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Course Name

Pneumatic Control System Maintenance & Troubleshooting

Sector Name

Instrumentation & Controls

Document Type

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Pneumatic Control System Maintenance & Troubleshooting

Course Introduction

This program trains participants in the theory of pneumatic instrumentation and the principles of operation, characteristics, and capabilities of components typically found in pneumatic control loops.

This course introduces the principles of pneumatic instrument operation, and the terms force, pressure, and compressibility are defined. The operation of pneumatic air supply system components, including compressors, dryers, filters, and regulators, is explained. System maintenance and testing are also taught. Filter cartridge replacement and regulator maintenance are demonstrated.

Pneumatic transmitters

This course describes the features and operation of sensors used in pneumatic instruments, including Bourdon tubes, filled bulbs, diaphragm capsules, and bellows. It teaches how both force and motion-balance pneumatic transmitters operate and how transmitter components, such as flapper/nozzles, relays, and restrictors, are cleaned and maintained.

This course focuses on the operation and maintenance of pneumatic controllers and recorders. The lesson teaches how the bellows, relays, links, and levers within a controller are configured to provide proportional, integral, and derivative control modes, both in direct and reverse action. Common maintenance practices are covered, including relay and restrictor cleaning and replacement, along with controller and recorder calibration.

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Target Audience

✓ Control & Instrumentation Engineer
✓ Controls Technologist
✓ Instrumentation Technician / Systems Control Tech
✓ Senior Control & Instrumentation Engineer
✓ Maintaining Equipment Engineer
✓ Facilities I&E / Controls Engineer
✓ Offshore Instrumentation Engineer

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Learning Objectives

- ✓ Define force as it applies to pneumatics
- ✓ Define pressure as it applies to pneumatics
- ✓ Define compressibility as it applies to pneumatics
- ✓ Discuss how and why pneumatics are used in the industry
- ✓ Describe why pneumatic instruments have a limited transmission distance
- ✓ Describe the purpose and operation of a booster
- ✓ List the effects of contaminants on a pneumatic system
- ✓ Check the operation of an air dryer
- ✓ Identify the parts of a regulator, adjust output pressure on a regulator, and maintain a regulator
- ✓ State four common sensing elements used in pneumatic instruments
- ✓ Identify the nozzle/flapper, relay, feedback element, and restrictor in a pneumatic instrument
- ✓ Explain the operation of a basic pneumatic instrument
- ✓ Interpret a manufacturer's schematic drawing of a pneumatic transmitter to describe its principle of operation and the location of parts
- ✓ List possible causes for a pneumatic transmitter to erroneously produce full output
- ✓ Describe the function of a controller

- ✓ Identify common components found in a controller and state the function of each
- ✓ Review proportional, integral, and derivative control modes
- ✓ Describe an appropriate application for each of the control modes
- ✓ List possible malfunctions in a controller and the probable causes
- ✓ Check the operation of a controller
- ✓ Align and calibrate a proportional-plus-reset controller
- ✓ Identify the components of a pneumatic recorder
- ✓ Disassemble and clean a pneumatic recorder

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Course Outline

✓ 01 Day One

Chapter 1: Pneumatic Device Operation

- ✓ Pneumatic Signal Transmission
- ✓ Transmission System Response
- ✓ Instrument Air System
- ✓ Supply Pressure & Instrument Signals
- ✓ Instrument Air System
- ✓ Instrument Air Supply
- ✓ Bourdon Pressure Gage
- ✓ Bellows-Type Pressure Elements
- ✓ Basic Diaphragm
- ✓ Flapper / Nozzle or Baffle / Nozzle
- ✓ Pneumatic Relay Schematic
- ✓ Pneumatic Transmitters
- ✓ Motion Balance Transmitter
- ✓ Pneumatic Temperature Transmitter
- ✓ Single Process Alarm
- ✓ Dual Process Alarm
- ✓ Deviation Process Alarm

Chapter 2: Instrument Performance

- ✓ Unit Systems - Instrumentation

- ✓ Relationship between Pressure Terms
- ✓ Specific Gravity
- ✓ Range and Span
- ✓ Suppressed and Elevated Zero Range
- ✓ Range and Span Terminology
- ✓ Accuracy
- ✓ Repeatability
- ✓ Linearity
- ✓ Conformity
- ✓ Hysteresis and Dead Band
- ✓ Performance Specifications
- ✓ Instrument devices Errors

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Course Outline

✓ 02 Day Two

Chapter 3: Pneumatic Instruments Calibration

- ✓ Calibration Block Diagram
- ✓ Hydraulic Dead Weight Tester
- ✓ U-Tube Manometers
- ✓ Schematic of Pneumatic Calibrator
- ✓ Electro-pneumatic Calibrator
- ✓ Hierarchy of Standards
- ✓ Five-Point Calibration
- ✓ Calibration Chart
- ✓ In-Shop or Field Calibration

Chapter 4: D/P Level Applications

- ✓ Hydrostatic Head Level Measurement
- ✓ Direct Connect Level Transmitter
- ✓ Open Tank Installation
- ✓ Closed Tank Installation, Dry Leg
- ✓ Closed Tank Installation, Wet Leg
- ✓ Remote Seals, Liquid, Closed Tank
- ✓ Bubbler Tube Level Measurement
- ✓ Liquid/Liquid Interface Measurement
- ✓ Density Measurement - Bubbler

Chapter 5: Control Modes Review

- ✓ On/Off Mode
- ✓ Differential Gap Operation
- ✓ Controller Modes - Proportional Band
- ✓ Controller Modes - Proportional Gain
- ✓ Proportional Response Units
- ✓ Proportional Band vs. Proportional Gain
- ✓ Proportional Only Control
- ✓ Offset
- ✓ Reset Response (Integral)
- ✓ Derivative Response
- ✓ Controller Modes and Their Uses
- ✓ Controller Action

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Course Outline

✓ 03 Day Three

Chapter 6: Feedback Controllers

- ✓ Proportional Mechanism
- ✓ Proportional + Reset
- ✓ Proportional + Reset + Derivative
- ✓ 2-Mode Stacked Diaphragm Controller
- ✓ 3-Mode Stacked Diaphragm Controller

Chapter 7: Other Pneumatic Units

- ✓ Auto to Manual Switching
- ✓ Derivative Response to Step Change
- ✓ Inverse Derivative Unit
- ✓ Pneumatic Analog Computer
- ✓ Connections for Dividing
- ✓ Pneumatic Adder/Subtractor
- ✓ Flow Rate vs. Differential Pressure
- ✓ Pneumatic Square Root Extractor
- ✓ Low-Pressure Selector
- ✓ High-Pressure Selector
- ✓ Constant Differential Relay

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Course Outline

✓ 04 Day Four

Chapter 8: Control Valve Types

- ✓ Typical Control Valve
- ✓ Single Ported Globe Valve
- ✓ Double Ported Globe Valve
- ✓ Diaphragm Valve
- ✓ Pinch Valve
- ✓ Angle Body
- ✓ Three-Way Bodies
- ✓ Typical Ball Valve
- ✓ Typical Ball Valves
- ✓ Segmented Ball Valve
- ✓ V-Notched Ball
- ✓ Butterfly Valve
- ✓ Rising Stem vs. Rotary
- ✓ Pressure Regulators
- ✓ Direct Operated Regulators
- ✓ Piloted Regulators
- ✓ Sanitary Regulators
- ✓ Sizing

Chapter 9: Actuators

- ✓ Spring Diaphragm Actuator
- ✓ Direct/reverse actuator
- ✓ Failure Direction
- ✓ Diaphragm Actuators
- ✓ Spring-Opposed Diaphragm Actuators
- ✓ A & D
- ✓ Single Acting Piston Actuators
- ✓ Double-Acting Piston Actuators
- ✓ Pneumatic Piston Actuators - A & D
- ✓ Stroking Actuators
- ✓ Forces in Linear Valves • Forces in Rotary Valves

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Course Outline

✓ 05 Day Five

Chapter 10: Positioners

- ✓ Principles of Operation
- ✓ Single Acting Positioner
- ✓ Measures of Loop Response
- ✓ Positioner Added to Flow Control Loop
- ✓ Positioner Added to Temperature Loop
- ✓ Fast Systems
- ✓ Double-Acting Cylinder
- ✓ Volume Booster
- ✓ Double Acting Positioner
- ✓ Other Accessories

Chapter 11: Valve Characteristics

- ✓ Inherent Flow Characteristics
- ✓ Globe Valve Plugs
- ✓ Typical Installed Flow Characteristics
- ✓ Pressure Drop across the Valve
- ✓ Overview of Valve Sizing
- ✓ Valve Selection - Performance
- ✓ Valve Selection - Installation
- ✓ Valve Selection - Maintainability

- ✓ Final Control Element - Split Ranging
- ✓ Application of Common Trim Materials
- ✓ Control Valve Tight Shut Off
- ✓ Bolted Packing Box Assembly
- ✓ Valve Packing Materials
- ✓ Bench Set / Bench Range

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Confirmed Sessions

FROM	TO	DURATION	FEES	LOCATION
June 29, 2026	July 3, 2026	5 days	4950.00 $	England , London
Sept. 14, 2026	Sept. 18, 2026	5 days	4250.00 $	UAE , Dubai
Nov. 9, 2026	Nov. 13, 2026	5 days	4250.00 $	UAE , Abu Dhabi
March 15, 2027	March 19, 2027	5 days	4250.00 $	UAE , Dubai

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