

**COURSE OVERVIEW IE0148**  
**Process Control, Troubleshooting & Problem Solving**  
**(E-Learning Module)**

**Course Title**

Process Control, Troubleshooting & Problem Solving (E-Learning Module)

**Course Reference**

IE0148

**Course Format & Compatibility**

SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

**Course Duration**

30 online contact hours  
 (3.0 CEUs/30 PDHs)



**Course Description**



This E-Learning course is designed to provide participants with a detailed and up-to-date overview of process control troubleshooting and problem solving. It covers the process measuring and control instrumentation; the three main components of instrumentation; the process control loop, process field transmitter, analog transmitters calibration electronic transmitter and smart transmitter; the manual and automatic control, compressor lube, seal oil instrumentation and lubricating oil system operation; and the industrial temperature measurement thermocouple, calibration, analogue temperature transmitters and resistance temperature detector (RTD).

Further, the course will also discuss the wiring, calibration procedures, infrared temperature measurement devices and pressure measurement; the u tube manometer, bourdon tube gauges, pressure gauge calibration, pneumatic hand-held test pump and process pressure switches; the basic procedure for calibration, flow measurements, variable area flowmeters, magnetic flow meters, ultrasonic flowmeters and clamp-on flowmeters; the open tank level calculation, interface level measurement and ultrasonic level measurement; and the design of process instrumentation control system.

During this interactive course, participants will learn the control loops, boiler water level control system, process control valve and actuators; the cascade loop application, boiler level cascade control, ratio control, bench set adjustment and calibration of electro pneumatic transducer; the calibration, emergency operational situation for control valves, valve type selection, valve cavitation and flashing; the electropneumatic positioner; the operator controls and readings, troubleshooting, control valve pressure test and valve automation diagram; the calibration of pneumatic fisher valve positioner; the operation of valve positioner split range; the distributed control system (DCS); the steps to logical analysis troubleshooting, identifying and locating the problem, fixing the problem and verifying that the problem is fixed; and the programmable logic controller including its components and wiring symbols.

### **Course Objectives**

The course should serve the following overall learning objectives:-

- Apply systematic techniques on process control troubleshooting and problem solving
- Understand of various control strategies and troubleshooting
- Define process measuring and control instrumentation and identify the three main components of instrumentation
- Discuss process control loop, process field transmitter, analog transmitters calibration electronic transmitter and smart transmitter
- Carryout manual and automatic control, compressor lube, seal oil instrumentation and lubricating oil system operation
- Identify industrial temperature measurement thermocouple, calibration, analogue temperature transmitters and resistance temperature detector (RTD)
- Illustrate wiring, calibration procedures, infrared temperature measurement devices and pressure measurement
- Recognize u tube manometer, bourdon tube gauges, pressure gauge calibration, pneumatic hand-held test pump and process pressure switches
- Apply the basic procedure for calibration, flow measurements, variable area flowmeters, magnetic flow meters, ultrasonic flowmeters and clamp-on flowmeters
- Employ open tank level calculation, interface level measurement and ultrasonic level measurement
- Explain the design of process instrumentation control system as well as control loops, boiler water level control system, process control valve and actuators
- Carryout cascade loop application, boiler level cascade control, ratio control, bench set adjustment and calibration of electro pneumatic transducer
- Apply calibration, emergency operational situation for control valves, valve type selection, valve cavitation and flashing
- Identify electropneumatic positioner and illustrate operator controls and readings, troubleshooting, control valve pressure test and valve automation diagram
- Calibrate pneumatic fisher valve positioner, operate valve positioner split range and identify distributed control system (DCS)
- Recognize the steps to logical analysis troubleshooting, identify and locate the problem, fix the problem and verify that the problem is fixed
- Discuss programmable logic controller including its components and wiring symbols

### Who Should Attend


This course provides an overview for all significant aspects and considerations of process control troubleshooting and problem solving for process control engineers and supervisors, instrumentation and control system engineers, automation engineers, instrumentation engineers and technologists. Further, process engineers, electrical engineers and supervisors and those involved in the design, implementation and upgrading of industrial control systems will also benefit from the practical aspects of this course.

### Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

### Certificate Accreditations


Certificates are accredited by the following international accreditation organizations: -

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USA International Association for Continuing Education and Training (IACET)

Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units (CEUs)** in accordance with the rules & regulations of the International Association for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

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British Accreditation Council (BAC)

Haward Technology is accredited by the **British Accreditation Council for Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

### **Training Methodology**

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test

Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

### **Course Fee**

As per proposal

### **Course Contents**

- Definitions of Process Measuring & Control Instrumentation
- The Three Main Components of Instrumentation
- Process Control Loop
- Why Boiler Drum Level Control?
- Process Field Transmitter
- Zero & Span Adjustments (Analog Transmitters)
- Calibration Electronic Transmitter
- Smart Transmitter
- Manual & Automatic Control
- Compressor Lube & Seal Oil Instrumentation
- Lubricating Oil System Operation
- Review Questions
- Industrial Temperature Measurement Thermocouple
- Thermocouple
- Thermocouple Temperature Transmitter
- Calibration
- Analogue Temperature Transmitters
- Thermocouple Reference Tables



- Resistance Temperature Detector (RTD)
- Applications
- Why Use an RTD Instead of a Thermocouple or Thermistor Sensor?
- Temperature Transmitters RTD (Pt100)
- Wiring
- Calibration Procedures
- Temperature Calibrator
- Handy Calibrators
- Selecting a Dry-Well Temperature Calibrator
- Temperature Calibrator
- Testing Temperature Switch
- Infrared Temperature Measurement Devices
- What is an Infrared Thermometer?
- Infrared Pyrometers
- Why Use an RTD Instead of a Thermocouple or Thermistor Sensor?
- Review Questions
- Pressure Measurement
- What is Pressure?
- Gage Pressure
- U Tube Manometer
- Advantages of U-Tube Manometer
- Disadvantages of U-Tube Manometer
- Bourdon Tube Gauges
- Assembly & Disassembly of Bourdon Tube Gauges
- Pressure Gauge Calibration
- Calibration of Pressure Gauges by Using Dead Weight Tester
- Pneumatic Hand-Held Test Pump
- Process Pressure Switches
- Adjustments of Process Pressure Switches
- Calibration of Bourdon Tube Gauges
- Process Pressure Switches
- Calibrating Pressure Switch
- Pressure Transmitters



- Basic Procedure for Calibration
- Flow Measurements
- Process Flow Rate
- Orifice Plate Flowmeters
- Why Use Orifice Plates?
- Installation of Orifice Plate Flowmeters
- Square Root Extractor
- Variable Area Flowmeters
- Magnetic Flow Meters
- Ultrasonic Flowmeters
- Clamp-On Flowmeters
- Review Questions
- Level Measurement
- Floats
- Level Gauges
- Sight Glass (Level Gauge)
- Magnetic Level Gauges
- How Magnetic Level Indicator Works
- Displacer
- Displacer Transmitters
- Hydrostatic Level Measurement
- Smart Differential Pressure Transmitter
- Measurement of Level in Industrial Application
- Voltage/Current Calibrator
- Installation
- Open Tank Level Calculation
- Calibration Range
- Pneumatic Pressure Transmitters
- Interface Level Measurement
- Separator Level
- Ultrasonic Level Measurement
- Ultrasonic Level Transmitter
- Pump Control Using Relays



- Dip |Tube or Bubbler Tubes
- Tank Level Control with an ABB Purge Meter Used as a Bubbler
- Float & Displacer Switches
- Review Questions
- Process Control
- Manual & Automatic Control
- Automatic Control Loop
- Terminology of Process Control System
- Controlled Variable
- Measured Variable
- Setpoint
- Error Signal
- Controller Output
- Manipulated Variable
- Design of Process Instrumentation Control System
- Turbo-Compressor Anti-Surge Control Systems
- Feedback Control
- Closed & Open Control Loops
- Boiler Water Level Control System
- Process Control Valve
- Actuators
- How Control Valves Work
- Rack & Pinion Pneumatic Actuator
- Steam Turbine Lube Oil Control System
- Feedforward Control
- Feedforward Plus Feedback
- Instrumentation Signals
- Process Control Instrumentation Signals
- Pneumatic Signals
- Controller & Output Current Loops
- Tracing Control Loop Problems
- Basic Control Modes
- Discrete Controllers





- Pump Controller
- Review Questions
- Control Algorithm (PID)
- Proportional Control (P)
- Proportional Band & Gain
- Pneumatic Proportional Control
- Manual Reset
- Reverse or Direct Acting Control Signal
- Changing the Control Operation Direction & Valve Direction
- Proportional-Plus-Integral Control
- Derivative or Rate Action
- PID Tuning
- Autotune or Accutune
- Review Questions
- Cascade Loop Application
- Reasons for Cascade Control
- Requirements for Cascade Control
- Examples of Cascade
- Boiler Level Cascade Control
- Cascade Control
- Ratio Control
- The Ratio Control Loop
- Series System with Ratio Relays
- Boiler Drum Level Control Systems
- Two-Element Drum Level Control System
- Three-Element Drum Level Control System
- Multivariable Loops
- Review Questions
- Control Valve & Process Control System
- Control Valve Main Parts
- Control Valve Force Balance
- Travel Adjustment
- Bench Set





- Bench Set Adjustment
- Rotary Valves
- Rack & Pinion Pneumatic Actuator
- Review Questions
- Calibration of Electro Pneumatic Transducer
- I To P Converter (Current-to-Pneumatic Converter)
- Pneumatic Valve / Actuator Operated by a Control Signal Using I to P Converter & P to P Positioner
- Calibration
- Calibration of Electro Pneumatic Positioner
- Emergency Operational Situation for Control Valves
- Electrically
- Pneumatic Volume Booster with Control Valves
- Volume Booster
- Selecting a Valve Type
- Equal Percentage
- Linear
- Quick Opening
- Gate Valves
- Globe Valves
- Cast Iron Flanged End Ball Valve
- Butterfly Valves
- Butterfly Valve Problems
- Eccentric Disc
- Butterfly Control Valve
- Safety Valves
- Valve Cavitation and Flashing
- Cavitation Damage
- Flashing
- What is Cavitation?
- Cavitation Effects
- Cavitation Sound
- Cavitation Control
- Self-Acting Control Valves

- Fisher Field Vue Dvc6200 Digital Valve Controllers
- Zero Power Condition
- Analog Calibration Adjust
- Digital Calibration Adjust
- Relay an Adjustment (Shroud Removed for Clarity)
- Printed Wiring Board (PWB) Connections & Settings
- Samson Series 3730 - Type 3730-2
- Electropneumatic Positioner
- Operator Controls & Readings
- Troubleshooting
- Control Valve Pressure Test
- Review Questions
- Actuators Controlled by Solenoid Valves
- Proximity Limit Switch (Inductive)
- Valve Automation Diagram
- Scotch Yoke Actuators
- Valve Positioner – Function of Valve Positioner
- When Should a Positioner be Fitted?
- Positioner Control Signal
- Fisher Pneumatic Positioner
- Principle of Operation
- Changing Valve Positioner Action
- Calibration of Pneumatic Fisher Valve Positioner
- Valve Positioner Split Range Operation
- Review Questions
- Distributed Control System (DCS)
- Introduction to DCS Process Control System
- Process Control by Controllers
- PID (P-Proportional, I-Integral & D-Derivative) Control Algorithm
- PID Indicating Controller
- DCS System Components
- DCS Hardware
- Basic Components of a Typical DCS

- Operator Workstation
- Engineering Workstation
- DCS Controllers
- Field Devices
- History Module
- Input /Output Elements (Module)
- Main Benefits of DCS
- Review Questions
- Reasons for Troubleshooting
- Purpose of Troubleshooting
- What are You Expected to Troubleshoot?
- Skills Beneficial for Troubleshooting
- Troubleshooting Skills Dependent on
- Steps to Logical Analysis Troubleshooting
- Verify that Something is Wrong
- Identify & Locate the Problem
- Fix the Problem
- Verify that the Problem is Fixed
- Documentation for Troubleshooting
- Tracing Control Loop Problems
- Review Questions
- Programmable Logic Controllers
- Advantages of PLCs
- PLC Controller Components
- Main Components
- Wiring Symbols
- Input
- Analog Inputs
- Relay Logic
- Ladder Logic
- Ladder Logic Programming
- Contact & Coil Status
- Ladder Diagram Software Programs (Ladder Logic)

- PLC Motor Control Program
- Latching
- Timer & Counter
- On-Delay Timer & Retentive On-Delay Timer
- On-Delay Timer
- Counters
- S7-1200 PLC Programming
- LAD Timers & Counters
- TOM Timer Box Instruction
- TOF Timer Box Instruction
- TONR Timer Box Instruction
- CTU Counter Instruction
- CTD Counter Instruction
- CTUD Counter Instruction
- CTUD Counter Instruction Example
- Review Questions