Process Instrumentation and Control: Measurement, Calibration and PID Loop Tuning

1 – 5 February 2027
Amsterdam - Zuidas business district hotel



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Introduction:

Process instrumentation and control problems rarely start in the control room: a flowmeter installed without straight run, a transmitter ranged wrongly, a sticking valve or a loop tuned years ago for different throughput will all show up as oscillation, manual mode and lost product. This Core Concept course takes instrument and control engineers and technicians from measurement principles and signal wiring through calibration, PID tuning and multi-loop strategies to loop documentation and fault finding. Participants build a Control Loop Assessment and Tuning Workbook for loops from their own plant.

Course Objectives:

- Select and install pressure, level, flow and temperature instruments to suit the process fluid, range and required accuracy
- Configure transmitters and verify 4-20 mA, HART and fieldbus signals from field device to control system input
- Calibrate instruments against a reference and estimate the measurement uncertainty of a complete loop
- Tune PID controllers from step test data and apply cascade, ratio and feedforward control where a single loop falls short
- Read and update P&IDs, loop diagrams and instrument datasheets as a basis for control system and alarm changes
- Diagnose poorly performing control loops by separating measurement, valve, tuning and process causes

Target Audience:

- Instrument engineers who specify, select and install field measurement devices
- Control engineers who configure and tune regulatory loops in DCS and PLC systems
- Instrument technicians who calibrate, commission and maintain transmitters and control valves
- Maintenance planners who schedule instrument calibration and loop checks
- Process and operations engineers who work with control teams on loop performance and alarms

Course Outline:

Day 1: Measurement Principles for Pressure, Level, Flow and Temperature

- Pressure Measurement: Gauge, Absolute and Differential Sensors with Impulse Line Installation
- Level Measurement Selection: Differential Pressure, Guided Wave Radar, Displacer and Nuclear Gauges
- Flow Meter Principles: Orifice Plate, Vortex, Magnetic, Coriolis and Ultrasonic Meters
- Temperature Measurement: Thermocouple and RTD Selection with Thermowell Installation
- Instrument Selection Matrix Against Process Fluid, Range and Turndown

Day 2: Transmitters, Signals and Instrument Documentation

- 4-20 mA Current Loop Design: Loop Power, Load Resistance and Live Zero
- HART Communication: FSK Overlay, Secondary Variables and Multidrop Mode
- Foundation Fieldbus, Profibus and Ethernet-APL Networks at Overview
- P&ID Instrument Tagging and Symbols Based on ISA S5.1
- Loop Diagram, Instrument Index and Datasheet Preparation

Day 3: Calibration, Control Valves and PID Tuning

- Five-Point Calibration Procedure, As-Found and As-Left Records and Calibration Intervals
- Loop Measurement Uncertainty Budget from Sensor, Transmitter and Input Card Errors
- Control Valve Characteristics, Actuators and Positioners at Overview
- PID Modes, Controller Algorithms and Step Test Process Identification
- PID Tuning with Ziegler-Nichols, Cohen-Coon and SIMC Rules

Day 4: Multi-Loop Strategies, Control Systems and Loop Faults

- Cascade Control Design: Inner and Outer Loop Speed and Tuning Order
- Ratio and Feedforward Control for Blending and Load Disturbances
- DCS and PLC Architecture: Controllers, I/O, Redundancy and Operator Stations
- Alarm Setpoints and Rationalisation Basics with ANSI/ISA-18.2-2009 as Reference
- Loop Troubleshooting: Valve Stiction, Noise, Aliasing and Interaction Diagnosis

Day 5: Control Loop Assessment and Tuning Modelling Build

- Flow Loop Case: Meter Sizing Check and Transmitter Range Verification
- Level Loop Case: Averaging Versus Tight Level Control Tuning
- Temperature Cascade Case: Step Test Data to Tuning Parameters
- Loop Performance Metrics: Variability, Time in Manual and Valve Travel
- Control Loop Assessment and Tuning Workbook Peer Review

Skills You Will Gain:

- Measurement Device Selection
- Transmitter Configuration
- Current Loop Fault Finding
- Instrument Calibration
- Uncertainty Estimation
- PID Loop Tuning
- Multi-Loop Control Design
- Instrument Documentation

Why Attend This Course:

- Return with a Control Loop Assessment and Tuning Workbook covering flow, level and temperature loops from your own plant
- Cut the time spent chasing loop problems by checking measurement, valve and tuning in a fixed order
- Explain tuning changes to operations with step test evidence rather than trial and error
- Compare instrument and control practice with peers from oil and gas, chemicals, power, water and manufacturing

Conclusion:

A control loop performs only as well as its measurement, its signal path, its final element and its tuning. The course moves from sensor principles and installation, through transmitters, fieldbus networks and documentation, to calibration, uncertainty and PID tuning, then to cascade, ratio and feedforward control, control system architecture, alarm basics and fault diagnosis. The final day turns this into a Control Loop Assessment and Tuning Workbook that engineers and technicians can use at their next loop review.