Industrial Hydraulic Systems: Principles, Components, Troubleshooting and Maintenance

29 March – 2 April 2027
Amsterdam - Zuidas business district hotel



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Introduction:

Industrial hydraulic systems drive presses, moulding machines, cranes, mobile plant and test rigs, yet many breakdowns trace back to contaminated oil, wrong valve settings, internal leakage and fault-finding by trial and error that replaces parts without finding the cause. This Core Concept course gives maintenance technicians and engineers a practical method to read ISO 1219-1 circuit diagrams, test pumps, valves and actuators, control fluid cleanliness with ISO 4406 codes and isolate stored energy safely. Participants build a Hydraulic Circuit Troubleshooting and Maintenance Plan for a machine from their own site.

Course Objectives:

- Calculate force, speed, flow and power in hydraulic circuits and read ISO 1219-1 circuit diagrams to trace how a machine operates
- Check the condition and performance of gear, vane and piston pumps, hydraulic motors, cylinders and accumulators, including accumulator gas precharge
- Set and test directional, pressure and flow control valves and recognise the adjustment points of proportional and servo valves
- Control hydraulic fluid contamination by sampling oil, interpreting ISO 4406 cleanliness codes and managing filter condition
- Diagnose slow, erratic, noisy or overheating hydraulic systems with a systematic fault-finding sequence and test instruments
- Isolate stored hydraulic energy safely and plan preventive maintenance for power units, hoses, seals and filters

Target Audience:

- Maintenance technicians who repair and adjust hydraulic power units, valves and cylinders on production machinery
- Mechanical and maintenance engineers responsible for the reliability of hydraulic presses, lifting equipment and mobile plant
- Maintenance planners who schedule oil sampling, filter changes and hose replacement
- Workshop supervisors who oversee hydraulic component repair, bench testing and reassembly
- Lubrication and condition monitoring staff who run oil cleanliness and sampling programmes

Course Outline:

Day 1: Hydraulic Principles, Power Units and Circuit Symbols

- Pascal's Law, Force Multiplication and Cylinder Area Calculations
- Flow, Velocity and Pressure Relationships with the Hydraulic Power Formula
- Hydraulic Power Unit Layout: Reservoir, Pump, Relief Valve, Filter and Cooler
- ISO 1219-1 Graphical Symbols for Pumps, Valves, Actuators and Lines
- Circuit Diagram Reading Exercise: Tracing Pressure, Return, Pilot and Drain Lines

Day 2: Hydraulic Pumps, Motors, Cylinders and Accumulators

- Gear, Vane and Axial Piston Pump Construction and Volumetric Efficiency
- Variable Displacement Pump Controls: Pressure Compensator and Load Sensing
- Hydraulic Motor Types with Torque and Speed Calculation
- Single-Acting, Double-Acting and Telescopic Cylinder Construction and End Cushioning
- Bladder, Diaphragm and Piston Accumulators with Gas Precharge Checks

Day 3: Directional, Pressure, Flow, Proportional and Servo Valves

- Spool Directional Control Valves: Centre Conditions and Solenoid or Pilot Operation
- Relief, Reducing, Sequence and Counterbalance Valve Setting Procedure
- Check, Pilot-Operated Check and Cartridge Logic Valve Applications
- Meter-In, Meter-Out and Bleed-Off Flow Control Speed Circuits
- Proportional and Servo Valve Overview: Amplifier Cards, Feedback and Null Adjustment

Day 4: Hydraulic Fluids, Contamination Control, Seals and Fault-Finding

- Mineral Oil, Water-Based and Synthetic Ester Fluid Selection and Viscosity Checks
- ISO 4406 Cleanliness Codes and Particle Counting from Oil Samples
- Suction, Pressure and Return Filter Placement with Differential Pressure Indicators
- Rod Seal, Piston Seal and O-Ring Failure Modes and Internal Leakage Tests
- Systematic Fault-Finding Sequence for Overheating, Aeration, Noise and Slow Actuators

Day 5: Inspection Walkthrough, Safe Isolation and Maintenance Plan Build

- Inspection Walkthrough of a Hydraulic Power Unit Against a Condition Checklist
- Fault Diagnosis Cases with Pressure Gauges, Flow Meters and Temperature Test Points
- Stored Energy Isolation Drill: Accumulator Discharge, Load Blocking and Lockout Verification
- Preventive Maintenance Schedule: Oil Sampling, Filter Changes, Hose Replacement and Leak Checks
- Hydraulic Circuit Troubleshooting and Maintenance Plan Build and Peer Review

Skills You Will Gain:

- Hydraulic Circuit Reading
- Hydraulic Force and Power Calculation
- Pump and Actuator Condition Testing
- Valve Setting and Adjustment
- Oil Cleanliness Management
- Hydraulic Fault Diagnosis
- Stored Energy Isolation
- Hydraulic Maintenance Planning

Why Attend This Course:

- Return with a Hydraulic Circuit Troubleshooting and Maintenance Plan prepared for a machine from your own site
- Shorten breakdowns by testing at the right points on the circuit instead of replacing parts by trial and error
- Extend pump, valve and seal life by keeping oil within target cleanliness and temperature limits
- Compare hydraulic maintenance practice with peers from manufacturing, steel, construction equipment, utilities and oil and gas

Conclusion:

Hydraulic machines stay productive when their circuits are understood, their oil is kept clean and their faults are traced methodically. The course moves from Pascal's law, power units and ISO 1219-1 symbols, through pumps, motors, cylinders and accumulators, to directional, pressure, flow, proportional and servo valves, then to fluids, ISO 4406 cleanliness, filtration, seals and fault-finding. The final day applies these methods in an inspection walkthrough and produces a Hydraulic Circuit Troubleshooting and Maintenance Plan ready for site use.