



## Final Control Elements

### Course 279: Final Control Elements

Covers how elements in a closed-loop system affect final control element. Describes components in final control subsystems. Discusses operations of solenoids, motors, relay systems, and PLCs. Explains pneumatic actuators and positioners. Describes mechanical advantage in several hydraulic control systems. Compares construction, characteristics, and applications of eight control valves. Traces operation of each element in typical feedwater, turbine, and robotic control systems.

TPC Training is accredited by IACET to offer **0.5 CEU** for this program.



#### Lesson 1: Final Control Elements in Process Loops

##### Topics

What is a Final Control Element?; Compensation; Feedback Loops; A Typical System with Feedback; Effects of Disturbances on Performance; Parts of a Final Control Subsystem; Electrical Control Signals; Amplifiers; Digital Signals; Fluidic Control Signals

##### Objectives

- Discuss the function of final control elements in process loops.
- Explain how an actuator is used with the final control element.
- Discuss the effect of a disturbance on the performance of a process loop.
- Describe the three parts of a final control element subsystem.
- Discuss the differences between electric and fluidic control signals in the operation of final control elements.

#### Lesson 2: Electric Actuators

##### Topics

Solenoids; Solenoid-Operated Valves; Electric Motors; DC Motors; AC Motors; Three-Phase Induction Motors; Single-Phase Induction Motors; Stepper Motors; Relay Systems; Programmable Logic Controllers

##### Objectives

- Describe the operation of a solenoid with a valve.
- Name the basic components of dc and ac electric motors and explain how they work.
- Discuss the advantages of universal motors and stepper motors.
- Explain how an electromechanical relay works.
- Name at least three kinds of relays in use today and give typical applications for them.
- Discuss the applications and advantages of programmable logic controllers.

#### Lesson 3: Pneumatic and Hydraulic Actuators

##### Topics

Pneumatic Actuators; Effects of Changing Pressure; Relationship of Pressure, Volume, and Temperature; Effects of Changing Temperature; Diaphragm Actuators; Piston Actuators; Positioners; Hydraulic Actuators; Hydraulic Principles; Mechanical Advantage; One-Way Hydraulic System; Two-Way Hydraulic System; Uses for Hydraulic Systems; Hydraulic Fluid; Hydraulic Maintenance

##### Objectives

- Describe the basic principles of operation for both pneumatic and hydraulic actuators.
- Discuss the relationships among pressure, temperature, and volume in a pneumatic system.
- Compare the operation of direct- and reverse-acting actuators.
- Describe the major components of a simple hydraulic system.
- Discuss the characteristics of proper hydraulic fluid and describe elements of hydraulic system maintenance.

#### Lesson 4: Control Valves

##### Topics

Control Valve Components; Kinds of Control Valves; Globe Valves; Cage Valves; Butterfly Valves; Ball Valves; Sliding-Gate Valves; Diaphragm Valves; Split-Body Valves; Proportional/Servo Valves; Other Control Valves; Control Valve Flow Characteristics; Mechanical Requirements; Selecting Control Valves

##### Objectives

- Describe the components of a control valve.
- Compare the operation and advantages of globe, cage, butterfly, ball, sliding-gate, diaphragm, and split-body valves.
- Discuss the operation, advantages, and disadvantages of proportional/servo valves.
- Explain the differences in linear, quick-opening, and equal-percentage flow characteristics.
- Discuss mechanical requirements for valves and valve actuator requirements.
- Explain the relationship of flashing and cavitation to proper control valve selection.

#### Lesson 5: Final Control Element Applications

##### Topics

Feedwater Control Systems; How the Feedwater Control System Works; Sequential Valve Control; Control and Block Valves; Relay Logic; Automatic Valve Control; Turbine Control Systems; Robotic Systems

##### Objectives

- Describe the sequential valve control used in a typical feedwater control system.
- Describe a typical relay logic system.
- Discuss the use of limit switches for automatic valve control.
- Describe the operation of a hydraulic fluid supply system for a turbine generator.
- Describe the operation of an industrial robotic system.