

## Operation Manual

### Diaphragm Sensed Gas Pressure Regulators

*(AP/AZ/AK Models: 20, 100, 500, 1000, 1000T 10PA, 1100, 1200, 12PA, 1300, 1400T, 14PA, 1500, 15PA, 1600, 1700, 1900, 2700, 9000, 90PA, 91PA, 9200*

*SL Models: 5200, 5400, 5500, 5800)*

#### A. General information

AP Tech pressure regulators are used in gas delivery systems to reduce the supply (inlet) pressure to a lower delivery (outlet) pressure. Many different models are available with many different operating characteristics (pressure ratings, flow capabilities, etc.) and porting configurations. Refer to the appropriate catalog data sheet for specific product information.

In this document, the term “supply pressure” is used to refer to the gas pressure on the high pressure or inlet side of the regulator being discussed. “Supply pressure” may also commonly be referred to as “inlet pressure”, “upstream pressure”, or “source pressure”.

“Delivery pressure” is used to refer to the gas pressure on the low pressure or outlet side of the regulator being discussed. “Delivery pressure” may also commonly be referred to as “outlet pressure” or “downstream pressure”.

**Note:** Pressure regulators are intended to be used to regulate gas outlet delivery pressure in piping systems. They are not intended for use in delivering liquids. Additional regulations that supplement or limit the intended use may apply depending on the regulator and media or industry-specific standards. Regulators are not intended for use as shut off valves. They are not intended to be used as a pressure/safety relief valve unless specifically stated. Regulators are not intended to be operated outside of their specific temperature, pressure, and flow specifications. It is the sole responsibility of the user to determine if the wetted materials are compatible with the process gas.

#### B. System Design/Product Selection

1. AP Tech diaphragm sensed gas pressure regulators are **not** safety accessories per EU Pressure Equipment Directive 97/23/EC or safety related devices per EU ATEX Directive 94/9/EC. The EU Pressure Equipment Directive requires the system designer to install a safety accessory (for example, safety relief valve or burst disc) where the design pressure of the downstream system is lower than the upstream pressure.
2. When selecting the pressure regulator model and configuration, verify the following information.
  - a. Verify the materials of construction are compatible with the intended process gas.
  - b. Verify the pressure and temperature ratings are acceptable for the intended application.
  - c. If the regulator is to be equipped with either a supply or delivery pressure gauge, verify that the pressure gauge range is suitable for the application. For high flow regulators used at high supply pressures, be sure to consider the supply pressure effect when selecting gauges. Refer to AP Tech Product Note PN 426 regarding supply pressure effect.

- d. Verify that the flow capability of the regulator is appropriate for the application.
3. Pressure regulators can be used under a large variety of operating conditions. The system designers shall decide product selection based upon their own analysis and testing to verify acceptable operation with specific equipment.

## C. Installation

1. Verify the pressure rating is acceptable for the intended application.
2. If the regulator is equipped with either a supply or delivery pressure gauge, verify that the pressure gauge range is suitable for the application. For high flow regulators used at high supply pressures, be sure to consider the supply pressure effect when verifying gauge range suitability. Refer to AP Tech Product Note PN 426 regarding supply pressure effect.
3. Inspect the regulator to determine the flow path through the regulator and how the regulator will need to be installed in the system.
  - a. The high pressure (inlet/supply) ports are labeled with an “HP” marked into the body near the ports. Arrows are sometimes used next to the HP to point toward a high pressure port.
  - b. The low pressure (outlet/delivery) ports are labeled with an “LP” marked into the body near the ports. Arrows are sometimes used next to the LP to point toward a low pressure port.
  - c. Dual stage regulators such as the AP1700 and AP2700 may have a monitor (1st stage outlet) port. The monitor port is labeled with an “MP” marked into the body near the port. Arrows are sometimes used next to the MP to point toward a monitor port.
  - d. Always connect the gas source to the high pressure port. Never connect the gas source to the low pressure port or monitor port as the regulator will be damaged and leakage can result.
4. Install the regulator using the appropriate method described below. A large variety of porting options and connections are available.
  - a. For tube stub connections, weld connectors or other components to the tube stubs per standard industry practice (reference SEMI standard F78).
  - b. For metal face seal connectors, assemble connections per standard practice described by fitting supplier (typically 1/8 turn past fingertight).
  - c. For NPT and BSPT connections, apply PTFE (e.g. Teflon) tape to connector threads and install connector in regulator body wrench tight.
  - d. For compression tube fittings, insert the tubing until it bottoms out in the fitting. Assemble nut fingertight. Then tighten the nut 1-1/4 turns past fingertight for 1/4 inch to 1 inch tube connections. For remaking connections, only tighten the nut slightly past fingertight until a rise in torque is detected—this is typically 1/10 turn.
  - e. For pneumatically actuated regulators (AP/AK/AZ10PA, AP/AK/AZ12PA, AP/AK/AZ14PAT, AP/AK/AZ15PA, AP90PA, and AP91PA), a separate line will need to be plumbed to provide the pneumatic actuator control pressure. The actuation port is 1/8th inch NPT and is located on the top center of the actuator. The maximum allowable control pressure is printed on a label surrounding the actuation port. A pilot regulator with an outlet pressure vent is recommended to control the actuation pressure.
  - f. Most regulators have threaded holes on the bottom for mounting. Refer to the applicable data sheet for details. However, for panel mount options, please refer to AP Tech Operation Manual *Panel Mounting Gas Pressure Regulators* for mounting procedures.

5. After installation, perform a leak test. A helium leak test, a pressure decay leak test, or a bubble leak test may be used depending on the application. A helium leak test is recommended for all face seal connections and welds per standard industry practice (reference SEMI standard F1).

## D. Preset Regulator Operation

**Note:** Preset regulators are adjusted at the factory to deliver a specified delivery pressure at a specified supply pressure at zero flow conditions. Instructions to adjust the preset outlet pressure can be found below.

**Caution:** Preset regulators (PS) and preset ready (PSR) are pressure regulators that may be adjusted by the operator. It is possible to adjust a preset regulator to a higher outlet pressure than its maximum rating. Do not adjust a regulator to deliver a higher pressure than its maximum rated outlet pressure at maximum rated inlet pressure. It should be noted that supply pressure effect (SPE) enables a regulator so adjusted to deliver more than maximum rating at inlet pressures lower than maximum rating and this is not a problem. Please refer to product notes PN 437, PN 403 and PN 426 for further information regarding PS, PSR and SPE.

1. Perform the following to adjust the regulator delivery pressure set point
  - a. Close the source valve.
  - b. Open a downstream valve to vent the inlet and outlet side of the pressure regulator to atmospheric pressure.
  - c. Remove the acorn nut from the stem.
  - d. If present on the stem, loosen any hex nuts.
  - e. Using a hex wrench, rotate the stem fully counterclockwise to close the regulator.
  - f. Close the downstream valve.
  - g. Slowly open the source valve to pressurize the regulator high pressure port.
  - h. Using a hex wrench, rotate the stem clockwise to increase the delivery pressure to the desired set point.

**Note:** The delivery pressure will decrease as the flow rate is increased. In order to obtain a specific delivery pressure at flow, adjust the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise when the flow is shut-off or decreased downstream.

- i. If present on the stem, tighten the bottom hex nut to 75 in-lb. If there is a second hex nut on the stem, tighten it against the bottom hex nut.
- j. Thread the acorn nut onto the stem and tighten against the hex nut (or cap if there are no hex nuts on the stem).

## E. Manually Adjustable Regulator Operation (non-PA models)

**Note:** A pressure regulator should not be used as a positive shut-off device.

**Caution:** Do not rotate the wheel counterclockwise under non-flowing conditions as damage to the regulator internal parts or leakage may result.

**Caution:** Do not pressurize the regulator outlet except by rotating the adjustment wheel clockwise as damage to the regulator internal parts or leakage may result.

**Caution:** It is possible to adjust a pressure regulator to a higher outlet pressure than its maximum rating. Do not adjust a regulator to deliver a higher pressure than its maximum rated outlet

pressure at maximum rated inlet pressure. It should be noted that supply pressure effect (SPE) enables a regulator to deliver more than maximum rating at inlet pressures lower than maximum and this is not a problem. Please refer to product notes PN 403 and PN 426 for further information regarding SPE.

1. Perform the following to open the regulator or increase the regulator delivery pressure set point.
  - a. Before opening the source valve, verify that the regulator adjustment wheel is turned fully counterclockwise (closed position).
  - b. Slowly open the source valve to pressurize the regulator high pressure port.
  - c. Rotate the wheel clockwise to increase the delivery pressure to the desired set point.  
**Note:** The delivery pressure will decrease as the flow rate is increased. In order to obtain a specific delivery pressure at flow, adjust the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise when the flow is shut-off or decreased downstream.
2. Perform the following to decrease the regulator delivery pressure set point.
  - a. Open a downstream valve to initiate a flowing condition.
  - b. Slowly rotate the wheel counterclockwise to reduce the delivery pressure.
  - c. In order to obtain a specific set point under flowing conditions, continue to rotate the wheel counterclockwise to reduce the delivery pressure below the desired set point. Then, rotate the wheel clockwise to increase the delivery pressure to obtain the set point at the desired flow condition.
3. Perform the following to close the regulator.
  - a. Close the source valve.
  - b. Vent to atmospheric pressure on both sides of the pressure regulator.
  - c. Rotate the wheel fully counterclockwise.

## F. Pneumatically Actuated Regulator Operation (PA models)

**Note:** A pressure regulator should not be used as a positive shut-off device.

**Caution:** Do not vent or otherwise reduce the actuation control pressure under non-flowing conditions as damage to the regulator internal parts or leakage may result.

**Caution:** Do not pressurize the regulator outlet except by slowly increasing the actuation control pressure as damage to the regulator internal parts or leakage may result.

**Caution:** It is possible to adjust a pressure regulator to a higher outlet pressure than its maximum rating. Do not adjust a regulator to deliver a higher pressure than its maximum rated outlet pressure at maximum rated inlet pressure. It should be noted that supply pressure effect (SPE) enables a regulator to deliver more than maximum rating at inlet pressures lower than maximum and this is not a problem. Please refer to product notes PN 403 and PN 426 for further information regarding SPE.

1. Perform the following to open the regulator or increase the regulator delivery pressure set point.
  - a. Before opening the source valve, verify that the actuation control pressure is at atmospheric pressure.
  - b. Slowly open the source valve to pressurize the regulator high pressure port.

- c. Slowly increase the actuation control pressure to increase the delivery pressure to the desired set point.  
**Note:** The delivery pressure will decrease as the flow rate is increased. In order to obtain a specific delivery pressure at flow, adjust the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise when the flow is shut-off or decreased downstream.
2. Perform the following to decrease the regulator delivery pressure set point.
  - a. Open a downstream valve to initiate flow.
  - b. Slowly reduce the actuation control pressure to reduce the delivery pressure.
  - c. In order to obtain a specific set point under flowing conditions, continue to decrease the actuation control pressure to reduce the delivery pressure below the desired set point. Then, increase the actuation control pressure to increase the delivery pressure and obtain the set point at the desired flow condition.
3. Perform the following to close the regulator.
  - a. Close the source valve.
  - b. Vent to atmospheric pressure on both sides of the pressure regulator.
  - c. Vent or otherwise reduce the actuation control pressure to atmospheric pressure.

*Please contact the factory or your local representative to answer questions or for further information.*