

## Operation Manual

### Piston Sensed Gas Pressure Regulators

*(Models KT9, KT10, Welded KT10, KT12)*

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#### A. General information

AP Tech pressure regulators are used in gas delivery systems to reduce the source pressure to a lower delivery (outlet) pressure. This operation manual is applicable to gas pressure regulators that use a piston to sense the delivery pressure.

Refer to the appropriate catalog data sheet for specific product information. For special options that are not shown in the data sheet, contact the factory or your local representative for questions on proper operation.

#### B. System Design/Product Selection

1. AP Tech piston 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.
  - d. Verify that the flow capability of the regulator is appropriate for the application.
3. KT9, KT10, Welded KT10, and KT12 regulators must be ordered with the non-relieving (non-venting) option if the process gas they are to be used with is hazardous (flammable, toxic, etc.). The self-relieving (venting) option on these models vents process gas through the regulator cap directly into the atmosphere surrounding the regulator, which is undesirable with a hazardous gas.
4. Pressure regulators can be used under a large variety of operation 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.
3. **Orientation:** 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) port(s) is labeled with an “HP” marked on the body near the port. Arrows are sometimes used next to the HP characters to point toward a high pressure port.
  - b. The low pressure (outlet/delivery) port(s) is labeled with an “LP” marked on the body near the port. Arrows are sometimes used next to the LP characters to point toward a low pressure port.
  - c. Always connect the gas source to the high pressure port. Never connect the gas source to the low pressure port as the regulator can be damaged and leakage can result.

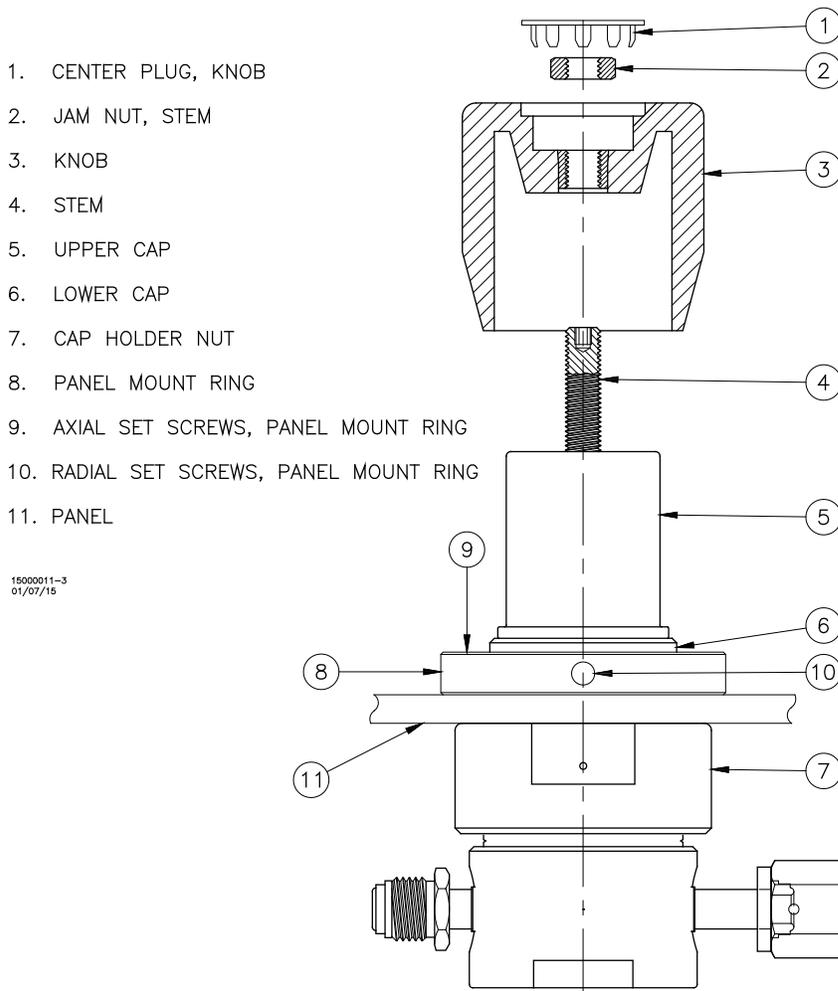
**Caution:** If a regulator was installed incorrectly and a low pressure port was pressurized above the rated outlet pressure, then the regulator must be returned to the factory for repair prior to use.

4. **Fitting Attachment:** Install the regulator using the appropriate method described below. For assembly of other type connections, consult connector manufacturer or contact the factory.
  - a. For NPT connections, apply PTFE (e.g. Teflon) tape to connector threads and install connector in regulator body wrench tight.
  - b. For straight thread o-ring connections (such as MS33649 porting), verify the proper mating fittings and o-rings are being used and install the fittings in the regulator. Tighten according to fitting manufacturer specification.
  - c. For metal face seal connectors (Welded KT10), assemble connections per standard practice described by fitting supplier (typically 1/8 turn past fingertight).
5. **Pneumatic Connections:** For pneumatically actuated KT10 and KT12 regulators, a separate line will need to be plumbed to provide the pneumatic actuator control pressure. Pressurized inert gas, typically nitrogen gas, or air may be used for actuation. The maximum allowable actuation control pressure is 100 psig. The actuation port is 1/8<sup>th</sup> inch NPT and is located on the top center of the actuator (See **Figure 4**). A pilot regulator with an outlet pressure vent is recommended to control the actuation pressure.
6. **Mounting:** If appropriate for the application, secure the regulator body using one of the below methods.
  - a. KT9 regulators may be mounted using either i) the two M5x0.8 threaded mounting holes on the bottom of the regulator or ii) the optional panel mount ring.
    - i) If using the mounting holes on the bottom of the regulator, size 10-32 UNF screws may be used in place of M5x0.8 screws since the diameter and pitch are close enough for 10-32 screws to fit in the M5x0.8 holes.
    - ii) Refer to section D for panel mount installation instructions.
  - b. For KT10 and KT12 regulators with NPT or straight thread connections, use the panel mount clamp option to secure the regulator. Refer to section D.2 for panel mount installation instructions. For Welded KT10 regulators with metal face seal connections, use the mounting holes in the bottom of the body to secure the regulator with either M5x0.8 or 10-32 UNF screws.
7. **Leak Testing:** After installation, perform a leak test. A pressure decay leak test is recommended to check for leak integrity of the regulator internal parts and external fitting connections. A bubble leak test may be performed to check for leaks at external fitting connections. A helium leak test is recommended for Welded KT9 and KT10 regulators with face seal connections per standard industry practice (reference SEMI standard F1).

**D. Panel Mount Installation**

**1. KT9 regulator (Refer to Figure 1):**

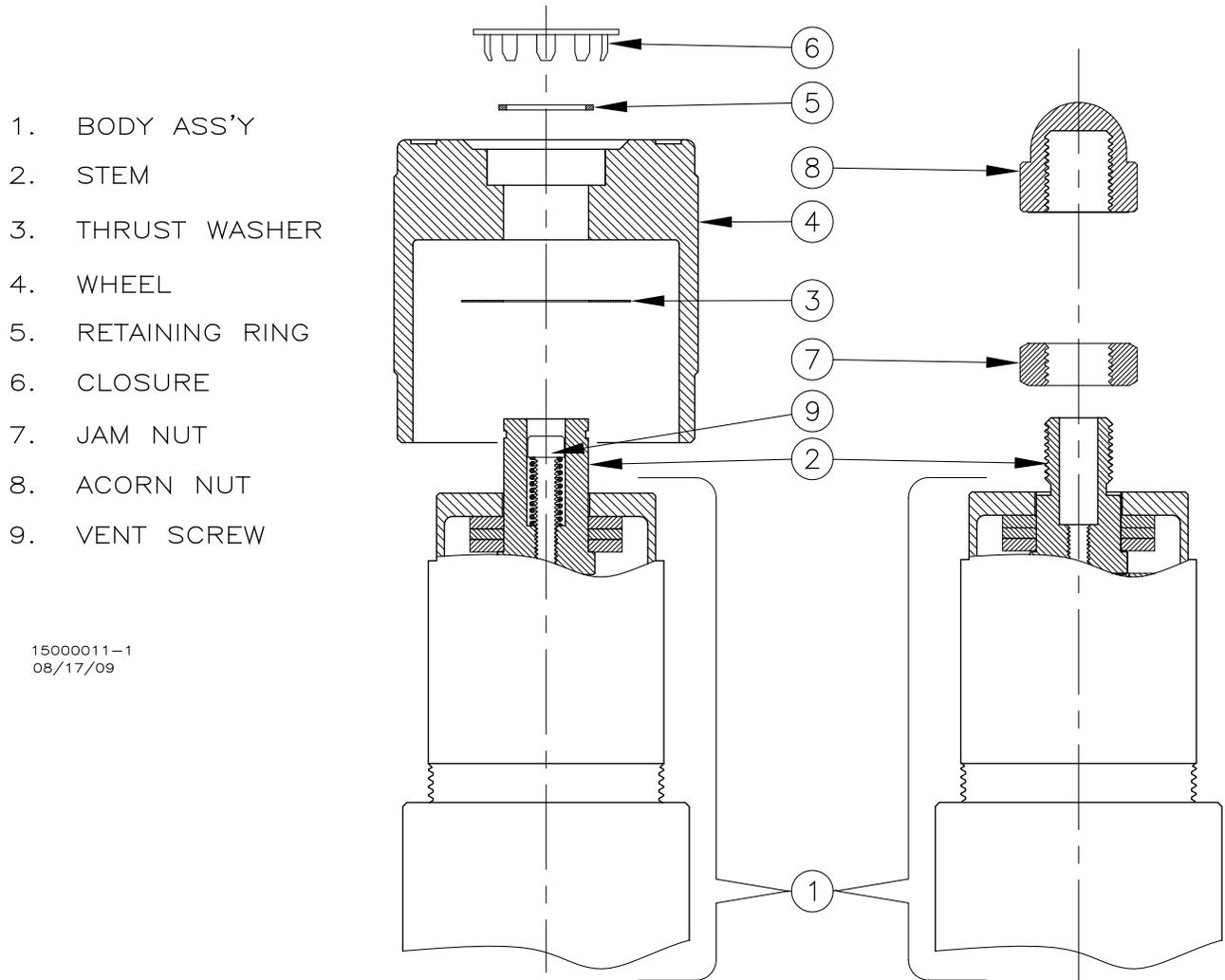
- a. Remove the knob (#3) as follows so that the regulator fits through the panel hole.
  - i) Open the regulator fully by turning the knob clockwise until it stops.
  - ii) Use a pointed device to pry the center plug (#1) from the top of the knob.
  - iii) Holding the knob in one hand to prevent it from rotating, use a 1/2" socket and wrench to unscrew the stem jam nut (#2) counter-clockwise.
  - iv) Remove the knob by unscrewing it counter-clockwise from the stem (#4).
- b. Install the regulator into the panel (#11) hole.
- c. Slide the panel mount ring (#8) over the regulator lower cap to sandwich the panel between the regulator cap holder nut (#7) and the panel mount ring.
- d. Tighten the two radial set screws (#10) in the panel mount ring against the regulator lower cap using a 3/32 hex key wrench.
- e. Tighten the two axial set screws (#9) against the panel using a 3/32 hex key wrench.
- f. Thread the knob back onto the stem until it stops against the top of the cap (#5).
- g. Thread the jam nut onto the stem until it stops on the knob.
- h. Holding the knob in one hand, tighten the jam nut against the knob with 100 in·lbf.
- i. Turn the knob fully counter-clockwise to close the regulator.
- j. Press the knob center plug back into the top of the knob.



**Figure 1. KT9 panel mount installation.**

2. **KT10 and KT12 regulators:**

- a. If necessary, remove the regulator wheel to install the regulator through the panel.
  - i) Refer to **Figure 2** to remove closure, retaining ring, wheel, and thrust washer.
- b. Refer to **Figure 3** for panel mount clamp installation.
  - i) Loosen the 10-32 screws on the clamp using a 5/32 inch hex wrench.
  - ii) Position the clamp on the regulator body so the 1/4-20 UNC threaded holes line up with the panel cutout, then retighten the 10-32 screws leaving the same gap between each half of the panel mount clamp.
  - iii) Install and tighten 1/4-20 UNC screws (customer supplied) to secure regulator to panel.
- c. Reinstall the thrust washer, wheel, retaining ring, and closure if removed in step a above.



**Figure 2.** KT10 and KT12 Adjustable and Preset Regulator Stem Assemblies.

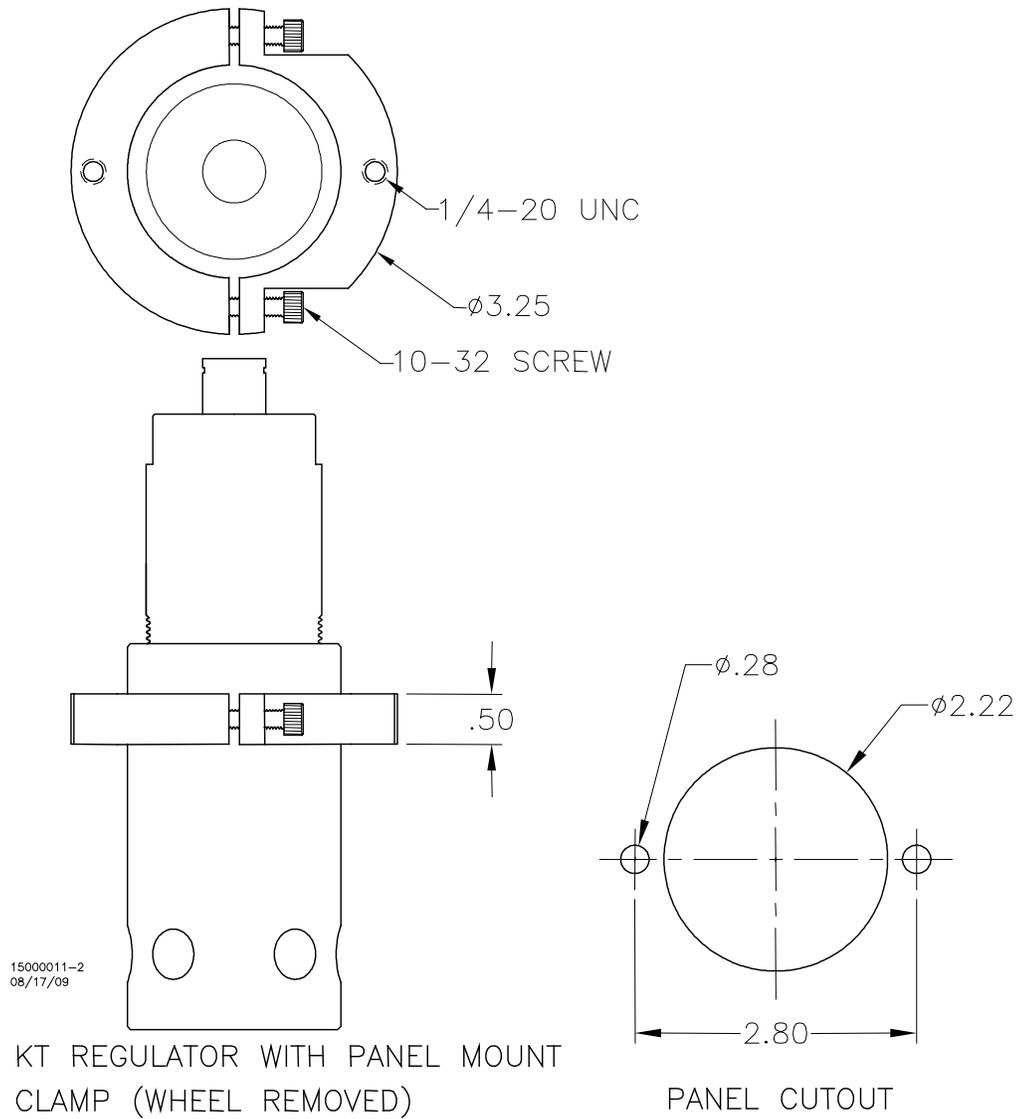
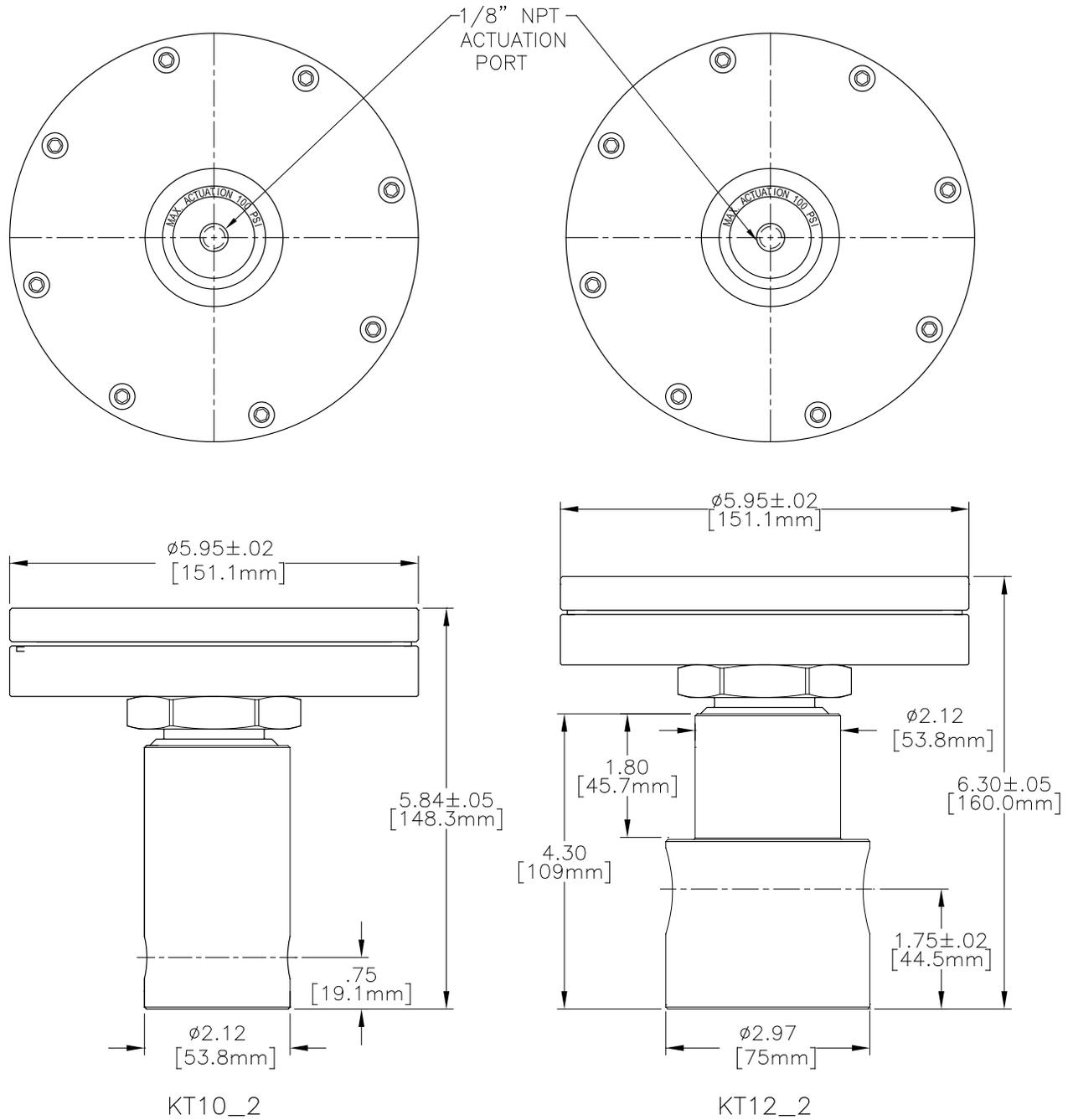


Figure 3. KT10 and KT12 Panel Mount Clamp Detail.



KT10-2 KT12-2  
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Figure 4. Pneumatically actuated KT10 and KT12 regulator dimensions.

## E. Manually Adjustable, Non-relieving (non-venting) Regulator Operation

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

**Caution:** Do not pressurize the regulator low pressure port, except by rotating the adjustment wheel clockwise (increasing the set point), as damage to the regulator internal parts or leakage may result.

1. Perform the following to increase the regulator delivery pressure set point.
  - a. Before opening the source valve, verify that the regulator adjustment wheel is turned fully counterclockwise (fully decreased position).
  - b. Slowly open the source valve to pressurize the regulator high pressure port.
  - c. Rotate the regulator wheel clockwise to increase the delivery pressure to the desired pressure.  
**Note:** The delivery pressure will decrease as the flow rate is increased. It may be advantageous to compensate by adjusting the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise if the flow is shut-off or decreased downstream.
2. Perform the following to decrease the regulator delivery pressure set point for non-relieving (non-venting) regulators.
  - a. Open a downstream valve to initiate a flowing condition.
  - b. Rotate the regulator wheel counterclockwise to reduce the delivery pressure below the desired pressure.
  - c. Close the downstream valve to stop flow.
  - d. Rotate the regulator wheel clockwise to increase the delivery pressure to the desired pressure.  
**Note:** The delivery pressure will decrease as the flow rate is increased. It may be advantageous to compensate by adjusting the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise if the flow is shut-off or decreased downstream.
3. Perform the following to fully decrease the regulator delivery pressure.
  - a. Close the source valve.
  - b. Vent outlet to atmospheric pressure.
  - c. Rotate the regulator wheel fully counterclockwise.

## F. Manually Adjustable, Self-relieving (self-venting) Regulator Operation

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

**Caution:** Do not pressurize the regulator low pressure port, except by rotating the adjustment wheel clockwise (increasing the set point), as damage to the regulator internal parts or leakage may result.

**Caution:** Self-relieving KT9, KT10, and KT12 regulators have a built in vent mechanism that vents the delivery pressure through the cap into the atmosphere if the delivery pressure exceeds the set point. Self-relieving KT9, KT10, and KT12 regulators should only be used with gases that can be safely released in the area where the regulator is being used.

**Note:** The self-relieving mechanism incorporated into AP Tech piston sensed regulators will come from the factory preset and should not need adjustment. However, if any of the three conditions below occur, then for KT10 and KT12 regulators, adjust the vent valve setting per section E.4. For KT9 models, the regulator will need to be removed from service and repaired.

- Condition 1: The regulator does not relieve its delivery pressure after several counterclockwise rotations of the adjustment wheel.
- Condition 2: Audible venting is detected inside the regulator bonnet without rotating the adjustment wheel.

**Note:** This condition may indicate a leak across the seat of the regulator. If adjusting the vent valve according to section E.4 results in a steadily increasing outlet pressure or excessive creep, then it is likely the regulator is leaking across the seat and needs to be repaired.

- Condition 3: Audible venting is detected inside the regulator bonnet while increasing the delivery pressure of the regulator by rotating the adjustment wheel clockwise.
1. Perform the following to increase the regulator delivery pressure set point.
    - a. Before opening the source valve, verify that the regulator adjustment wheel is turned fully counterclockwise (fully decreased position).
    - b. Slowly open the source valve to pressurize the regulator high pressure port.
    - c. Rotate the regulator wheel clockwise to increase the delivery pressure to the desired pressure.  
**Note:** The delivery pressure will decrease as the flow rate is increased. It may be advantageous to compensate by adjusting the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise if the flow is shut-off or decreased downstream.
  2. Perform the following to decrease the regulator delivery pressure set point for self-relieving (self-venting) regulators.
    - a. Slowly rotate the regulator wheel counterclockwise to reduce the delivery pressure below the desired pressure. The self-relieving feature will vent the delivery pressure through the regulator bonnet to atmosphere.
    - b. Rotate the regulator wheel clockwise to increase the delivery pressure to the desired pressure.  
**Note:** The delivery pressure will decrease as the flow rate is increased. It may be advantageous to compensate by adjusting the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise if the flow is shut-off or decreased downstream.
  3. Perform the following to fully decrease the regulator delivery pressure.
    - a. Close the source valve.
    - b. Vent outlet to atmospheric pressure.
    - c. Rotate the regulator wheel fully counterclockwise.
  4. When necessary perform the following to adjust the vent valve (KT10 and KT12 only). Refer to **Figure 2**.
    - a. Remove the closure (6) on the top of the regulator adjustment wheel (4).
    - b. Rotate the adjustment wheel clockwise to set the delivery pressure to approximately 10% of regulator's rated maximum outlet pressure or 200 psig whichever is greater, with all valves downstream of the regulator closed.
    - c. Use a flat tip screwdriver to turn the vent screw (9) clockwise until gas can be heard venting through the bonnet of the regulator.
    - d. Once venting is heard, turn the vent screw counterclockwise until audible gas flow stops plus one half additional turn.
    - e. Replace the closure on the top of the adjustment wheel.

## G. Preset Regulator Operation

**Note:** Preset regulators are adjusted at the factory to customer specified conditions. Generally, no readjustment will be required.

1. Perform the following to readjust the regulator delivery pressure set point. Refer to **Figure 2**
  - a. Close the source valve.
  - b. Vent outlet to atmospheric pressure. This should vent both source and delivery pressures to atmospheric pressure since the regulator is preset to some set point.
  - c. Remove acorn nut (8) from top of stem (2).
  - d. Loosen jam nut (7).
  - e. Place a 3/8 inch open end wrench on stem flats and rotate stem fully counterclockwise (fully decreased position).

- f. Slowly open the source valve to pressurize the regulator high pressure port to the desired inlet pressure.
- g. Using 3/8 inch wrench on stem flats, turn stem clockwise to increase the delivery pressure to the desired pressure.  
**Note:** The delivery pressure will decrease as the flow rate is increased. It may be advantageous to compensate by adjusting the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise if the flow is shut-off or decreased downstream.
- h. Reinstall jam nut and tighten to 100 in-lb against regulator bonnet.
- i. Reinstall acorn nut and tighten to 40 in-lb against jam nut.

## H. Pneumatically Actuated, Non-relieving (non-venting) Regulator Operation

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

**Caution:** Do not reduce the actuation control pressure under no flow conditions as damage to the regulator internal parts or leakage may result.

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

1. Perform the following to 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 pressure. See **Figure 5** and **Figure 6** for delivery pressure versus actuation control pressure charts for the pneumatically actuated KT10 and KT12 models.

**Note:** The delivery pressure will decrease as the flow rate is increased. It may be advantageous to compensate by adjusting the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise if the flow is shut-off or decreased downstream.

2. Perform the following to decrease the regulator delivery pressure set point for non-relieving (non-venting) regulators.
  - a. Open a downstream valve to initiate a flowing condition.
  - b. Reduce the actuation control pressure to reduce the delivery pressure below the desired pressure.
  - c. Increase the actuation control pressure to obtain the desired delivery pressure.

**Note:** The delivery pressure will decrease as the flow rate is increased. It may be advantageous to compensate by adjusting the regulator to the desired delivery pressure while operating at the desired flow conditions. Be aware the delivery pressure will rise if the flow is shut-off or decreased downstream.

3. Perform the following to fully decrease the regulator.
  - a. Close the source valve.
  - b. Vent outlet pressure to atmospheric pressure while applying actuation control pressure to allow both sides of the pressure regulator to vent to atmospheric pressure.
  - c. Vent or otherwise reduce the actuation control pressure to atmospheric pressure.

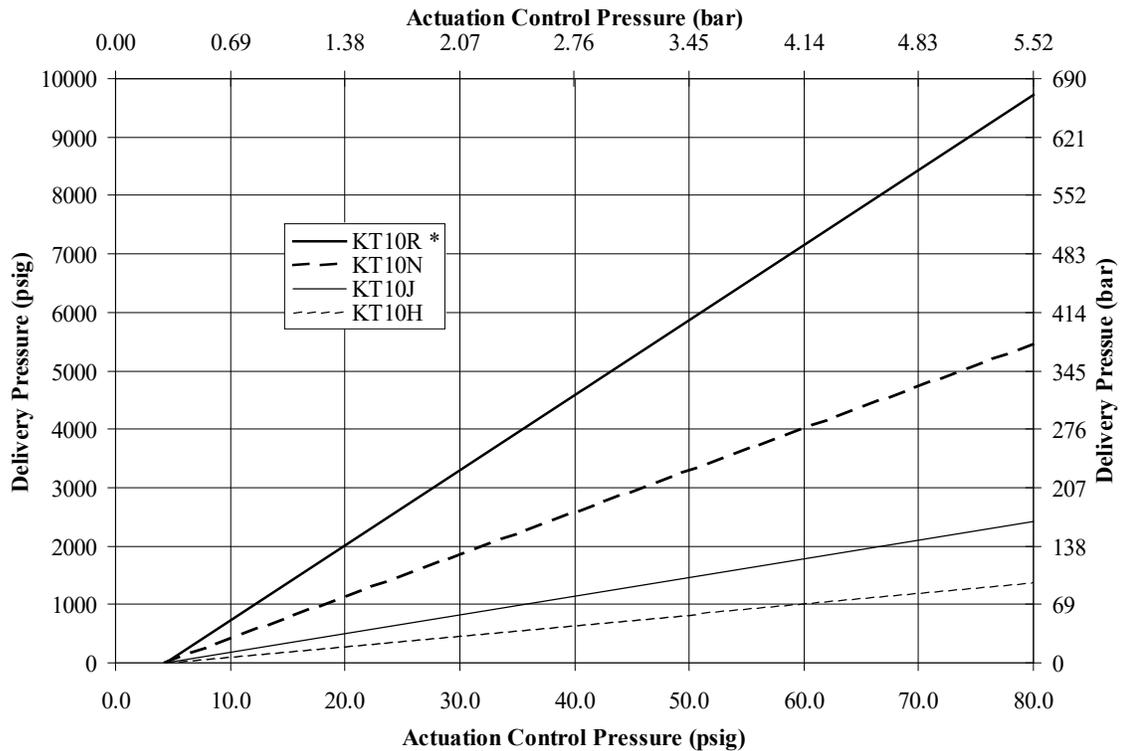
*Please contact the factory or your local representative to answer questions or for further information*

I. Supply Pressure Effect Values

Table 1. AP Tech piston regulator supply pressure effect values.

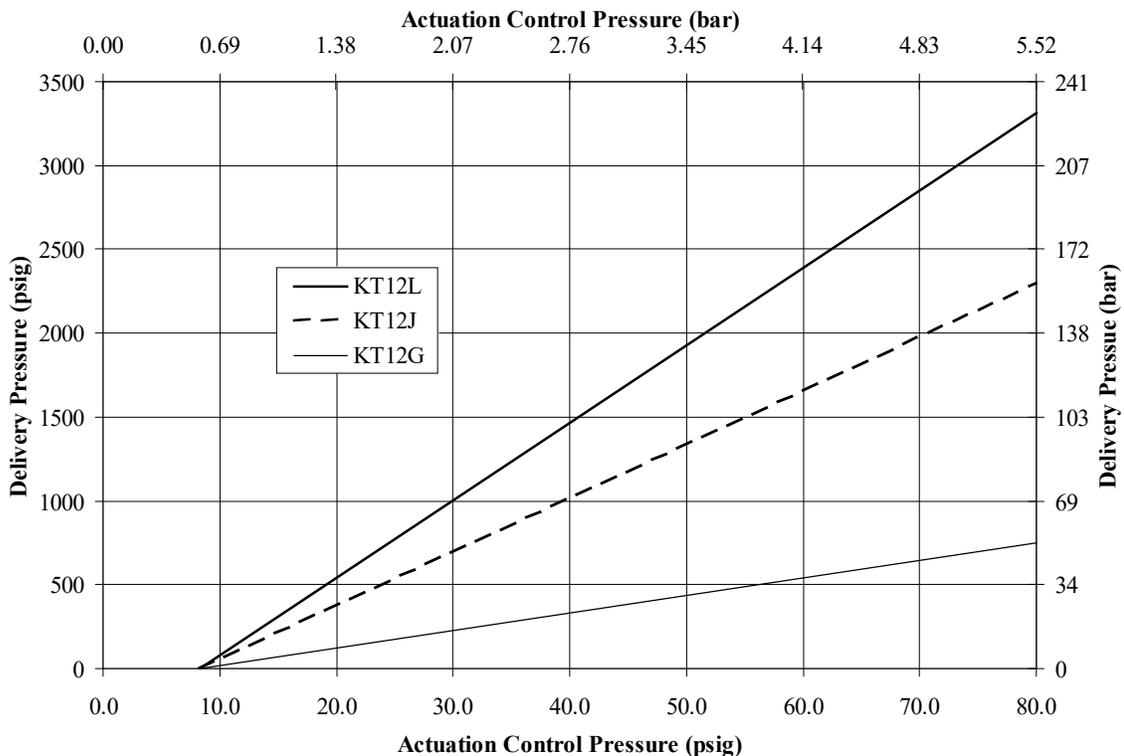
Model	Supply Pressure Effect (Increase in delivery pressure for every 100 psi decrease in source pressure)
<b>Standard KT9:</b>	
KT9D	1.2
KT9F	1.2
KT9L	4.8
<b>High Flow KT9:</b>	
KT9D VS HF	3.0
KT9F VS HF	3.0
KT9L VS HF	12
<b>Standard KT10:</b>	
KT10F	0.7 psi
KT10H	0.7 psi
KT10J	1.3 psi
KT10L	2.9 psi
KT10N	2.9 psi
KT10P	5.1 psi
KT10R	5.1 psi
<b>High Flow KT10:</b>	
KT10F HF	1.2 psi
KT10H HF	1.2 psi
KT10J HF	2.1 psi
KT10L HF	4.8 psi
KT10N HF	4.8 psi
KT10P HF	8.6 psi
<b>Standard KT12:</b>	
KT12E	0.3 psi
KT12G	0.3 psi
KT12I	0.9 psi
KT12J	0.9 psi
KT12L	1.3 psi
<b>High Flow KT12:</b>	
KT12E HF	0.9 psi
KT12G HF	0.9 psi
KT12I HF	2.7 psi
KT12J HF	2.7 psi
KT12L HF	3.9 psi

**J. Pneumatically Actuated Regulator Pressure Ratio Charts**



**Figure 5.** Pneumatically actuated KT10 delivery pressure vs. actuation control pressure.

\* Note: KT10R not available on welded body KT10's.



**Figure 6.** Pneumatically actuated KT12 delivery pressure vs. actuation control pressure.