Mechatronics for Engineers and Technicians: Sensors, Servo Drives and Machine Fault-Finding

15 – 19 February 2027
Amsterdam - Zuidas business district hotel



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Introduction:

Mechatronics faults on automated machines rarely stay inside one trade: a misread encoder looks like a mechanical jam, a drifting pressure switch looks like a program error, and a tripped safety relay looks like a dead drive. Downtime grows while electricians, fitters and controls staff each test their own part. This Core Concept course trains maintenance engineers and technicians to read a machine as one system of sensors, signal paths, controllers, drives and actuators, and to trace faults across those boundaries. Participants build a Machine Mechatronic Map and Cross-Domain Fault-Finding Guide for a machine at their own site.

Course Objectives:

- Map the sensing, control, drive and actuation chain of an automated machine into a single signal-flow diagram that the whole maintenance crew can use
- Select, wire and check inductive, capacitive, photoelectric, encoder, pressure and temperature sensors, including their signal conditioning
- Compare electric, pneumatic and hydraulic actuation on a machine axis and verify that each actuator receives the command and feedback it expects
- Set up servo and stepper drives, run position and velocity loop tuning and recognise the symptoms of poor loop settings
- Verify controller I/O, fieldbus links and safety circuits against the machine drawings and the ISO 13849-1 performance level of each safety function
- Diagnose automated machine stoppages with a half-split, cross-domain fault-finding method and record the cause for repeat-failure prevention

Target Audience:

- Maintenance engineers responsible for the availability of automated machines, packaging lines and assembly equipment
- Electrical and instrument technicians responsible for sensors, wiring, drives and controller I/O on production machinery
- Mechanical fitters responsible for pneumatic, hydraulic and mechanical transmission parts that work alongside electronic controls
- Reliability and maintenance planners responsible for fault records, spares for drives and sensors and repeat-failure reduction
- Production line supervisors responsible for first-line response to machine stoppages and handover to maintenance crews

Course Outline:

Day 1: Mechatronic System Architecture and Machine Baseline

- Mechatronic System Model: Sensing, Control, Drive, Actuation and Mechanical Transmission Blocks
- Machine Signal-Flow Diagram from Operator Command to Axis Motion
- Reading Electrical, Pneumatic and Mechanical Drawings Together for One Machine
- Downtime Log Review: Separating Mechanical, Electrical, Sensor and Control Stoppages
- Machine Baseline Checklist: Axes, Sensors, Drives, Controllers and Safety Devices

Day 2: Sensors, Transducers and Signal Conditioning

- Inductive, Capacitive and Photoelectric Proximity Sensors: Sensing Range, PNP and NPN Outputs
- Incremental and Absolute Encoders: Resolution, Quadrature Signals and Index Pulse
- Pressure Transducers, Thermocouples and RTDs on Machine Utilities
- Signal Conditioning: Amplification, Filtering, Isolation and 4-20 mA Loop Checks
- Machine Vision Sensors at Overview: Presence, Orientation and Code Reading Checks

Day 3: Actuators, Servo and Stepper Drives and Motion Control

- Pneumatic Cylinders, Valve Terminals and Air Preparation Units on Automated Machines
- Electromechanical Actuators: Ball Screws, Belt Axes and Linear Guides Compared with Fluid Power
- Stepper Motors and Drives: Full Step, Microstepping and Lost-Step Detection
- Servo Motor and Drive Commissioning: Feedback Setup, Homing and Travel Limits
- Position and Velocity Loop Tuning: Gain, Integral Time, Following Error and Overshoot Checks

Day 4: Controller Interfacing, Communications and Machine Safety Circuits

- PLC and Microcontroller I/O Interfacing: Sinking, Sourcing, Relay and Transistor Outputs
- High-Speed Counter and Pulse-Train Outputs for Encoder Feedback and Stepper Command
- Fieldbus and Industrial Ethernet at Overview: Device Status, Diagnostics and Cable Faults
- Safety Relays, Emergency Stop Chains, Interlocked Guards and Light Curtains
- ISO 13849-1 Performance Levels PL a to e and Categories B to 4 for Machine Safety Functions

Day 5: Machine Inspection Walkthrough and Cross-Domain Fault-Finding Guide

- Inspection Walkthrough: Automated Machine Checked Against the Mechatronic Baseline Checklist
- Half-Split Fault-Finding Method Across Sensor, Controller, Drive and Actuator Boundaries
- Fault Cases: Encoder Noise, Following Error Trips, Sticking Valves and Bypassed Guard Switches
- Repeat-Failure Record and Spares Plan for Sensors, Drives and Pneumatic Parts
- Machine Mechatronic Map and Cross-Domain Fault-Finding Guide Build and Peer Review

Skills You Will Gain:

- Machine Signal-Flow Mapping
- Sensor Selection and Wiring
- Signal Conditioning Checks
- Servo Drive Commissioning
- Motion Loop Tuning
- Controller I/O Verification
- Safety Circuit Checking
- Cross-Domain Fault Diagnosis

Why Attend This Course:

- Return with a Machine Mechatronic Map and Cross-Domain Fault-Finding Guide for an automated machine you maintain
- Shorten stoppages by locating the failed block between sensor, controller, drive and actuator before any part is changed
- Work on equal terms with electrical, mechanical and controls colleagues because each trade's drawings and test points are covered
- Compare machine maintenance practice with peers from packaging, food and beverage, automotive parts, pharmaceuticals and metals

Conclusion:

Automated machines stop for reasons that cross trade lines, so the people who restore them need to read the whole chain from sensor to motion. The one week move from system architecture and drawings, through sensors, signal conditioning, actuators, servo and stepper drives and loop tuning, to controller interfacing, communications and ISO 13849-1 safety functions. The final day applies a machine walkthrough and fault cases to build the Machine Mechatronic Map and Cross-Domain Fault-Finding Guide ready for use by the site maintenance team.