

MODEL P5

PISTON SENSING SINGLE STAGE PRESSURE REDUCING REGULATOR


SECTION I

I. DESCRIPTION AND SCOPE

The Model P5 is a pressure reducing regulator used to control downstream (outlet or P_2) pressure. The unit is suitable for gaseous or liquid services. Available in sizes 1/4" (DN8), 3/8" (DN10) and 1/2" (DN15). Refer to Technical Bulletin P5-TB for design conditions and selection recommendations.

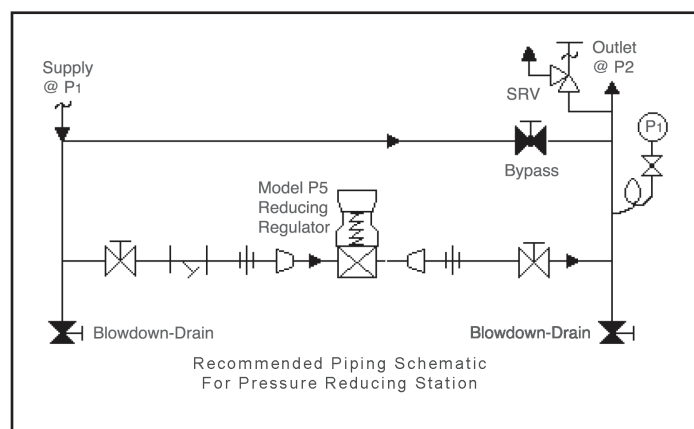
SECTION II

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 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): Regulator may be rotated around the pipe axis 360°. Recommended position is with 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 piston (14). The registering pressure is the outlet, P_2 , or downstream pressure. The range spring (15) opposes piston movement. As outlet pressure drops, the range spring pushes

the piston down, opening the port; as outlet pressure increases, the piston pushes up and the port opening closes.

2. A failure of the piston seals (19.20) 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 piston (see Section IV. Startup, Step 7). Higher pressures could damage the diaphragm. (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 the 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 Model P5 basic regulator and Figure 1 for the piston subassembly.

B. Piston Replacement:



CAUTION

To prevent damage to body, use soft jaws when placing body in a vise. Position so that vise closes over the flats on lower end of body.

1. Securely install the body (1) in a vise with the knob (4) directed upwards.



WARNING

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

2. Relax range spring (15) by turning knob (4) CCW until rotation comes to a complete stop.
NOTE: It is not necessary to remove the knob before removing the spring chamber (6) from the body (1).
3. Remove spring chamber (6) by grasping the flats and turning CCW. Upon removal, the range spring (15), range spring clip (16), and spring button (5) should remain inside the spring chamber. Remove pusher plate (18).
4. Remove snap ring (7) from piston.
5. Lift piston (14) out of body (1) and remove back-up ring (19) and piston o-ring (20). Remove body gasket (10).



Figure 1:
Piston Subassembly

6. Clean body (1) 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.
7. Inspect and replace any necessary parts. Use only parts manufactured and supplied by Cashco, Inc. for these products. See Section VIII.
8. Place the gasket (10) onto the body (1) flange. Use o-ring lube on o-ring (20) and slide o-ring and back-up ring (19) on piston (14). Place piston subassembly into the body (1).
9. Install snap ring (7) above piston assembly. Position pusher plate (18) on top of piston post.
10. 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 body gasket (10). Tighten to the following torque value: 65–70 Ft lbs (88–95 Nm).
11. Pressurize with air and spray liquid leak detector around body (1) and spring chamber (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.

C. Trim Replacement:

1. Remove spring chamber subassembly and piston subassembly per Section VI, Steps B.1. – B.5.
2. Remove seat retainer (13) by turning CCW.
3. Remove poppet (8) and poppet spring (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 poppet spring (9) into body cavity.
7. Place poppet (8) inside the poppet spring (9). The angled seating surface of the poppet 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 to the following torque value: 6.25 Ft-lbs (8.47 Nm).
9. Reinstall piston subassembly and spring chamber assembly per Section VI, Steps B.8. – B.11.
10. 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.*
11. Pressurize with air and spray liquid leak detector around body (1) and spring chamber (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.

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. 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 not 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. Too much droop.	B1. Review droop expected. B2. 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 piston 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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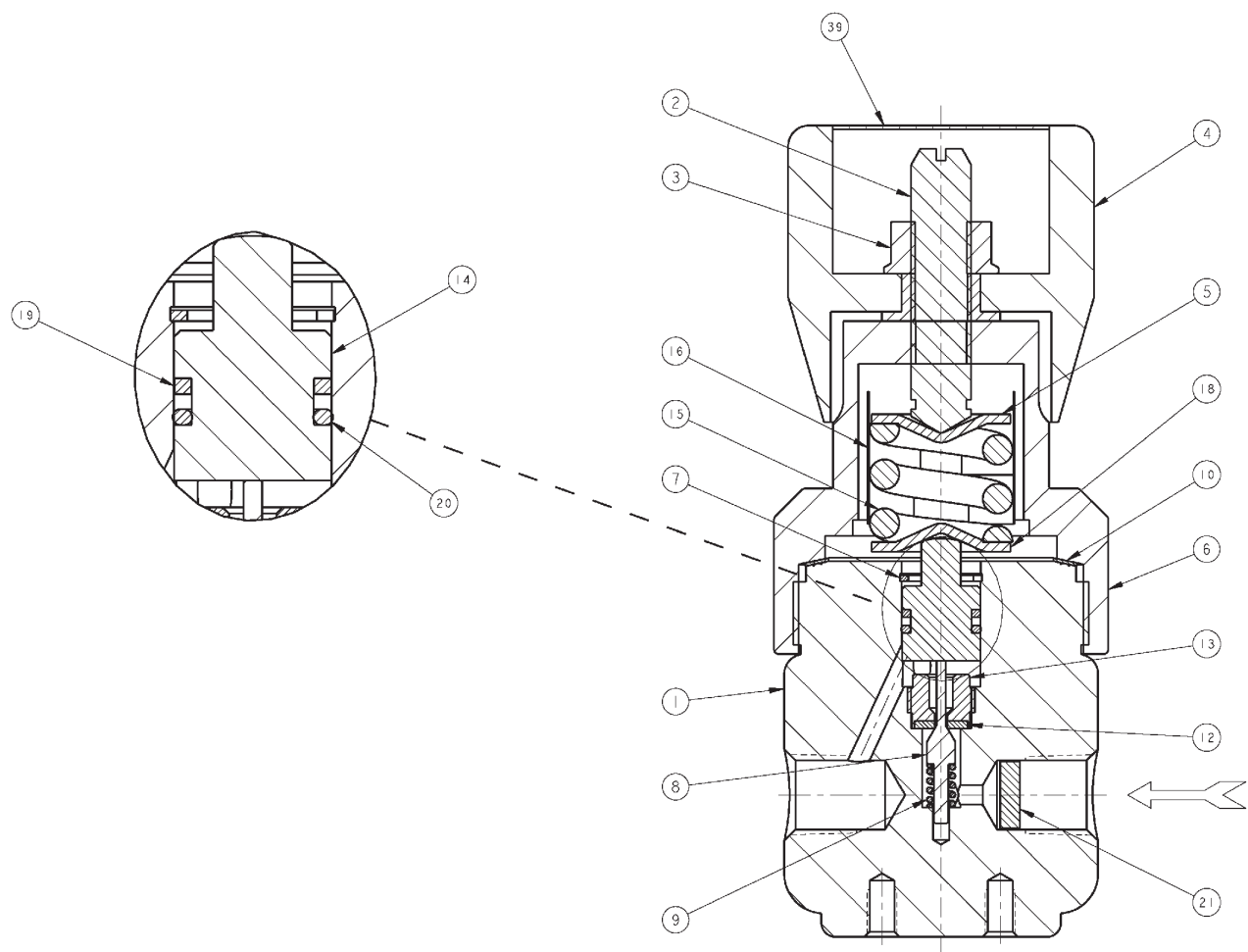
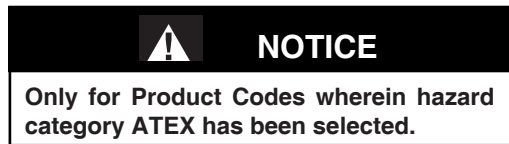


Figure 2:

Item No.	Description	Repair Parts Kit B
1	Body	
2	Adjusting Screw	
3	Knob Nut	
4	Knob	
5	Spring Button	
6	Spring Chamber	
7	Snap Ring-----	††
8	Poppet-----	††
9	Poppet Spring -----	††
10	Body Gasket -----	††
12	Seat -----	††
13	Seat Retainer -----	††
14	Piston	
15	Range Spring	
16	Spring Clip	
18	Pusher Plate	
19	Back-up Ring -----	††
20	Piston O-ring-----	††
21	Inline Filter-----	††
39	Snap in cover	
††	Recommended Spare Part	

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.

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