



Instrumentation & Controls

Fault Diagnosis and Troubleshooting in Control Systems

Course Introduction

This course teaches a systematic approach to troubleshooting and start-up as they apply to single and multi-loop control loops. Covers how pressure, level, flow, and temperature loops operate to maintain good process control systems. Knowledge of instrumentation and control is assumed.

Target Audience

- Instrumentation and control engineers and technicians
- Design, installation and maintenance engineers and technicians in the process industries
- System integrators
- System consultants

Learning Objectives

- Understand why a systematic approach to troubleshooting is most effective
- Follow specified procedures for proper loop check-out
- Verify, locate, and identify performance problems and the causes of the problems
- Take or recommend appropriate follow-up procedures to minimize problem recurrence
- Identify the common causes of sensor, transmitter, controller, and final control element problems
- Troubleshoot control systems
- Apply DCS functions for troubleshooting

- Understand pneumatic and electronic loops
- Apply safety practices for start-up
- Check and utilize control loop documentation
- Diagnose and solve problems related to single loop control loops
- Diagnose and solve problems with ratio, cascade and three-element control loops
- Diagnose problems using DCS displays for information
- Construct and tune a feedback control loop

Course Outline

- **01 Day One**

- 1: Learning to Troubleshoot**

- Experience
 - Apprenticeships
 - Mentoring
 - Classroom Instruction
 - Individual Study
 - Logic and Logic Development

- 2: The Basics of Failures.**

- Definition of Failure
 - How Hardware Fails
 - How Software Fails
 - Environmental Effects on Failure Rates
 - Functional Failures
 - Systematic Failures
 - Common-cause Failures
 - Root-cause Analysis

- **02 Day Two**

3: Failure States

- Overt and Covert Failures
- Directed Failures
- Directed Failure States
- What Failure States Indicate

4: Logical/Analytical Troubleshooting Frameworks

- Logical/Analytical Troubleshooting Framework
- Specific Troubleshooting Frameworks
- How a Specific Troubleshooting Framework Works
- Generic Logical/Analytical Frameworks
- A Seven-step Procedure
- Examples of How to Use the Seven-step Procedure
- Vendor Assistance Advantages and Pitfalls
- Why Troubleshooting Fails

• 03 Day Three

5: Troubleshooting Methods

- Why Use Other Troubleshooting Methods?
- Substitution Method
- Fault Insertion Method
- “Remove and Conquer” Method
- “Circle the Wagons” Method
- Trapping
- Complex to Simple Method
- Consultation
- Intuition
- Out-of-the-Box Thinking

6: Safety

- General Troubleshooting Safety Practices
- Human Error in Industrial Settings
- Plant Hazards Faced During Troubleshooting
- Troubleshooting in Electrically Hazardous (Classified) Areas
- Protection, Procedures, and Permit Systems

• 04 Day Four

7: Tools and Test Equipment

- Hand Tools
- Contact-type Test Equipment
- Noncontact Test Equipment
- Simulators/Process Calibrators
- Jumpers, Switch Boxes, and Traps
- Documenting Test Equipment and Tests
- Accuracy of Test Equipment

8: Troubleshooting Scenarios

- Mechanical Instrumentation
- Process Connections
- Pneumatic Instrumentation
- Electrical Systems
- Electronic Systems
- Valves
- Calibration
- Programmable Electronic Systems
- Communication Loops
- Transient Problems
- Software
- Flow Meters
- Level Meters

• 05 Day Five

9: Troubleshooting Hints

- Mechanical Systems
- Process Connections
- Pneumatic Systems
- Electronic Systems
- Grounding
- Calibration Systems
- Tools and Test Equipment
- Programmable Electronic Systems
- Serial Communication Links (Loops)
- Safety Instrumented Systems (SIS)

- Critical Instrument Loops
- Electromagnetic Interference
- Valves
- Miscellaneous

10: Aids to Troubleshooting

- Maintainability
- Drawings
- Tagging and Identification
- Equipment Files
- Manuals
- Maintenance Management Systems
- Vendor Technical Assistance
- Direct Vendor Access
- Maintenance Contracts

Confirmed Sessions

FROM	TO	DURATION	FEES	LOCATION
June 16, 2025	June 20, 2025	5 days	4250.00 \$	UAE - Dubai
Aug. 11, 2025	Aug. 15, 2025	5 days	4950.00 \$	Italy - Milan
Dec. 1, 2025	Dec. 5, 2025	5 days	4250.00 \$	UAE - Abu Dhabi
Feb. 9, 2025	Feb. 13, 2025	5 days	4250.00 \$	KSA - Riyadh