Idea will can fly when you ask why?

PROCESS AND CONTROL LOOP CHARACTERISTICS

Pairoch krongton

Instrument

Thai-Austrian Technical College

PROCESS AND CONTROL LOOP CHARACTERISTICS

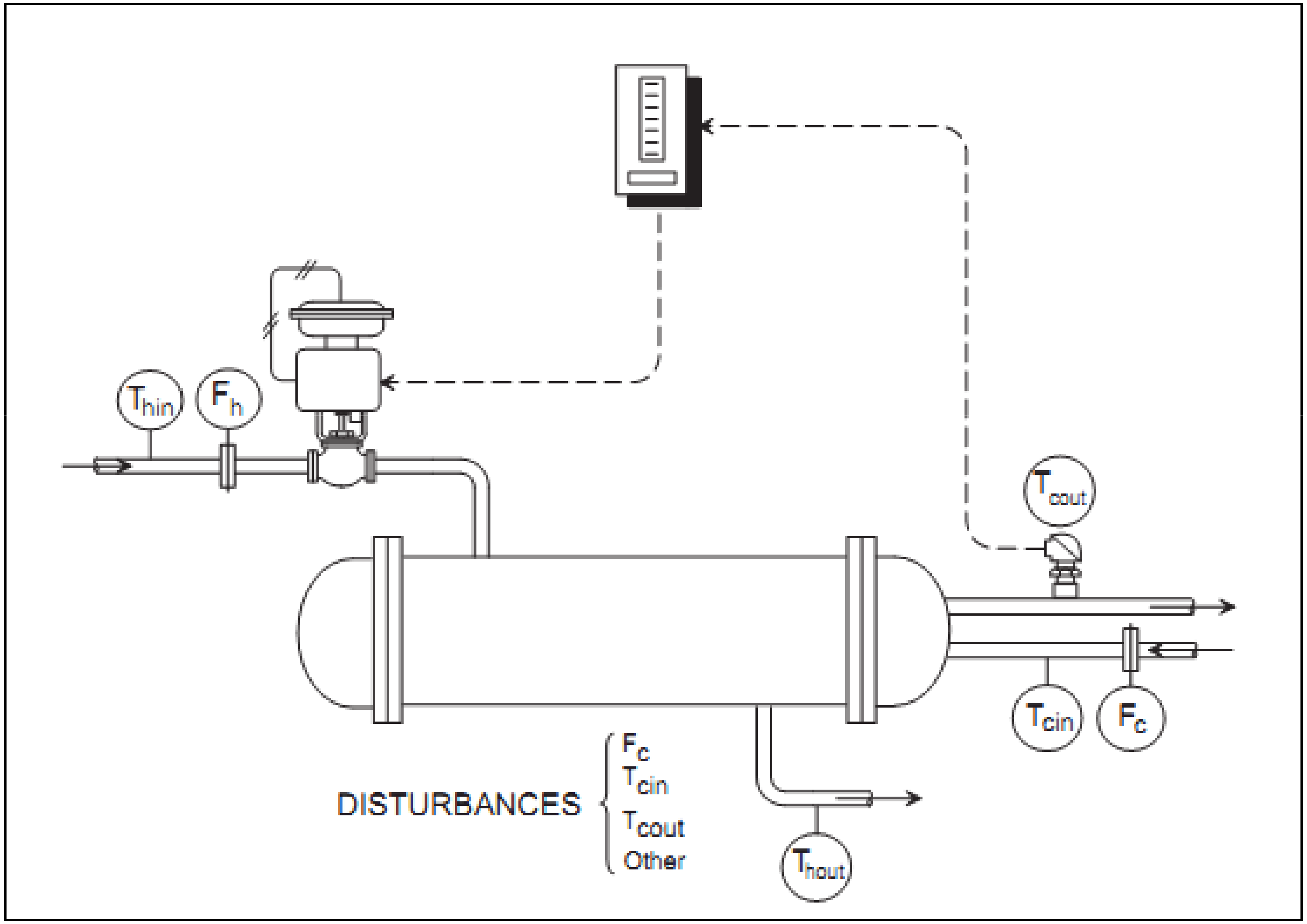


Figure 3-1. Disturbances to a Control Loop

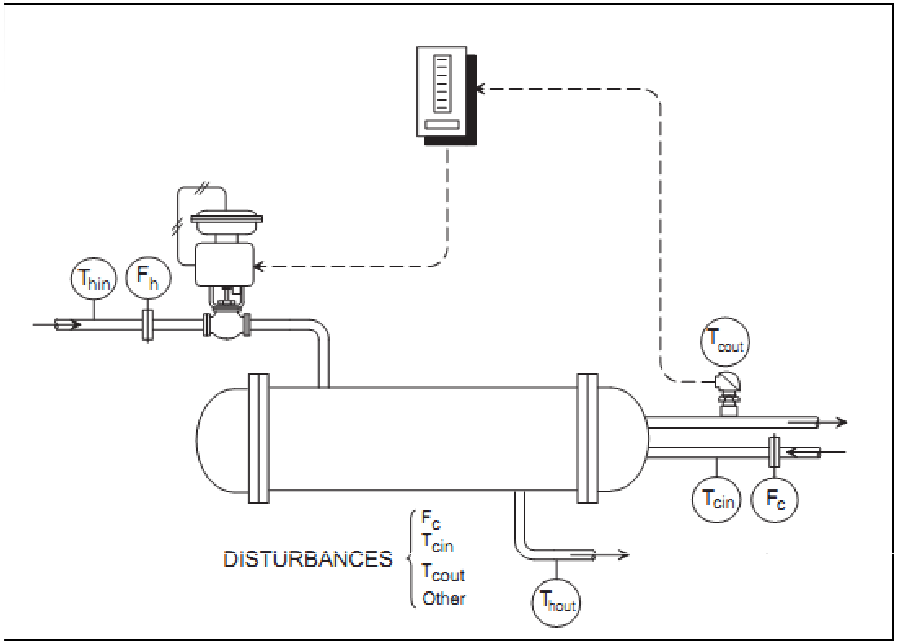
PROCESS AND CONTROL LOOP CHARACTERISTICS

- Changes in the process flow rate, Fc;
- Changes in the process inlet temperature, Tcin;
- Changes in the source temperature of the heating medium, Thin;
- Changes in the upstream or downstream pressure of the heating medium.

(This would change the hot stream flow rate, Fh, even though the valve position did not change.)

- Scaling of the heat exchanger tubes—thus affecting the heat transfer coefficient; and
- Environmental effects, if the heat exchanger is not perfectly insulated.

PROCESS AND CONTROL LOOP CHARACTERISTICS



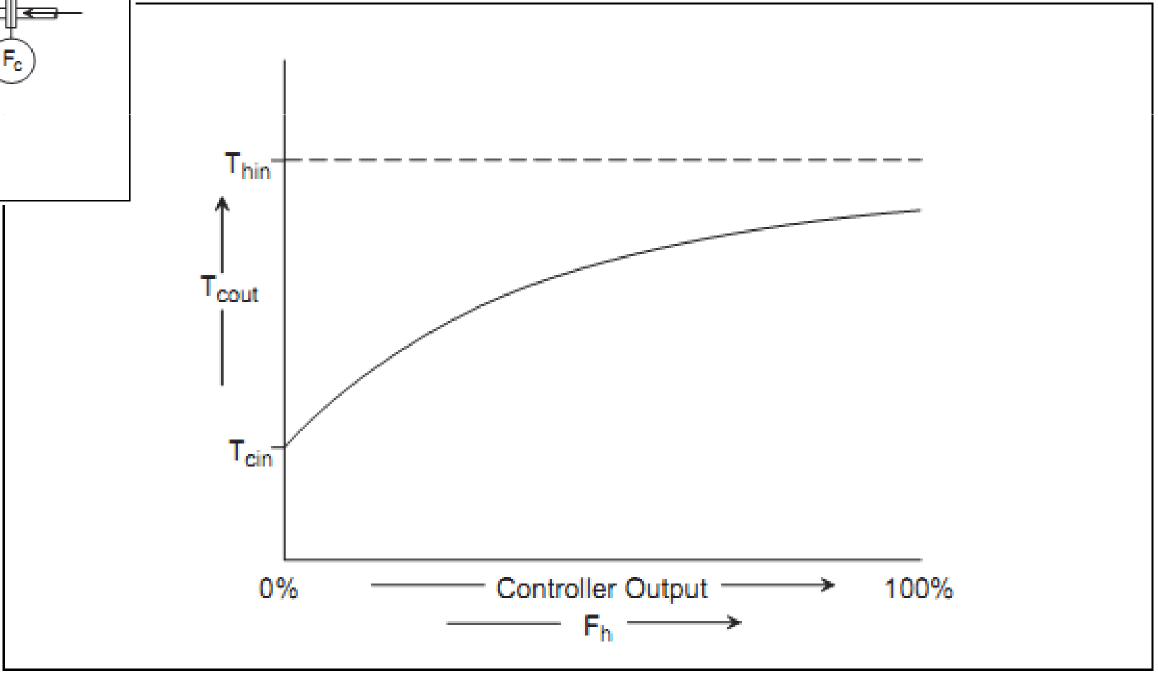


Figure 3-2. The Process Graph

PROCESS AND CONTROL LOOP CHARACTERISTICS

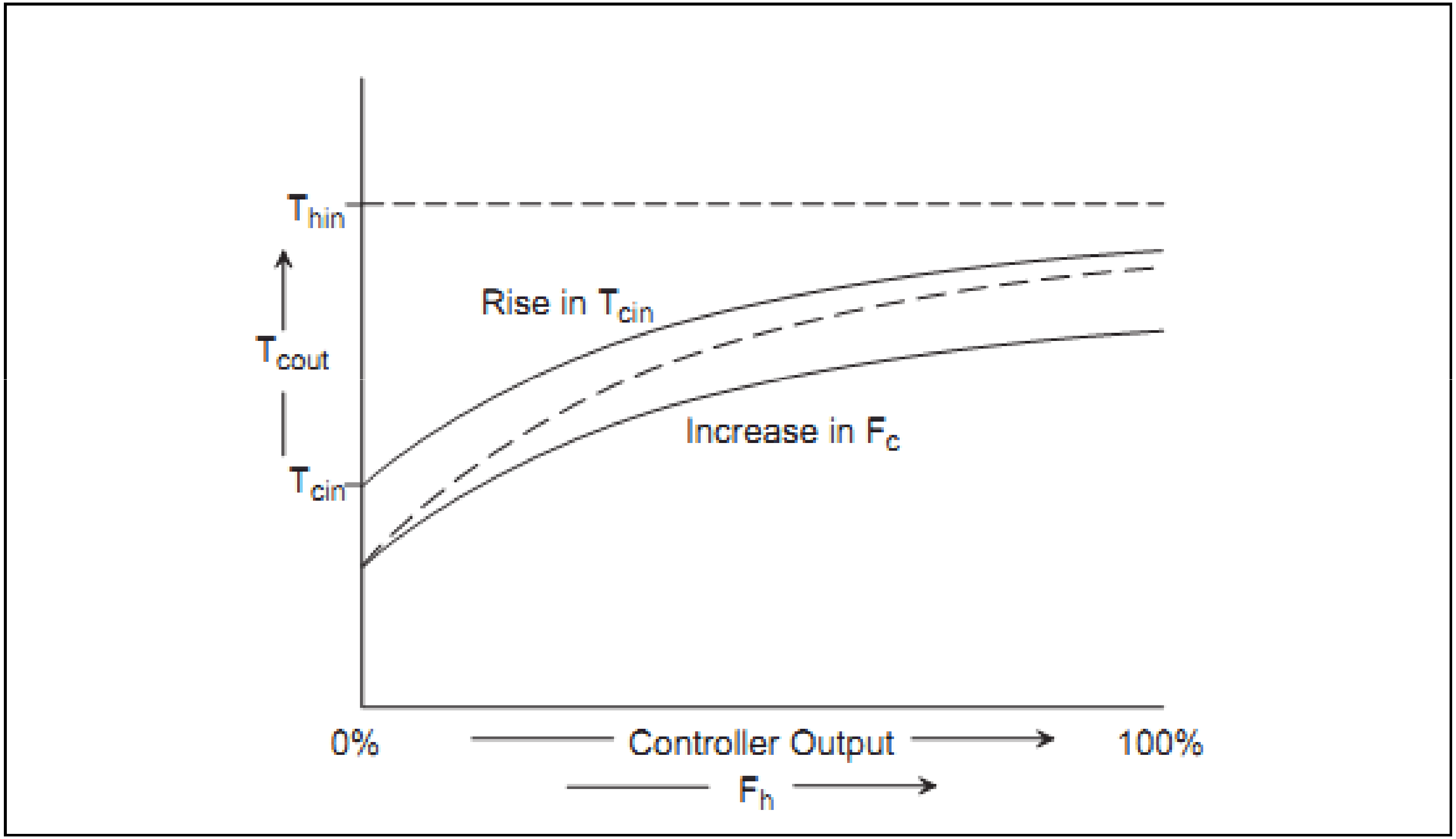
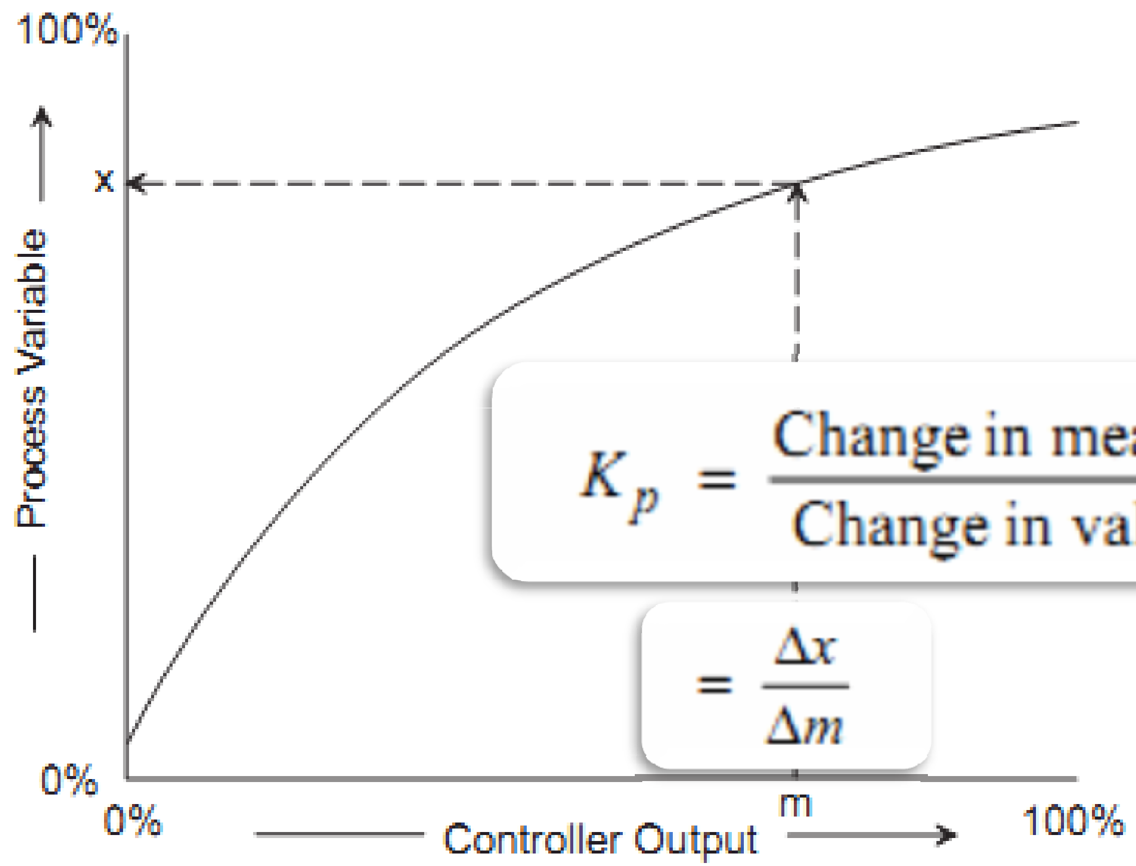


Figure 3-3. The Shifting of a Process Graph As a Result of Disturbances

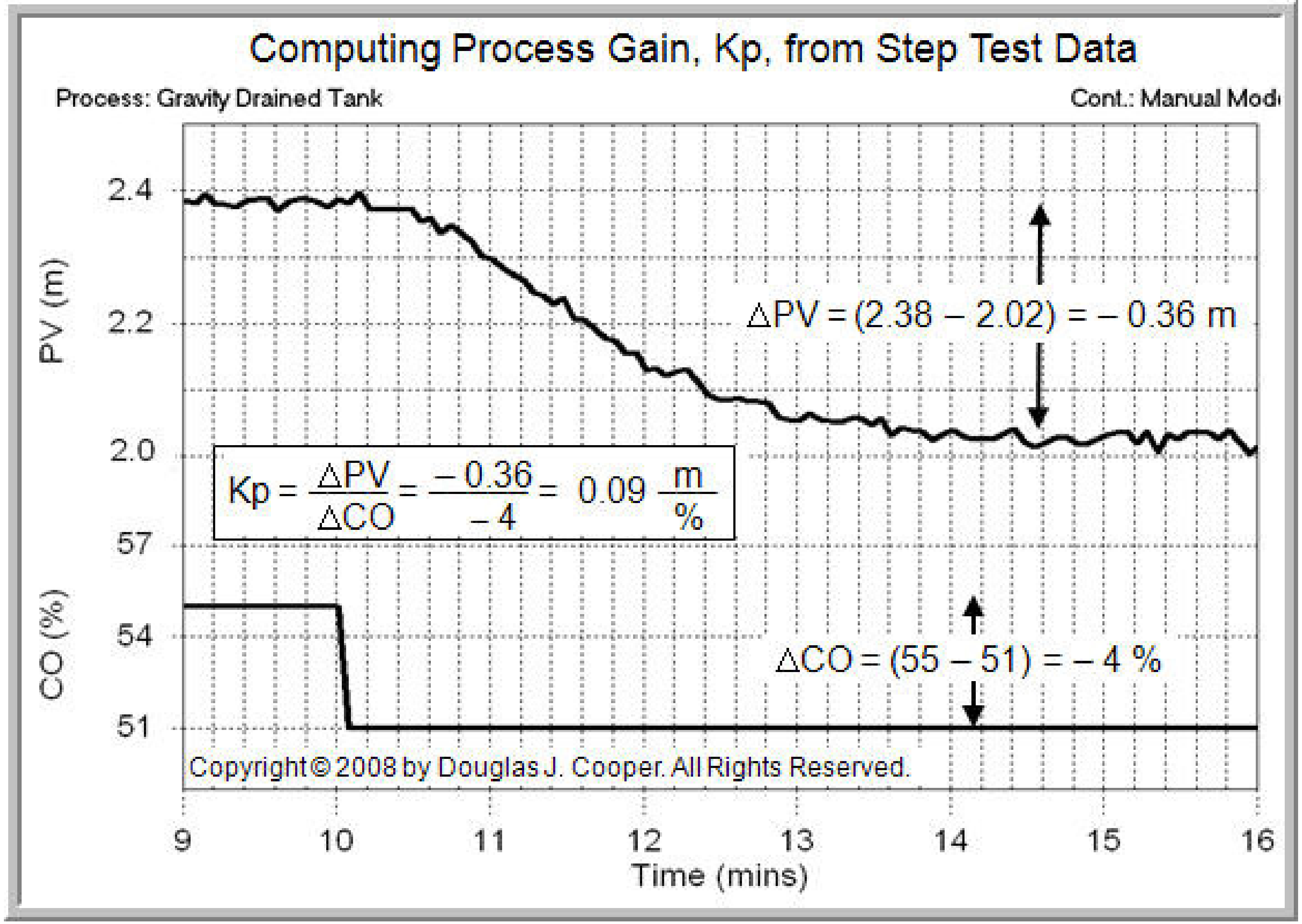
PROCESS AND CONTROL LOOP CHARACTERISTICS



$$K_p = \frac{\text{Change in measurement}}{\text{Change in valve signal}}$$

$$= \frac{\Delta x}{\Delta m}$$

Figure 3-4. The Process Graph Determines the Controller Output Required to Bring the Measurement to a Desired Value


Computing Process Gain, Kp, from Step Test Data
Process: Gravity Drained Tank
Cont.: Manual Mod
PV (m)
2.4
2.2
2.0
ΔPV = (2.38 – 2.02) = – 0.36 m
Kp = ΔPV / ΔCO = – 0.36 / – 4 = 0.09 m / %
CO (%)
57
54
51
ΔCO = (55 – 51) = – 4 %
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9
10
11
12
13
14
15
16
Time (mins)

PROCESS AND CONTROL LOOP CHARACTERISTICS

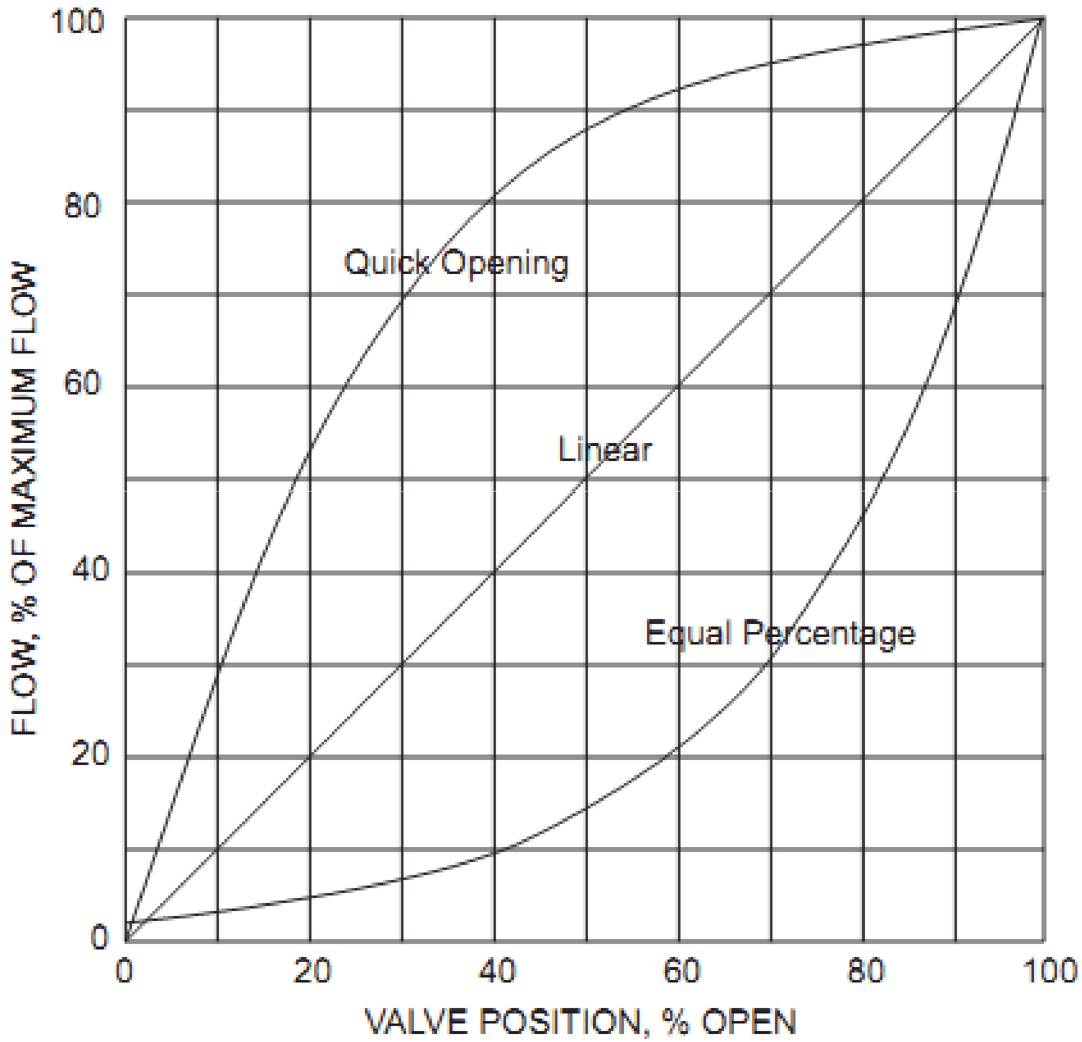


Figure 3-5. With Constant ΔP across the Valve, Flow versus Valve Position Follows the Manu-factured Characteristics

PROCESS AND CONTROL LOOP CHARACTERISTICS

$$\frac{\text{Minimum } \Delta P \text{ (when valve is wide open)}}{\text{Maximum } \Delta P \text{ (when valve is closed)}}$$

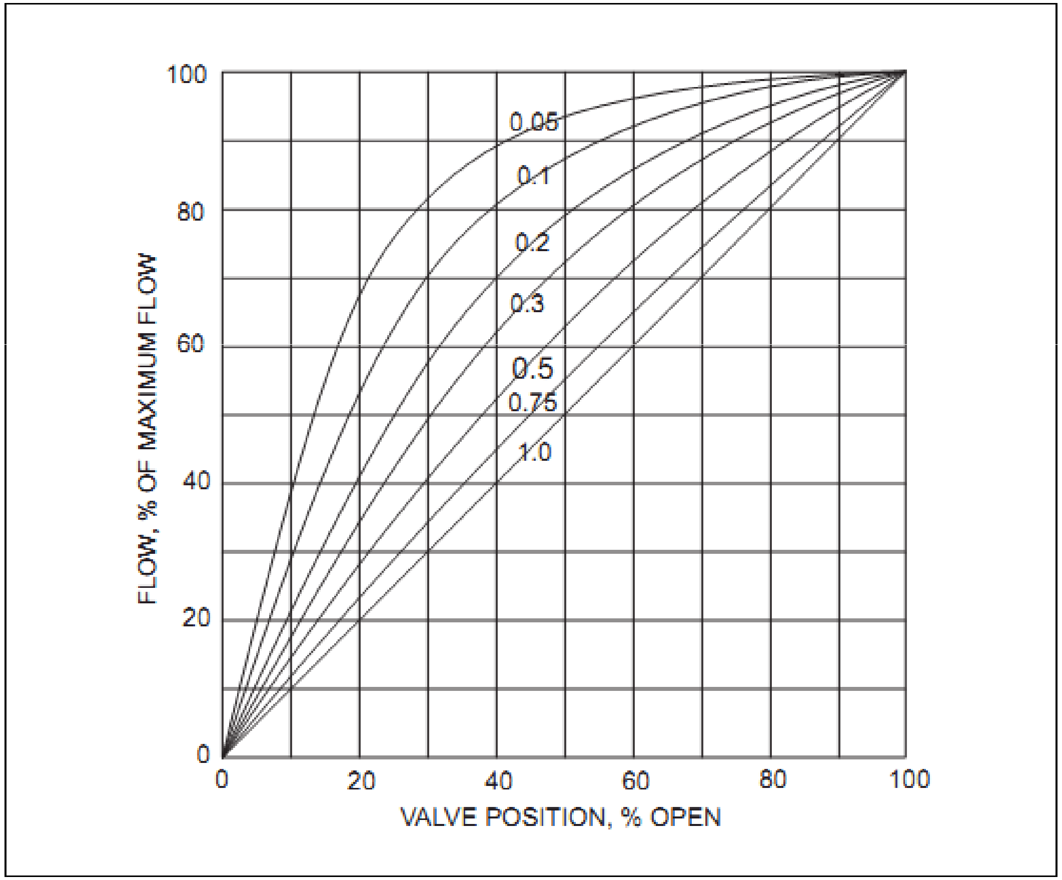
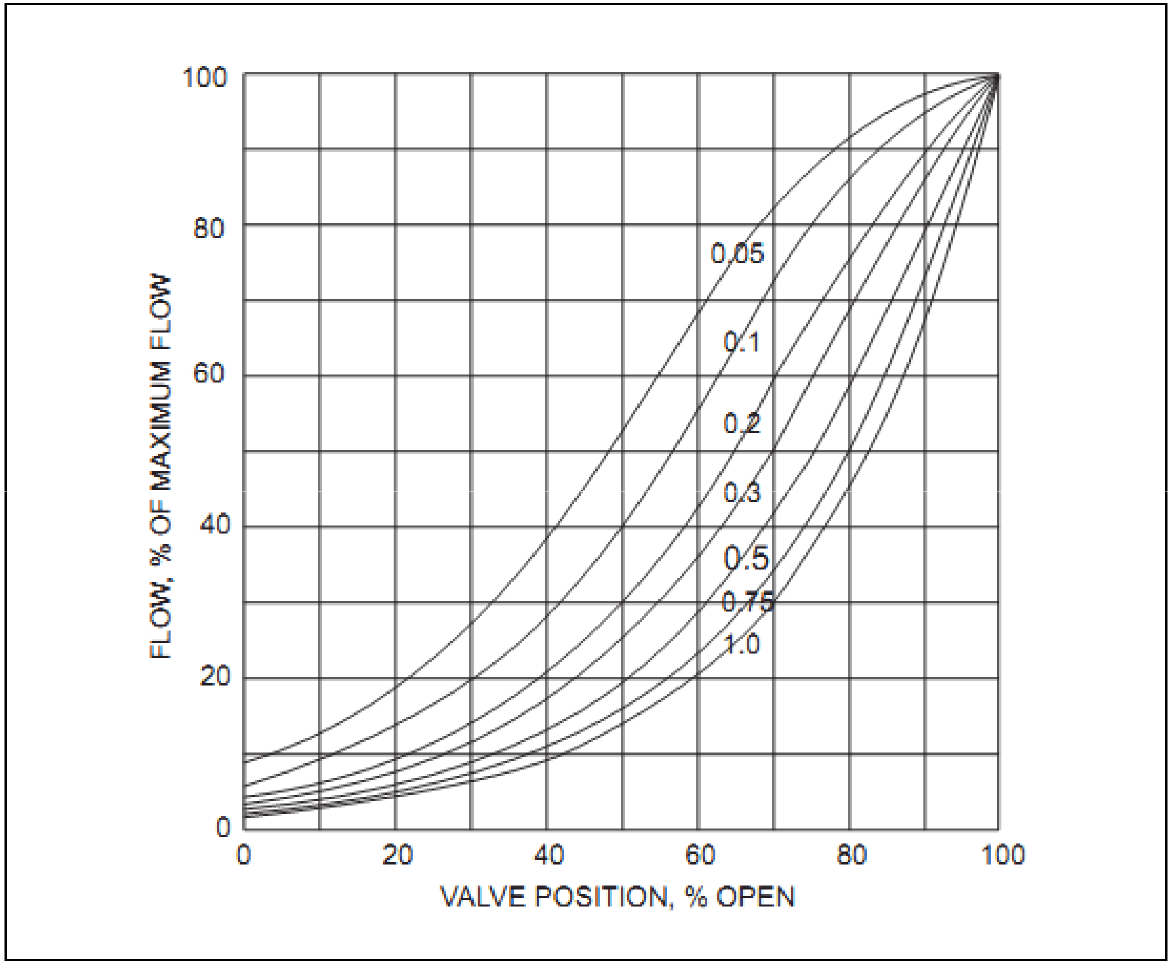


Figure 3-6. Installed Characteristics for a Linear Valve for a Range of Pressure Drop

PROCESS AND CONTROL LOOP CHARACTERISTICS



Ratios: $\dfrac{\text{Minimum } \Delta P}{\text{Maximum } \Delta P}$

DYNAMIC CHARACTERISTIC

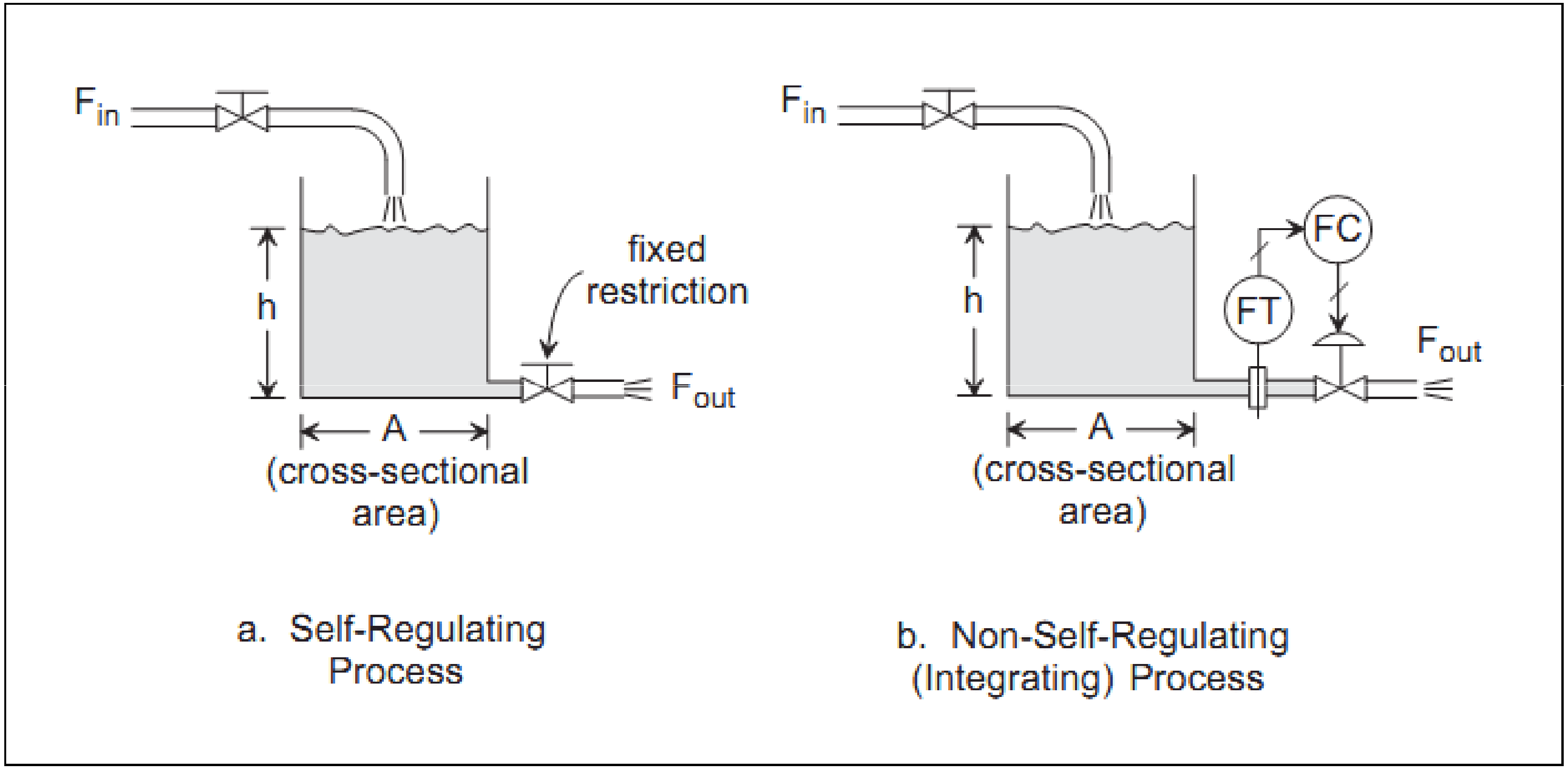


Figure 3-8. Hydraulic Analogies of Common Types of Process Characteristics

PROCESS AND CONTROL LOOP CHARACTERISTICS

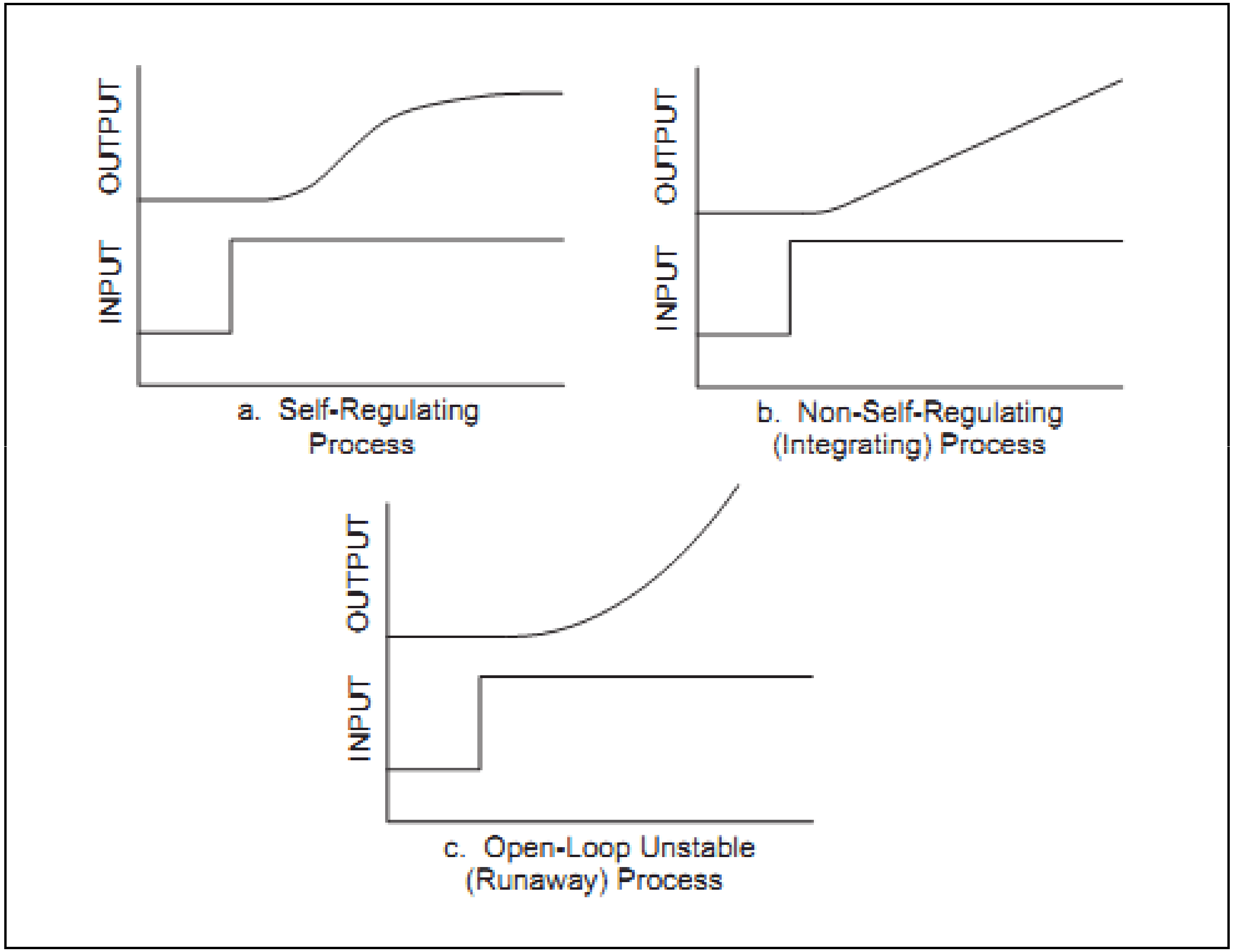


Figure 3-9. Step Input Response of Common Types of Process Characteristics

PROCESS AND CONTROL LOOP CHARACTERISTICS

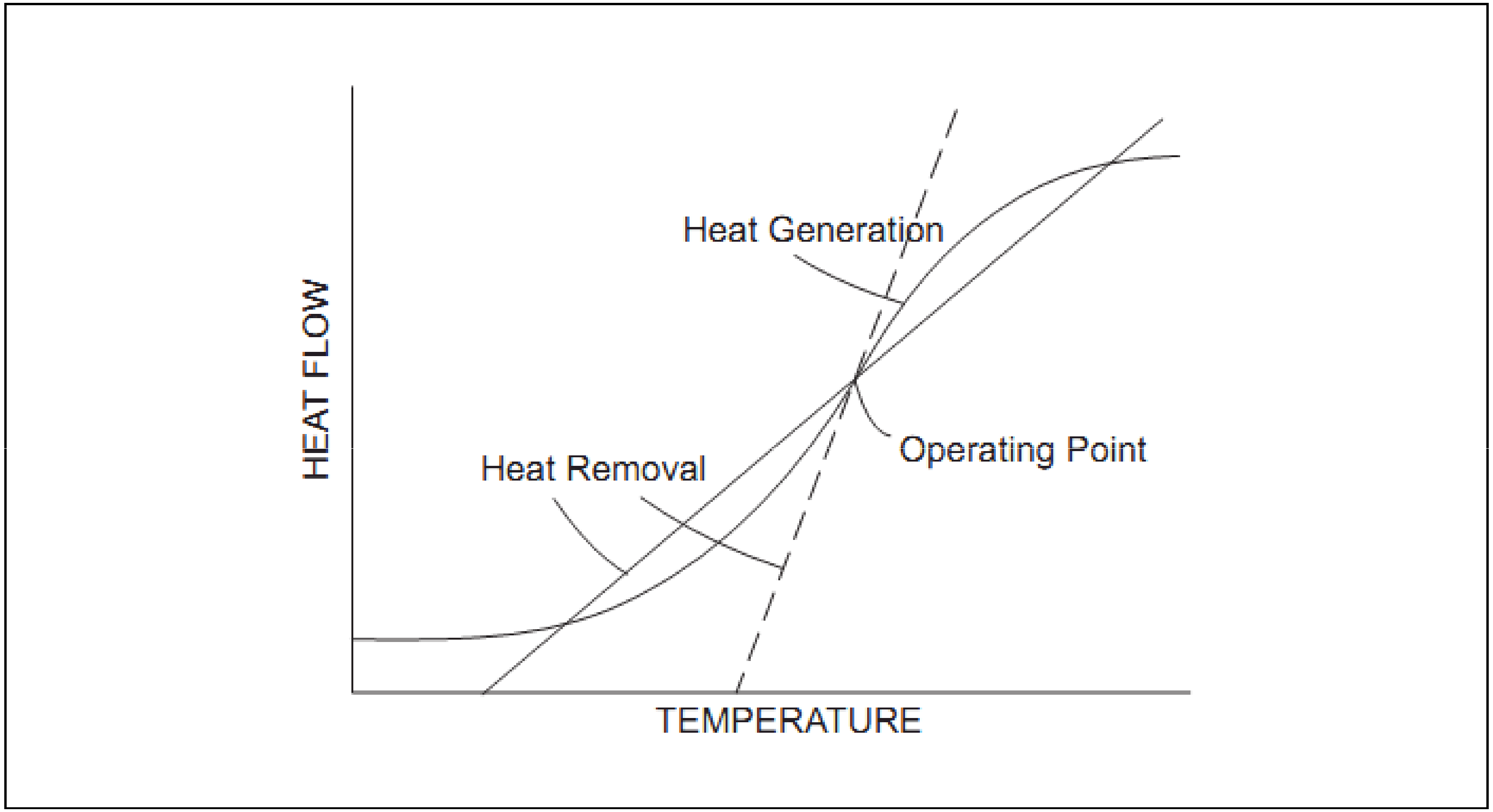


Figure 3-10. Heat Flow versus Temperature Curves for Exothermic Reactor

PROCESS AND CONTROL LOOP CHARACTERISTICS

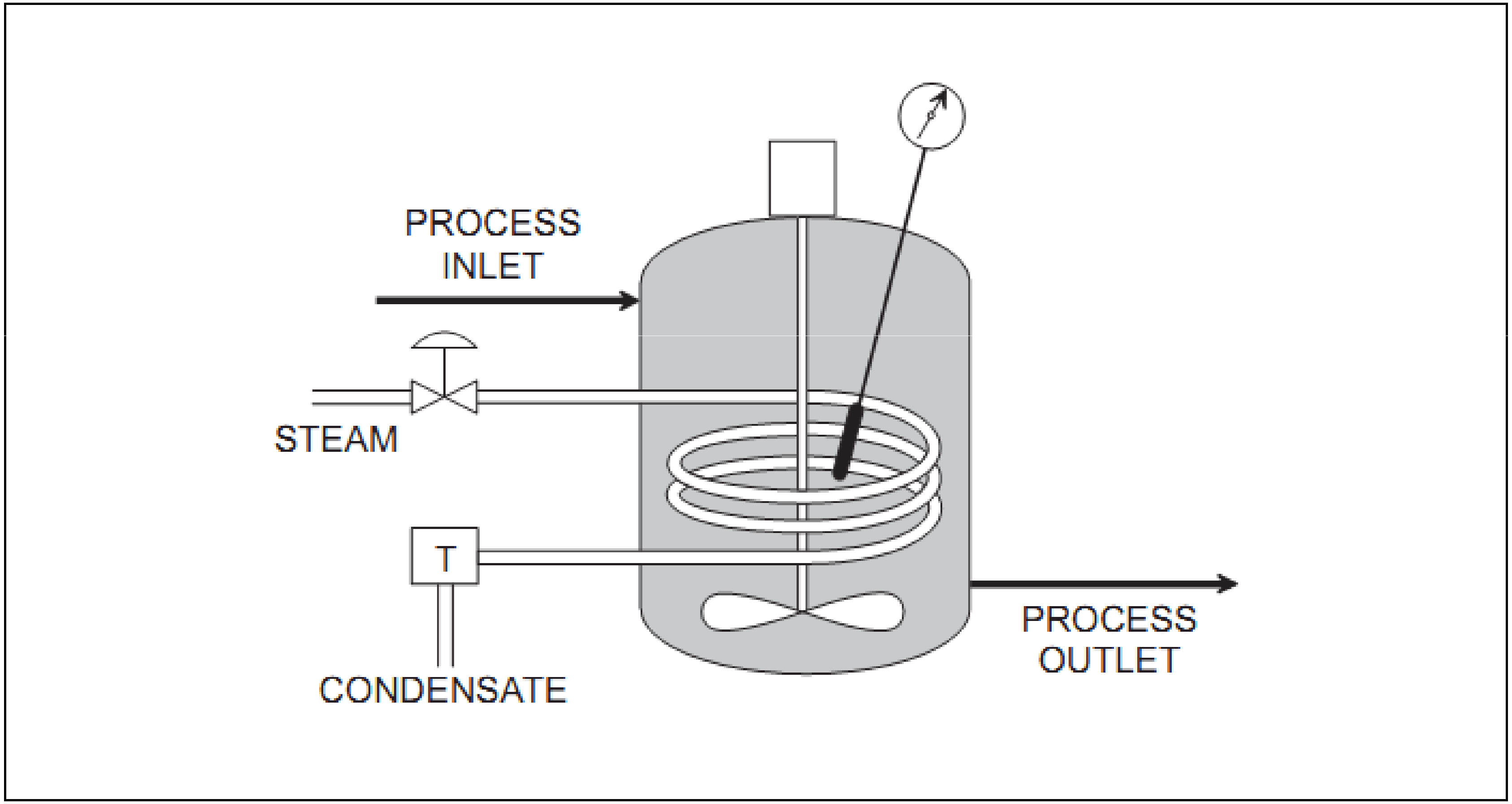
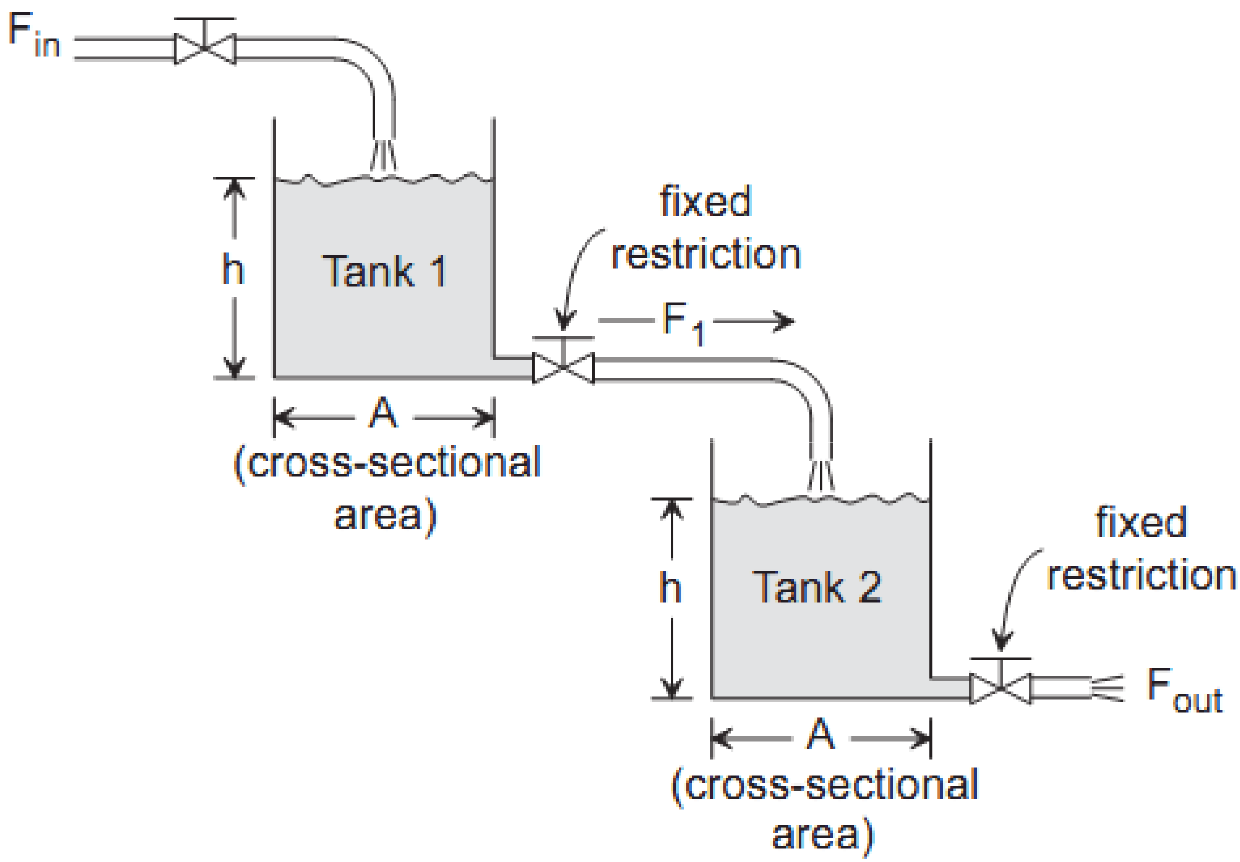


Figure 3-11. Process with Single Point of Energy Storage

PROCESS AND CONTROL LOOP CHARACTERISTICS



a. Uncoupled First-order Lags

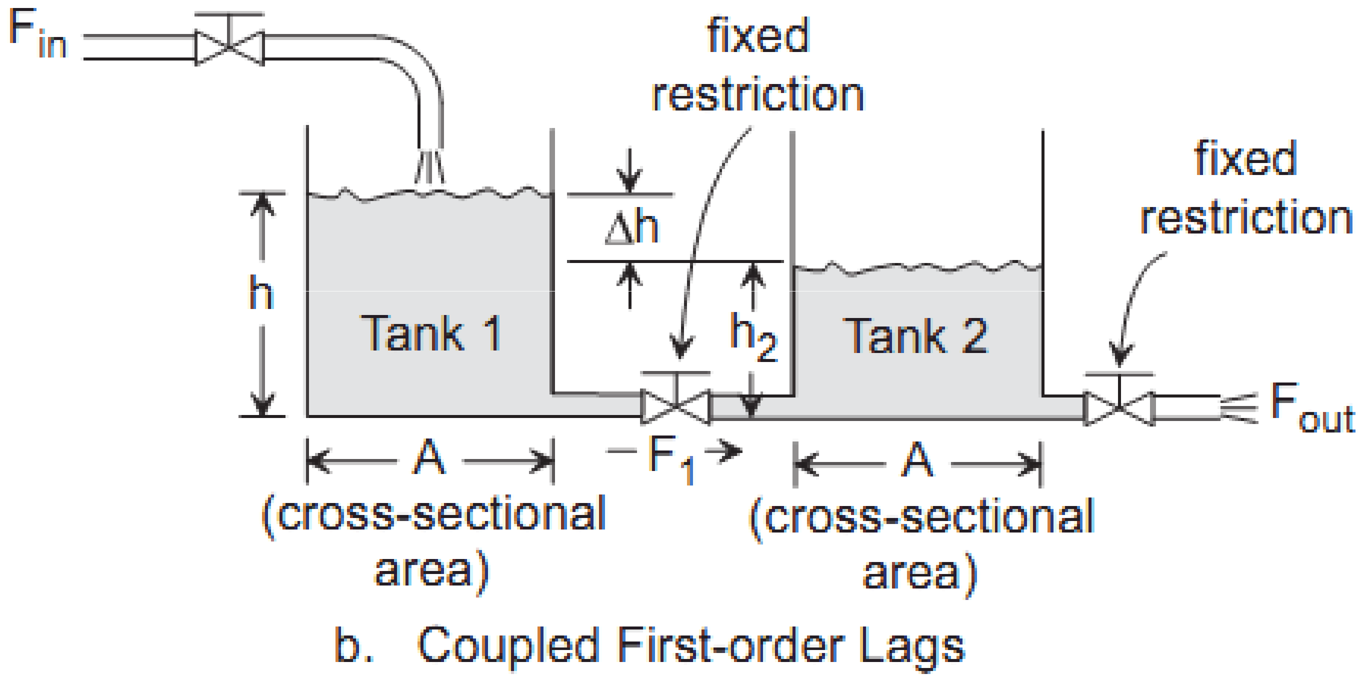


Figure 3-12. Hydraulic Analogies for Two Points of Mass Storage

PROCESS AND CONTROL LOOP CHARACTERISTICS

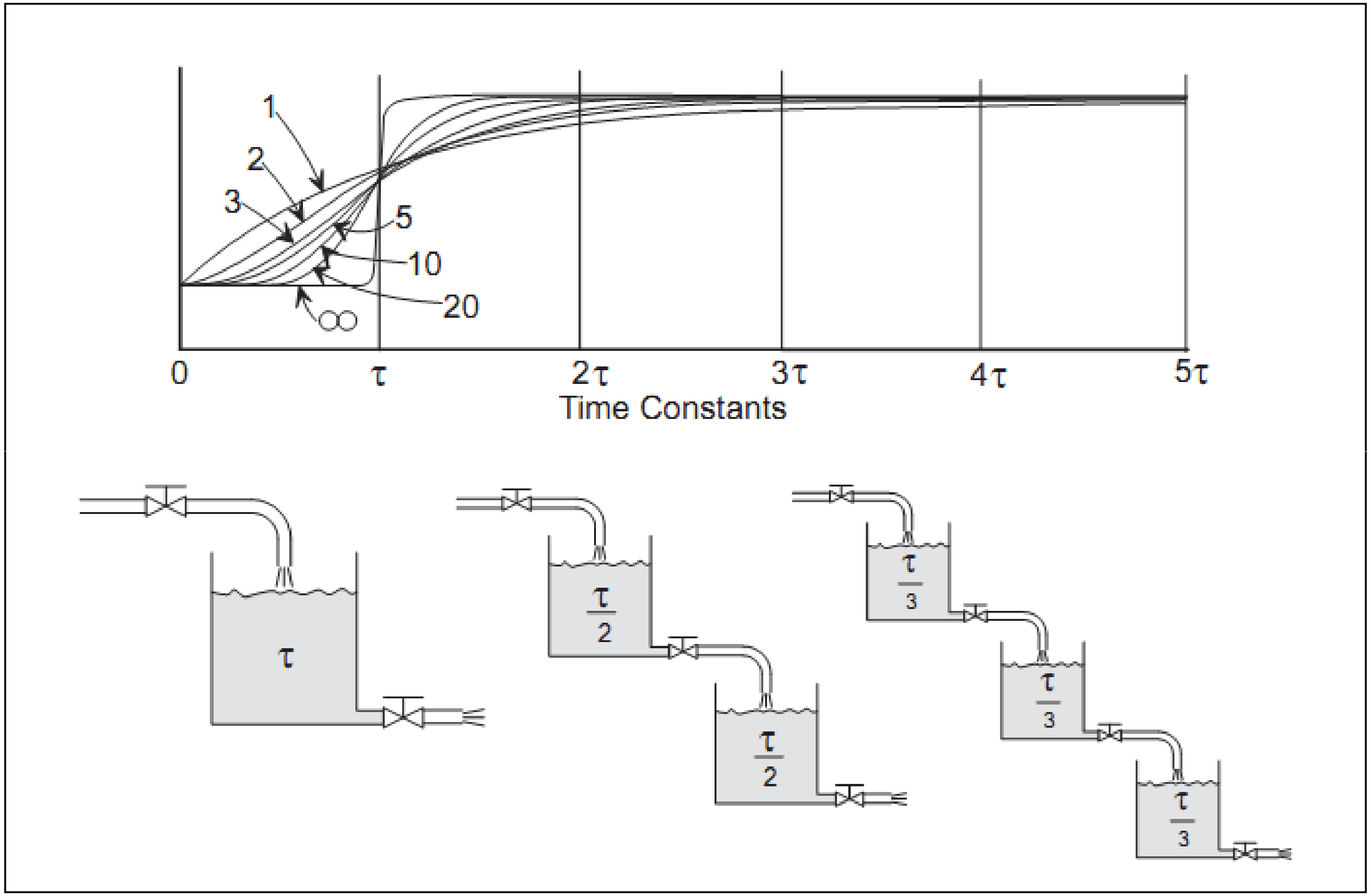


Figure 3-13. The Response of Multiple Uncoupled First-order Lags in Series

PROCESS AND CONTROL LOOP CHARACTERISTICS

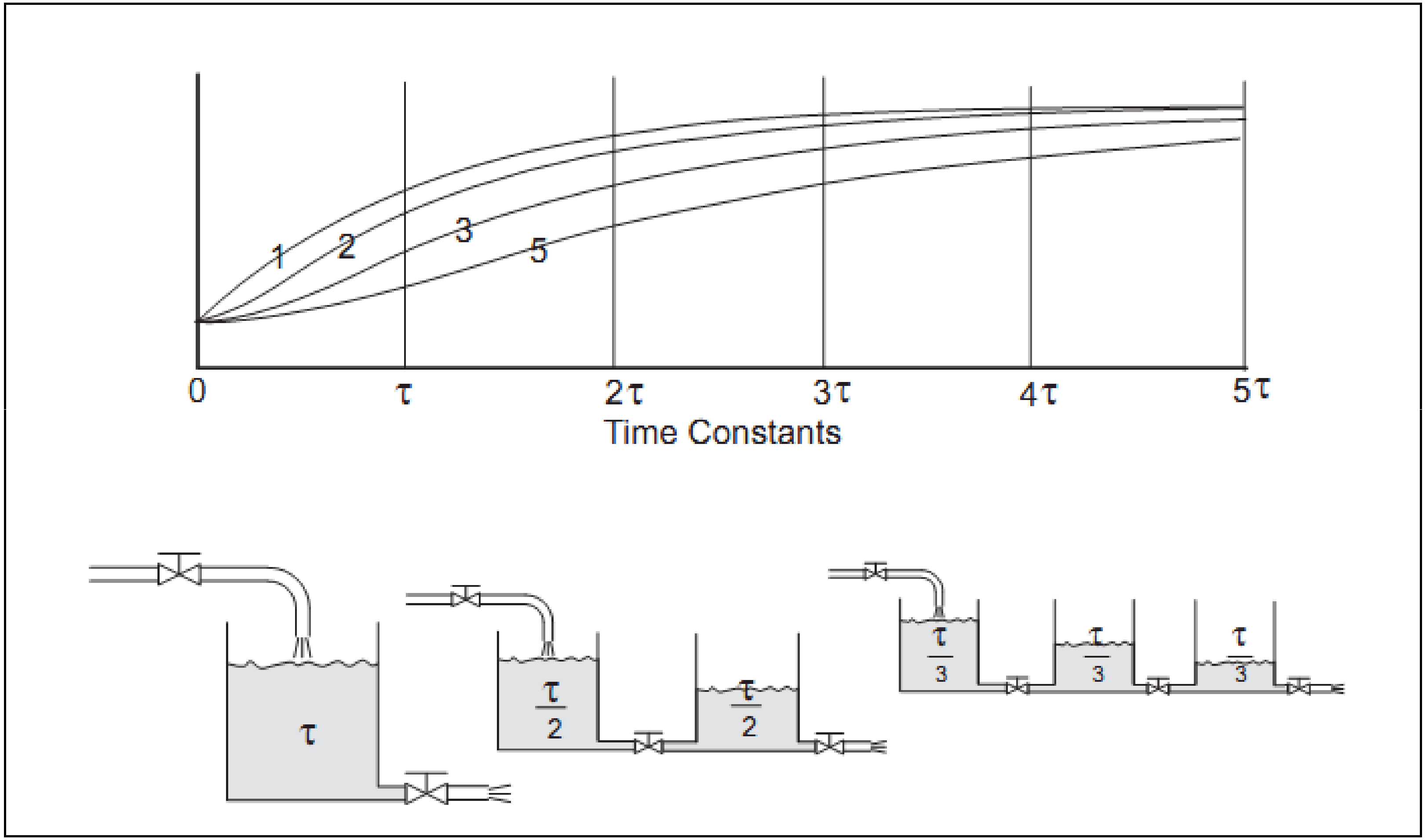


Figure 3-14. The Response of Multiple Coupled First-order Lags in Series

PROCESS AND CONTROL LOOP CHARACTERISTICS

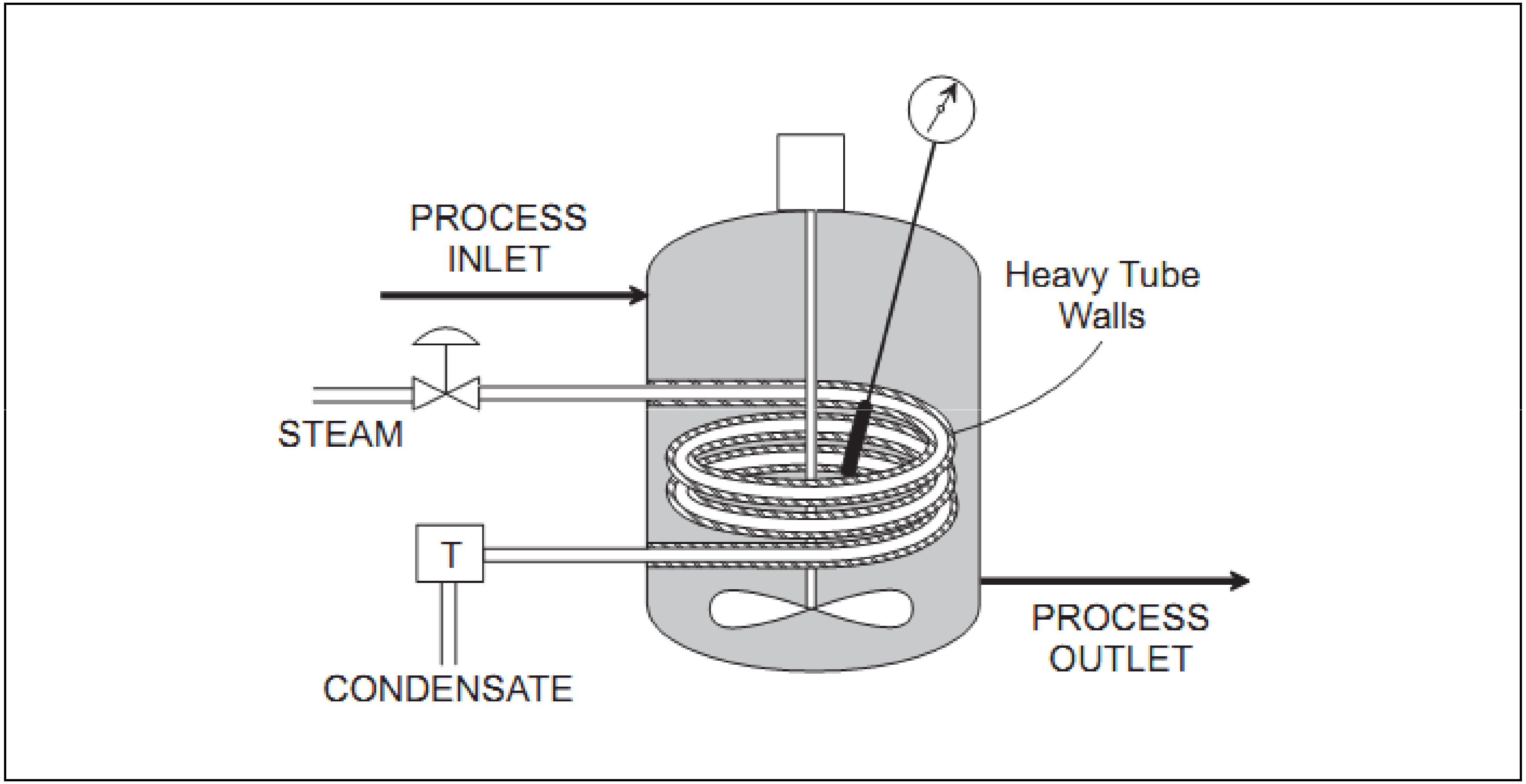


Figure 3-15. Example of Coupled First-order Lags

PROCESS AND CONTROL LOOP CHARACTERISTICS

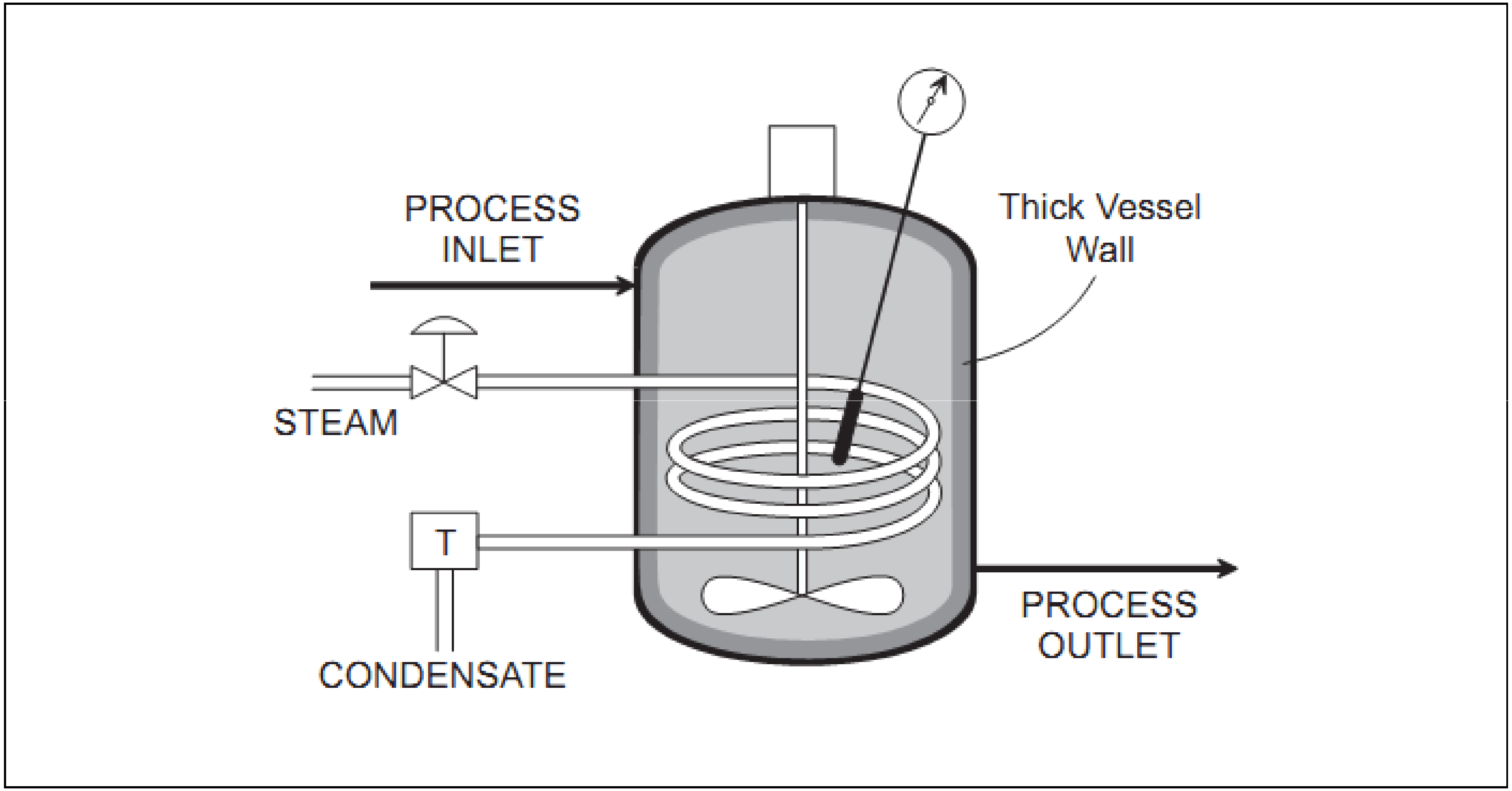


Figure 3-16. Example of Side Lag

PROCESS AND CONTROL LOOP CHARACTERISTICS

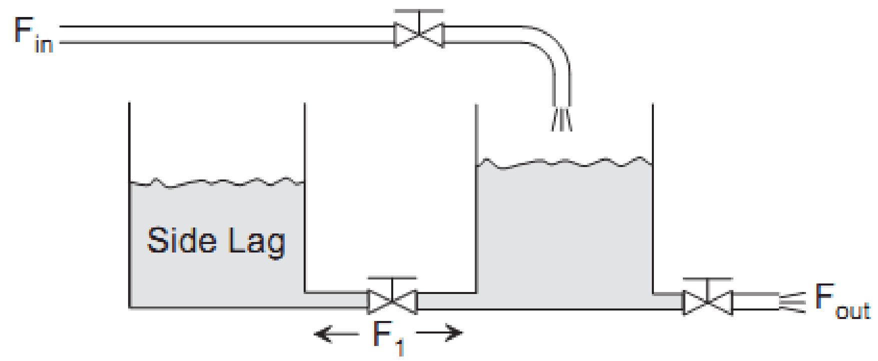


Figure 3-17. Hydraulic Analogy of Side Lag

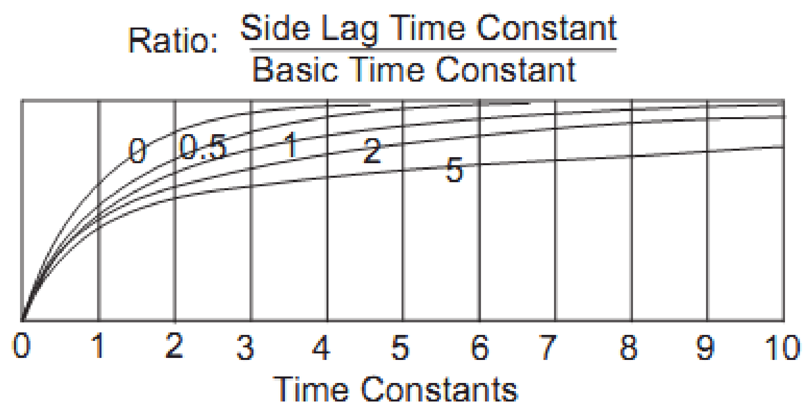


Figure 3-18. Response of Basic Lag Plus Side Lag

PROCESS AND CONTROL LOOP CHARACTERISTICS

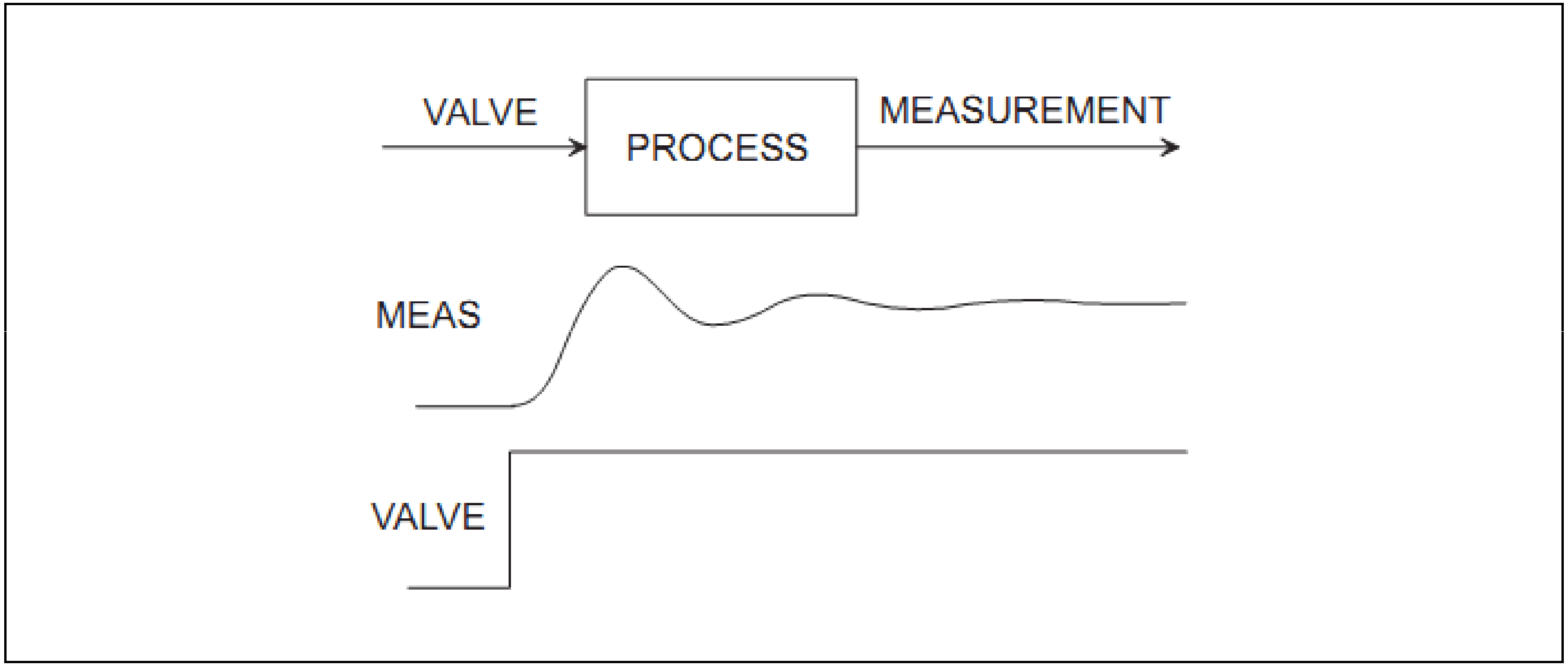


Figure 3-19. Open-Loop Response: Damped Oscillatory Behavior

PROCESS AND CONTROL LOOP CHARACTERISTICS

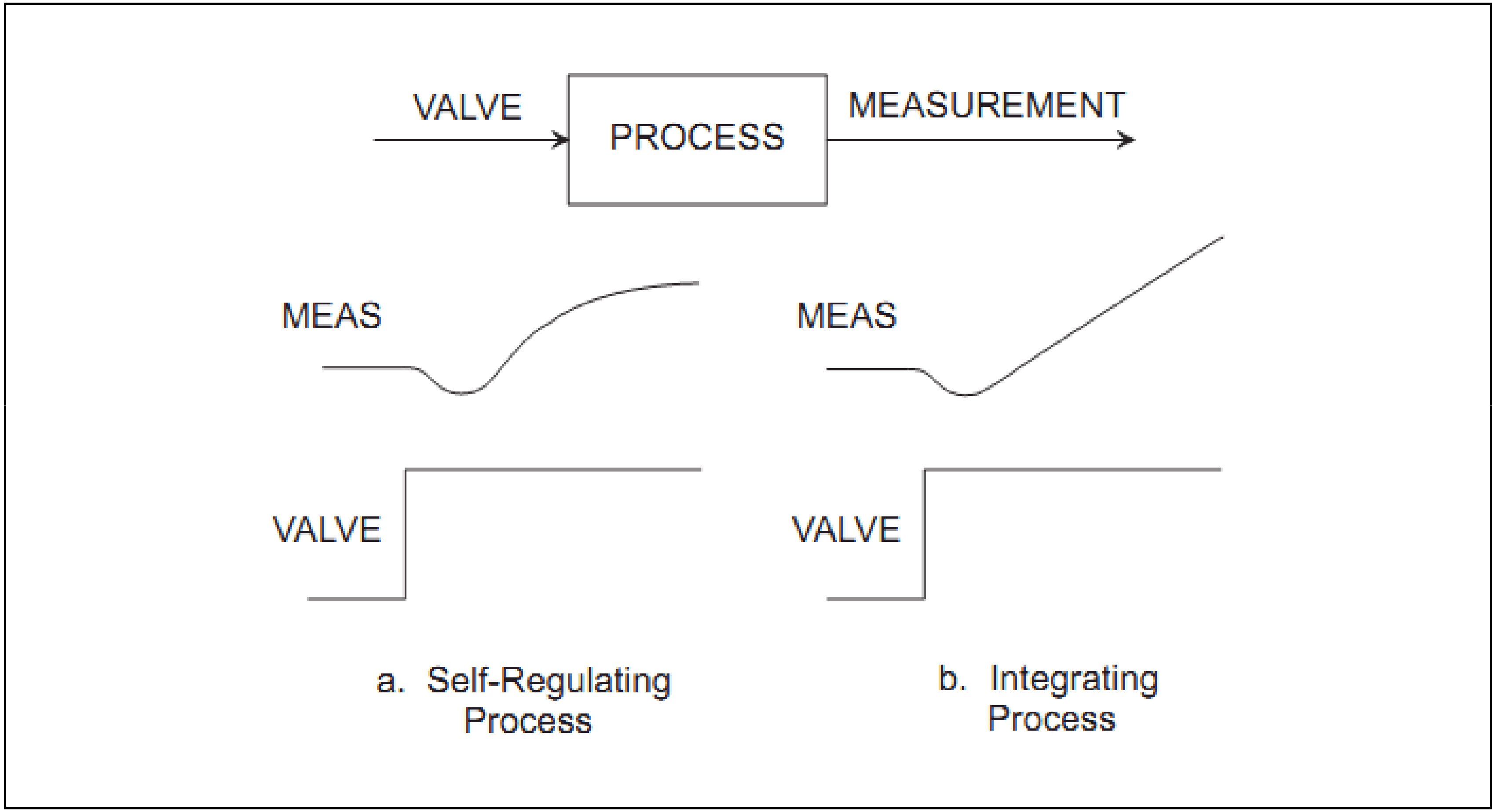


Figure 3-20. Inverse Open-loop Response

PROCESS AND CONTROL LOOP CHARACTERISTICS

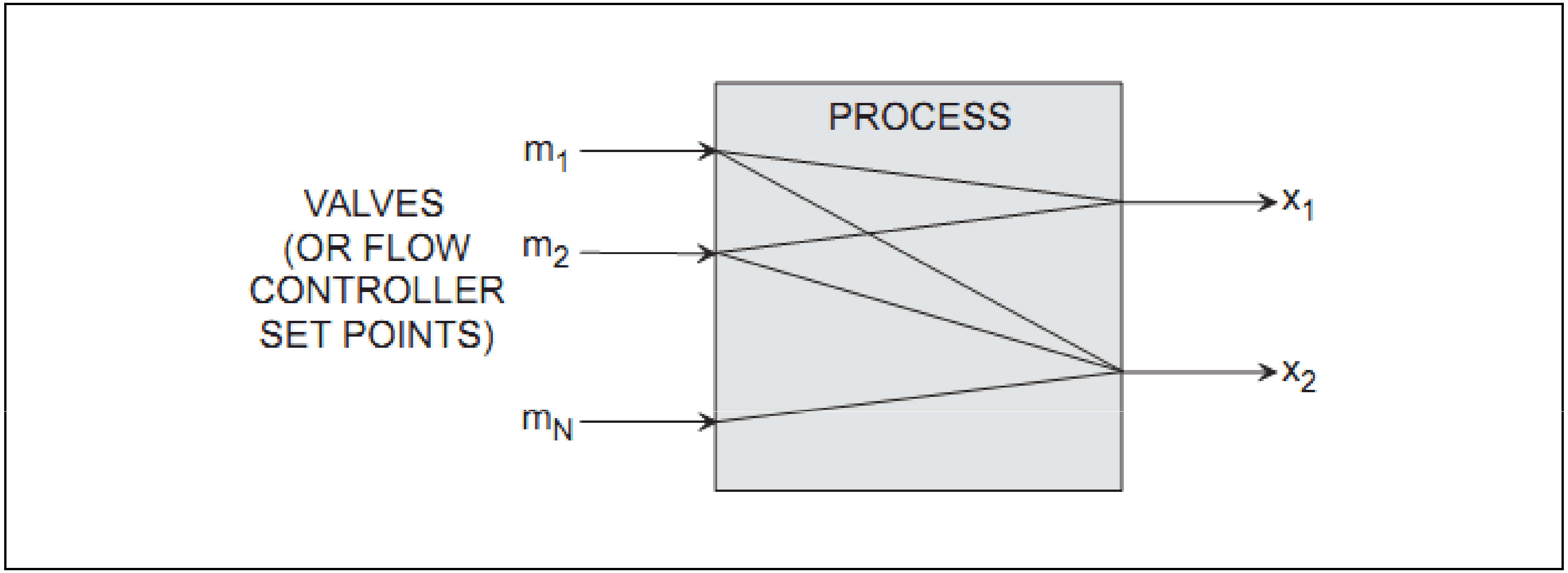


Figure 3-21. Multiple-Input, Multiple-Output Processes (Interacting Control Loops)

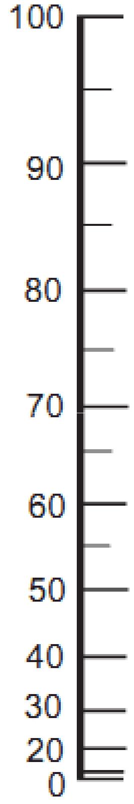
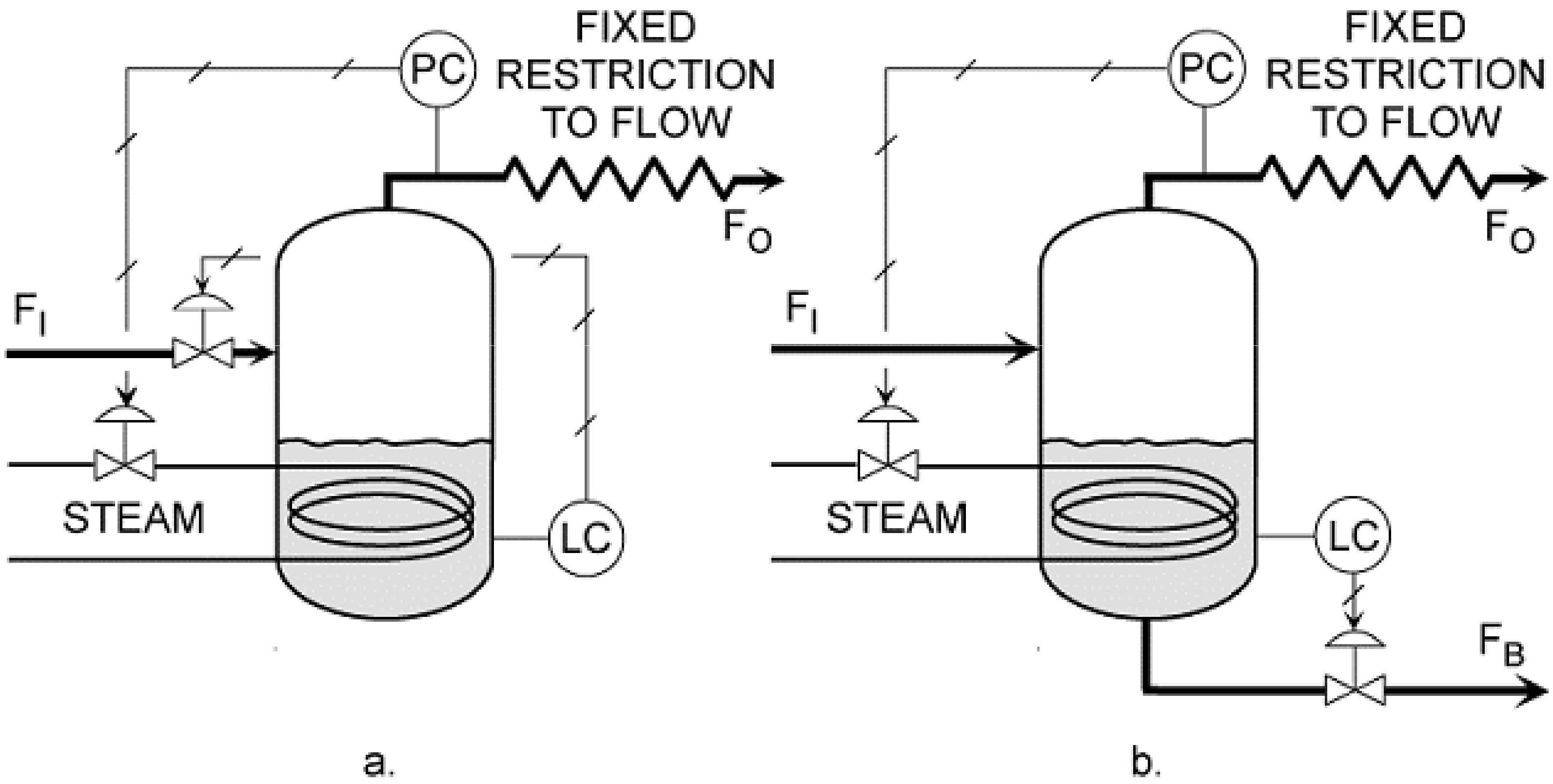


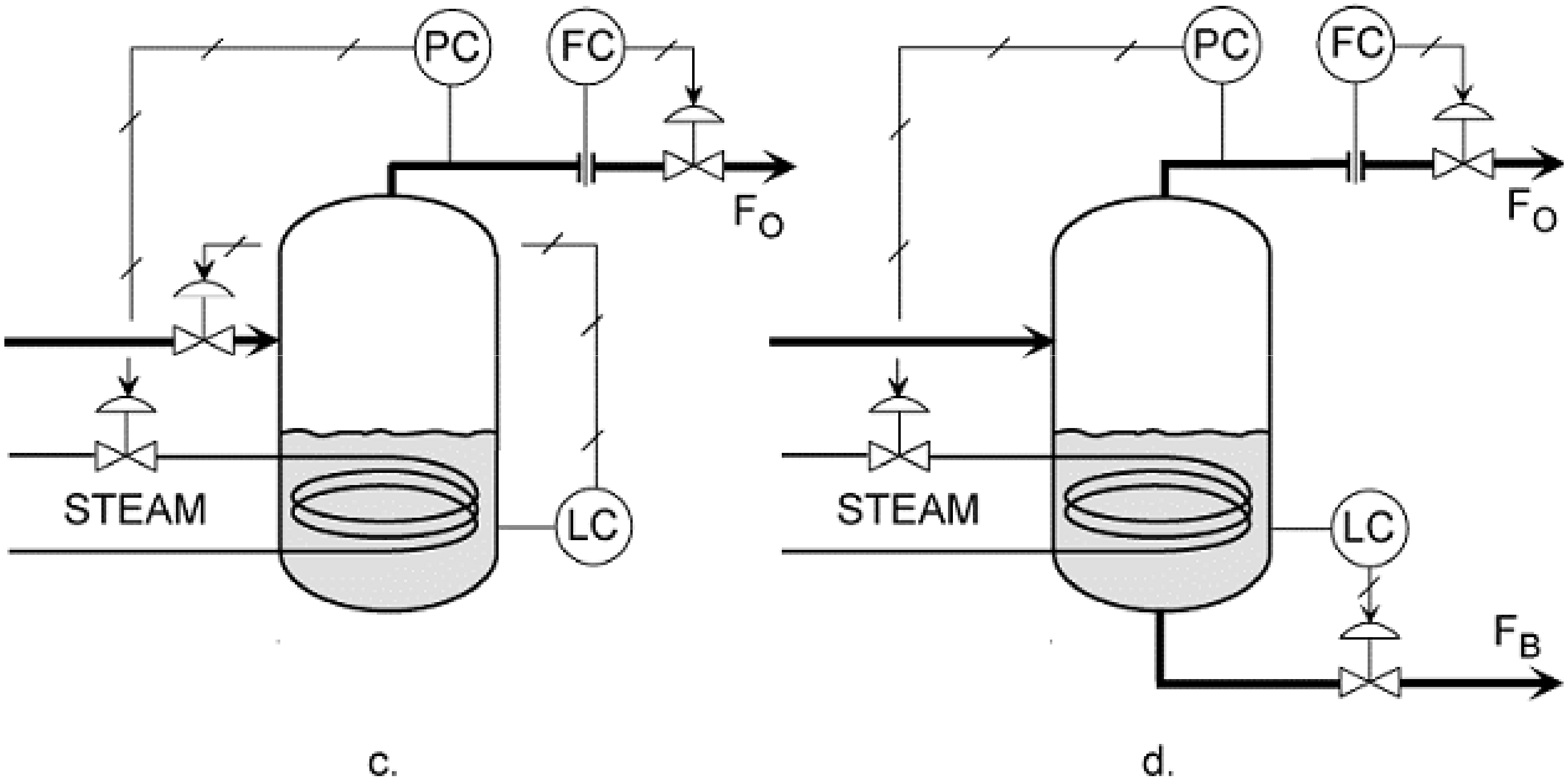
Figure 3-22. Nonlinear Display Scale When Flow Is Measured by a Differential Pressure Sensor without Square Root Extraction

PROCESS AND CONTROL LOOP CHARACTERISTICS



The Pressure Loop Controls a Self-Regulating Process

PROCESS AND CONTROL LOOP CHARACTERISTICS



The Pressure Loop Controls an Integrating Process

PROCESS AND CONTROL LOOP CHARACTERISTICS