

Lab 6 Upstream Auto Pressure Control with a Proportioning Valve

Name: _____

Purpose

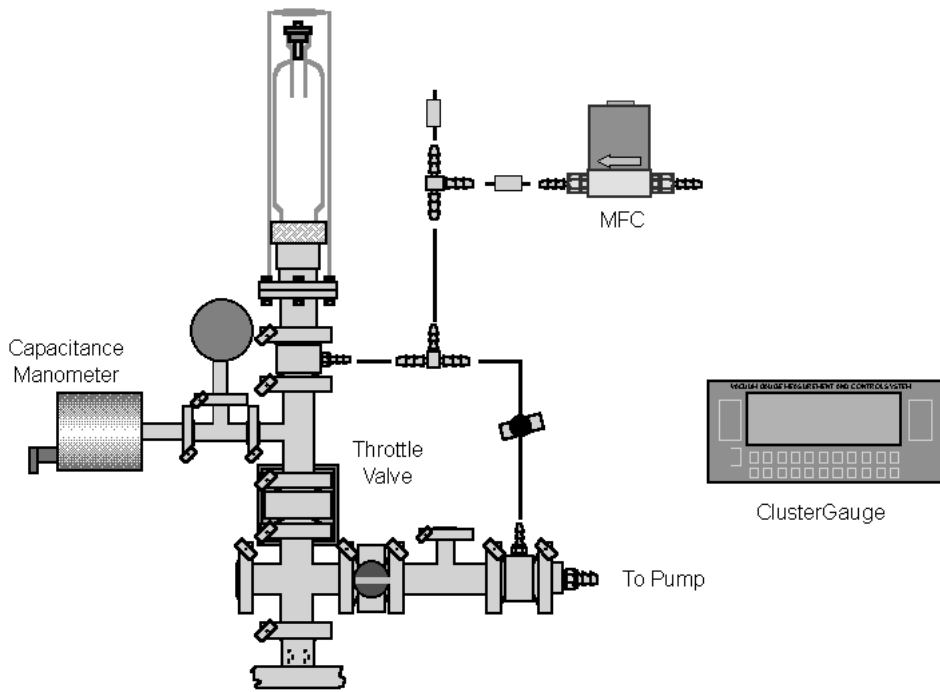
The purpose of this lab is to:

- 1) Understand the upstream mode of pressure control.
- 2) Contrast the upstream mode with downstream control (Lab 5).

Procedure

The MKS Vacuum Training System can be configured to operate in the upstream pressure control mode using the proportioning valve in the mass flow controller as the control element.

In the figure below, identify each element of the upstream control system and how they are linked to form a closed-loop control system. Do the same (in different color pen or pencil) for the downstream control configuration.



With the manual butterfly valve open and with the MFC, bypass and vent pinch clamps closed, turn on the pump and allow the system to reach base pressure.

Configure the system for upstream control as follows:

Enter the Set-up Mode and change the MFC from SETPOINT mode to RATIO mode.

Enter a set point value of 100 sccm and check to ensure that the MFC range is at 100 also. This takes the MFC out of its normal set point mode and places its valve in a pressure control function. The MFC's sensor will now monitor flow but it is no longer part of the control loop.

Check the 153 throttle valve to ensure that the valve is fully opened. Place the Hold/Normal toggle switch in the Hold position.

Enter the Tuning Mode and toggle with PgUp/PgDn to view the Control Set-up Screen. Change the Polarity from DIRECT (downstream) to REVERSE (upstream).

With PgUp/PgDn view the PID Tuning Mode screen. Enter a [S]etpoint of 1 Torr and put the Valve Mode on [C]lose. This closes the MFC's control valve. Set the [G]ain to 100 and [L]ead to 5. Open the MFC pinch clamp.

Convert to [P]id control. Does the system stabilize at the set point pressure? If it doesn't readjust the Gain and Lead to make the system stable. Try to reduce the Gain and increase the Lead. When the system settles, note Lead and Gain settings and the Valve Output value (Note: Valve Output is the level of the signal being sent to the valve and is a percent of the full scale flow value.)

Change the Setpoint to 10 Torr. Does the system re-stabilize? What does the MFC valve do (open or close more)? Record the valve output (in % open).

Close the manual butterfly valve and open the bypass pinch clamp. Does the pressure stay stable at 10 Torr? What is the Valve Output now (in %)? Has it increased or decreased from the value in the previous step? Explain why.

With this system, if you were controlling pressure at 0.3 Torr, would you choose the upstream control mode or downstream? Why?

If you were controlling at 50 Torr, which method would be more appropriate? Why?

If your process required a constant mass flow of 50 sccm and a pressure of 0.3 Torr, which control method would you select? Could the system meet these requirements? If not, what changes might you make?

Lab written by M. Quirk and V. Ybarra, Jr. at Austin Community College, based on information from the VTS-1 equipment manual written by MKS Instruments, Inc. Comments may be submitted to S. Hansen at: MKS Instruments, Inc., Six Shattuck Rd., Andover, MA 01 or by email to hansens@mksinst.com.

Permission is granted for the use of this material for instructional purposes within established institutions of learning provided that there is the customary acknowledgment of the sources.