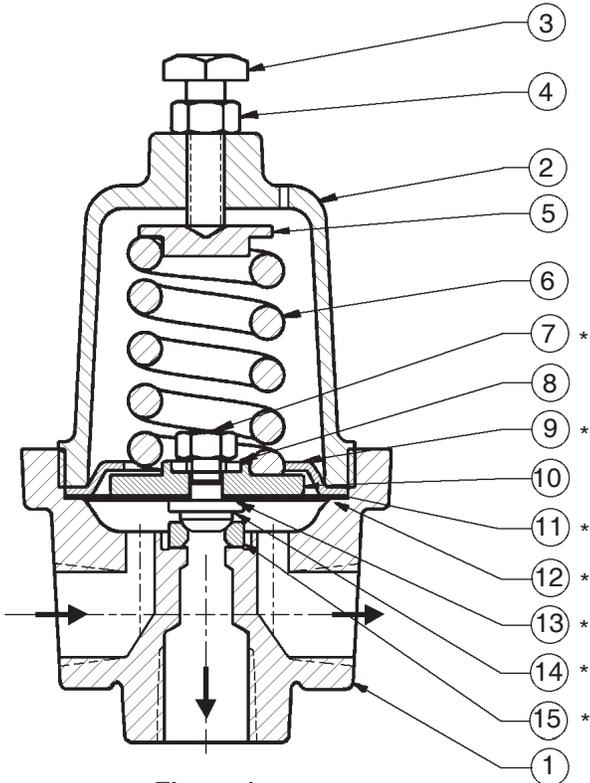
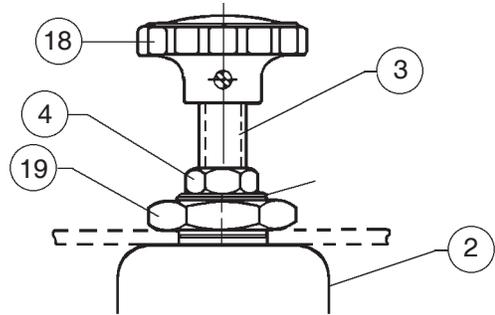


Figure 1:
Basic Model CA-2 with
3-Connection Flow-Thru Body



Option-22 Panel Mounting (handwheel portion is same for Option-2 Handwheel)

ITEMS NOT SHOWN

- 16 Closing Cap
- 20 Closing Cap Gasket
- 21 Drive Screw

<u>Item No.</u>	<u>Description</u>	<u>Repair Parts Kit B</u>
1	Body	
2	Spring Chamber	
3	Adjusting Screw	
4	Lock Nut	
5	Spring Button	
6	Range Spring	
7	Pressure Plate Nut	*
8	Lock Washer	
9	Diaphragm Stop	
10	Pressure Plate	
11	Diaphragm	*
12	Diaphragm Gasket	*
13	Plug Gasket	*
14	Plug	*
15	Seat Ring	*
17	Nameplate	
18	Handwheel or Knob	
19	Mounting Nut	

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ATEX 94/9/EC: Explosive Atmospheres and Cashco Inc. Regulators



These valves satisfy the safety conditions according to EN 13463-1 and EN 13463-5 for equipment group IIG 2 c.

Caution: Because the actual maximum temperature depends not on the equipment itself, but upon the fluid temperature, a single temperature class or temperature cannot be marked by the manufacturer.

Specific Precaution to Installer: Electrical grounding of valve must occur to minimize risk of effective electrical discharges.

Specific Precaution to Installer: Atmosphere vent holes should be plugged to further minimize the risk of explosion.

Specific Precaution to Maintenance: The Valve Body/ Housing must be regularly cleaned to prevent buildup of dust deposits.

Specific Precaution to Maintenance: Conduct periodic Continuity Check between Valve Body/ Housing and Tank to minimize risk of electrical discharges.

Attention: When repairing or altering explosion-protected equipment, national regulations must be adhered to. For maintenance and repairs involving parts, use only manufacturer's original parts.

ATEX requires that all components and equipment be evaluated. Cashco pressure regulators are considered components. Based on the ATEX Directive, Cashco considers the location where the pressure regulators are installed to be classified Equipment-group II, Category 3 because flammable gases would only be present for a short period of time in the event of a leak. It is possible that the location could be classified Equipment-group II, Category 2 if a leak is likely to occur. Please note that the system owner, not Cashco, is responsible for determining the classification of a particular installation.

Product Assessment

Cashco performed a conformity assessment and risk analysis of its pressure regulator and control valve models and their common options, with respect to the Essential Health and Safety Requirements in Annex II of the ATEX directive. The details of the assessment in terms of the individual Essential Health and Safety Requirements, are listed in Table 1. Table 2 lists all of the models and options that were evaluated and along with their evaluation.

Models and options not listed in Table 2 should be assumed to not have been evaluated and therefore should not be selected for use in a potentially explosive environment until they have been evaluated.

Standard default options for each listed model were evaluated even if they were not explicitly listed as a separate option in the table. Not all options listed in the tables are available to all models listed in the tables. Individual TB's must be referenced for actual options.

When specifying a regulator that is to be used in a potentially explosive environment one must review the evaluations in Table 1 and 2 for the specific model and each and every option that is being specified, in order to determine the complete assessment for the unit.

A summary of the models and options found to have an impact on ATEX assessment due to potential ignition sources or other concerns from the ATEX Essential Health and Safety Requirements, are listed below.

1. The plastic knob used as standard on some models, (P1, P2, P3, P4, P5, P7, 3381, 4381, 1171, and 2171) is a potential ignition source due to static electricity. To demonstrate otherwise, the knob must be tested to determine if a transferred charge is below the acceptable values in IEC 60079-0 Section 26.14 (See items 25, 27, and 28 in Appendix A). Until the plastic knob has been shown to be acceptable, then either the metal knob option, or a preset outlet pressure option is required to eliminate this ignition source (See items 45 and 64 in Tables).
2. The pressure gauges offered as options on a few of the regulator models (DA's, P1-7, D, 764, 521), use a plastic polycarbonate window that is a potential ignition source due to static electricity. To demonstrate that the gauges are not a potential source of ignition, the gauges would need to be tested to determine if a transferred charge is below

indicating the gauge is compliant with the ATEX Directive (See items 26, 27, and 28 in Appendix A). Until compliance is determined, regulators should not be ordered with pressure gauges for use in potentially explosive environments.

3. Tied diaphragm regulators with outlet ranges greater than 100 psig should be preset to minimize the risk that improper operation might lead to an outboard leak and a potentially explosive atmosphere (See item 6 in Table 1).
4. 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 regulator with the self-relieving option in a flammable gas system could create an explosive atmosphere in the vicinity of the regulator.
5. Regulators with customer supplied parts are to be assumed to not have been evaluated with regard to ATEX and thus are not to be used in a potentially explosive environment unless a documented evaluation for the specific customer supplied parts in question has been made. Refer to Table 1 for all models and options that have been evaluated.

Product Usage

A summary of ATEX related usage issues that were found in the assessment are listed below.

1. Pressure regulators and control valves must be grounded (earthed) to prevent static charge build-up due to the flowing media. The regulator can be grounded through any mounting holes on the body with metal to metal contact or the system piping can be grounded and electrical continuity verified through the body metal seal connections. Grounding of the regulator should follow the same requirements for the piping system. Also see item 30 in Table 1.
2. The system designer and users must take precautions to prevent rapid system pressurization which may raise surface temperatures of system components and tubing due to adiabatic compression of the system gas.
3. Heating systems installed by the user could possibly increase the surface temperature and must be evaluated by the user for compliance with the ATEX Directive. User installation of heating systems applied to the regulator body or system piping that affects the surface temperature of the pressure regulator is outside the scope of this declaration and is the responsibility of the user.
4. 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 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 rise under any operating conditions. If a process gas temperature rise is possible under operating conditions, then the system designer must investigate whether the regulator body and downstream piping may increase in temperature enough to create a potential source of ignition.

The process gas expansion is typically modeled as a constant enthalpy throttling process for determining the temperature change. A Mollier diagram (Pressure – Enthalpy diagram with constant temperature, density, & entropy contours) or a Temperature – Entropy diagram with constant enthalpy lines, for the process gas, can be used to determine the temperature change. Helium and hydrogen are two gases that typically increase in temperature when expanding across a regulator. Other gases may increase in temperature at sufficiently high pressures.

Product Declaration

If the above issues are addressed by selecting options that do not have potential sources of ignition, avoiding options that have not been assessed, and by taking the proper usage issue precautions, then Cashco regulators can be considered to be a mechanical device that does not have its own source of ignition and thus falls outside the scope of the ATEX directive.