Date: _____ Name: _____

LABORATORY EXERCISE 14
CHARACTERISTICS OF RATIO CONTROL

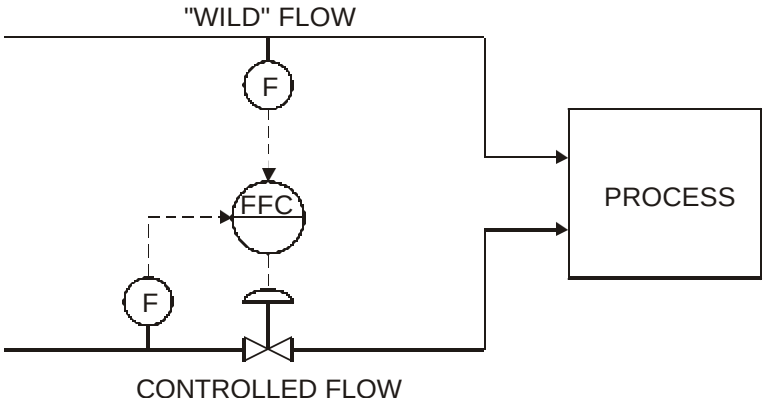
OBJECTIVE: To demonstrate the behavior of ratio control.

PREREQUISITE: Completion of PC-ControLAB tutorial (under **Help | Tutorial**) or an equivalent amount of familiarity with the program operaiton.

BACKGROUND: Ratio control is used when it is necessary to maintain a certain ratio between the flow rate of two streams. One stream, called the "wild" flow, is measured only. It is the pacing stream. The other stream, the controlled flow, is controlled so as to maintain a specified ratio between the two.

There are two general types of ratio control. In one type, illustrated in this laboratory exercise, the ratio is manually set. In the other type, the ratio is automatically set by the output of a Primary feedback controller. That type of ratio control is illustrated by Laboratory Exercise 17, Multiplicative Feedforward Control.

A typical configuration of ratio control is shown in the following figure. For illustrative purpose, this laboratory exercise assumes that the controlled flow is Steam Flow, with a measured range of 0 – 1000 P/hr. The "wild" flow is a process stream, with a measured range of 0 – 400 gpm.



1. RUNNING THE PROGRAM

Start **Windows.**

Run **PC-ControLAB**.

Click on **Control | Select Strategy | Ratio.**

Click on **Process | Select Model**; highlight "RatioFlo.mdl" and press **Open**

2. CONTROLLER SET UP

Press **Tune** and enter the following tuning parameters (representative of a flow loop).

Gain: 0.5

Reset: 0.15 min/rpt

Deriv: 0.00 min

Put the controller in **Auto**.

Observe:

Present value of process variable, in engineering units _____

Present value of process variable, in percent of measurement span: _____

Present value of "wild" variable, in engineering units (gray trace, labeled LOAD) _____
(Click on the label "GPM" to change the vertical scale from the PV to the wild flow.)

Present value of "wild" flow, in percent of measurement span: _____

Ratio, $\frac{\text{PV, \% of span}}{\text{Wild flow, \% of span}}$: _____

Click on the label "Steam Flow (PV-2)" above the faceplate.

Click on the button labeled R on the controller faceplate to access the present calculated ratio, as well as the set ratio. Calculated ratio: _____

Set ratio: _____

In concept, the set ratio back could be calculated from the present ratio of measured variables; this would provide bumpless transfer from the AUTO mode to the RATIO mode. This would probably not be wise, however, since the required ratio is normally set by process conditions or product specifications. The operator, not the system, should be the one to enter the required ratio. Therefore, the set ratio is not backcalculated in this program or in most commercial systems.

When the ratio is set by the output of a feedbacfk controller (for instance, in the Multiplicative Feedforward control strategy – see Exercise 17), the ratio is back calculated, thus producing the output for the Primary controller. This provides for bumpless transfer from Manual to Auto for the Primary.

If you change the controller to the Ratio mode now, where do you think the controller set point will go? _____

Try it! Put the controller in Ratio. What is the SP? _____

You probably observed that that made quite a "jolt" to the flow loop. A wise operator probably would not change from Auto to Ratio when there was that much difference between the existing ratio and the ratio setting. Instead, he/she would probably set the ratio setting to whatever the application or product specifications required, then adjust flow set point until actual ratio met the required ratio. Then the switch to Ratio mode would be made.

Press R and enter a set ratio of 0.5.

After the loop stabilizes, observe:

Present value of PV, in engineering units _____

Present value of PV, in percent of measurement span: _____

Present value of "wild" variable, in engineering units _____

Present value of "wild" flow, in percent of measurement span: _____

Ratio, $\frac{\text{PV, \% of span}}{\text{Wild flow, \% of span}}$: _____

Press **StepIncr** twice to simulate an increase in "wild" flow.

Did the controlled flow (PV) follow it at the set ratio? _____

Press **StepDecr** twice, then press **AutoLoad**. This simulates a randomly varying wild flow.

Does the controlled flow (PV) follow it at the set ratio? _____