KOENIG SOLUTIONS · COURSE OUTLINE

Fundamental Basics of Instrumentation & Control

Industrial Measurement, Control Loops & Refinery Safety

A foundation-level introduction to instrumentation and process control using practical examples relevant to Saudi Aramco Base Oil Company - Luberef.

16 MODULES | GUIDED PRACTICE | REFINERY CASE STUDIES

COURSE OVERVIEW

This course introduces the essential principles of industrial instrumentation and control for personnel working in petroleum processing and base oil refining. Participants learn how pressure, temperature, flow and level are measured; how instruments are identified on drawings; and how signals, controllers and final control elements work together to maintain process conditions.

Examples use simplified refinery scenarios involving heating, distillation, extraction, dewaxing, storage and transfer operations. Learners also develop basic awareness of DCS/PLC/SCADA systems, alarms, interlocks, field checks, calibration concepts, troubleshooting and safe work practices. Activities are designed for online delivery through guided diagrams, worksheets and simulated readings.

WHO THIS COURSE IS FOR

- Entry-level instrumentation and maintenance technicians.
- Operations and production personnel in base oil and refining facilities.
- Junior engineers and technical staff needing I&C fundamentals.

PREREQUISITES

- No previous instrumentation or process-control experience required.
- Basic arithmetic and familiarity with industrial equipment are helpful.
- General computer skills for guided online exercises.

LEARNING OBJECTIVES

What You Will Learn

- Explain the purpose of measurement and automatic control in base oil refinery operations.
- Identify pressure, temperature, flow and level variables, common units, ranges and basic instrument characteristics.
- Recognize common instrument symbols and tags on simplified process and instrumentation diagrams (P&IDs).
- Describe the operating principles and typical uses of introductory pressure, temperature, flow and level instruments.
- Interpret basic 4-20 mA signals, instrument scaling, loop-check records and calibration terminology.
- Distinguish open-loop and closed-loop control and identify the main elements of a feedback-control loop.
- Explain the basic effects of proportional, integral and derivative control using simple process-response examples.
- Recognize control valves, actuators, positioners, pumps and other common final control elements.
- Describe the fundamental functions of DCS, PLC, SCADA, HMI displays, alarms and trends.
- Differentiate routine control, alarms, interlocks and protective shutdowns at an awareness level.
- Apply safe-work awareness and a structured first-line inspection approach to common instrument problems.
- Interpret a simplified refinery case study linking instruments, control loops and operational observations.

Learning level: Foundation / Beginner · Delivery approach: Instructor-led explanations, demonstrations and guided virtual exercises.

16 Modules

01

Instrumentation & Control in Base Oil Refining

TOPICS

Purpose of instrumentation; measurement versus control; process equipment and operating conditions; examples from distillation, extraction, dewaxing, tank farms and transfer lines.

02

Process Variables & Measurement Fundamentals

TOPICS

Pressure, temperature, flow and level; density and viscosity awareness; measurement units; range, span, accuracy, repeatability; sensors, indicators and transmitters.

03

Reading P&IDs; & Instrument Documentation

TOPICS

PFD versus P&ID; common instrument tags and symbols; line types; instrument index, data sheets and basic loop diagrams; locating instruments on a sample process.

04

Pressure Measurement Instruments

TOPICS

Gauge, absolute and differential pressure; gauges and pressure transmitters; basic sensing principles; applications to pumps, filters and process vessels.

05

Temperature Measurement Instruments

TOPICS

Thermocouples, RTDs, thermowells and temperature transmitters; measurement locations; applications to heaters, exchangers and process lines.

06

Flow Measurement Instruments

TOPICS

Orifice and DP flowmeters; turbine, vortex, Coriolis and electromagnetic flowmeters; basic suitability considerations for petroleum streams and utilities.

07

Level Measurement Instruments

TOPICS

Sight glasses, differential pressure, displacers, radar and ultrasonic level measurement; tanks, drums and vessels; common measurement limitations.

08

Signals, Wiring & Basic Calibration

TOPICS

Analog and digital signals; 4-20 mA, pneumatic signal concepts and HART overview; loop power and wiring basics; zero, span, scaling, loop checks and calibration concepts.

16 Modules

09

Introduction to Process Control Loops

TOPICS

Open-loop versus closed-loop control; setpoint, process variable, manipulated variable, error and disturbance; feedback using tank level and temperature examples.

10

PID Control: Fundamental Concepts

TOPICS

Proportional, integral and derivative actions in plain language; offset, overshoot and response; manual versus automatic operation; basic controller trend interpretation.

11

Control Valves & Final Control Elements

TOPICS

Control valve body, actuator and positioner; pneumatic and electric actuators; fail-open/fail-closed concepts; valves, pumps and variable-speed drives as final elements.

12

DCS, PLC & SCADA Fundamentals

TOPICS

Basic roles of DCS, PLC and SCADA; controller, I/O, HMI and operator workstation; monitoring, trends, alarms and control-room/field interface.

13

Alarms, Interlocks & Process Safety Basics

TOPICS

Process alarms versus shutdown actions; basic interlocks, ESD and SIS awareness; hazardous-area precautions; safe response and authorization principles.

14

Installation & Field Work Essentials

TOPICS

Instrument mounting and connections; impulse tubing; cable routing, grounding and shielding overview; tag checks; permits, isolation and lockout/tagout awareness.

15

Inspection, Maintenance & Troubleshooting

TOPICS

Routine inspection and preventive maintenance; drift, plugged impulse lines, wiring faults and sticking valves; basic fault finding, records and communication with operations.

16

Integrated Base Oil Refinery Case Study

TOPICS

Trace temperature, pressure, flow and level instrumentation across illustrative refinery and storage systems; read P&ID; tags; identify loops, valves and alarms; discuss safe first-line checks.

HANDS-ON EXERCISES

Practise What You Learn

Guided online activities use illustrative refinery diagrams, simulated instrument readings and practical worksheets to reinforce each module.

01 Refinery instrumentation walk-through	Mark measurement points on an illustrative base-oil process overview (storage, transfer, heating and separation).
02 Measurement and unit practice	Match pressure, temperature, flow and level to units; identify range, span and expected readings on simple instrument data sheets.
03 P&ID; symbol identification	Read a simplified pump-tank-heater P&ID; and identify instrument tags, lines and basic control-loop relationships.
04 Pressure instrument scenario	Choose a basic pressure measurement approach for a filter or pump suction/discharge monitoring case.
05 Temperature sensing scenario	Compare RTD and thermocouple examples for a heater outlet and storage/utility temperature indication.
06 Flowmeter selection exercise	Compare flow-measurement methods for a hydrocarbon transfer line and a conductive utility-water line.
07 Level monitoring case	Identify suitable introductory level methods for a storage tank and a vessel; discuss false or unreliable readings.
08 Signal and calibration practice	Convert simulated 4-20 mA readings to percent of span; interpret zero/span checks and a simple loop-check sheet.

HANDS-ON EXERCISES

Practise What You Learn

Guided online activities use illustrative refinery diagrams, simulated instrument readings and practical worksheets to reinforce each module.

09 Feedback loop identification	Label setpoint, process variable, controller, actuator and disturbance for a storage-tank level-control loop.
10 PID trend interpretation	Review simple simulated process trends to distinguish steady response, offset and overshoot.
11 Valve and actuator identification	Interpret basic valve/actuator symbols and compare fail-open versus fail-closed scenarios.
12 Control-room display walk-through	Identify PV, SP, controller mode, alarms and trends on a sample DCS/HMI screen.
13 Alarm versus trip scenario	Sort sample refinery events into process alarm, operator action and protective-trip awareness categories.
14 Safe work pre-check	Review a sample permit/isolation checklist and identify missing basic instrument-work precautions.
15 Basic fault-finding worksheet	Follow a guided checklist for a noisy level signal or a valve not responding to a controller command.
16 Applied refinery case review	Annotate a simplified integrated P&ID; with instrument types, basic loops and alarm points; explain first-line observations.