Process Control: Instrumentation Trainer

The JobMaster Process Control - Instrumentation Trainer simulates industrial plant systems found in oil and gas, chemical and food production plants around the world. This training system makes an excellent platform for training in all aspects of multi-variable process control and monitoring. Featuring fully assembled components including water storage tank, level tank, preheater tank, transparent shell and tube heat exchanger, water cooling tower, pumps and instruments for the measurement of level, flow, temperature and pressure.

The multi-variable process control trainer can be connected to a programmable logic controller (PLC) or a distributed control system (DCS) for multi-variable configuration and process monitoring.

Specifications

Mechanical Construction:

**Platform**
- Dimension: (LWH) 1000mm x 500mm x 1500mm
- Weight: 100 kg
- Material: Stainless Steel

**Process Pipeline**
- Size: 0.5"
- Material: Stainless Steel

Main Components:

**Level Transmitter**
- Output: 4 – 20 mA
- Measurement range: 0 – 100 mm H2O

**RTD**
- Output: 4 – 20 mA
- Measurement range: 0 – 100 °C

**Flow Transmitter**
- Output: 4 – 20 mA
- Measurement range: 0 – 10 mm

**Panel mounted PID controller**
- Input: x1, 4 – 20 mA
- Output: x1, 4 – 20 mA
- Interface: Serial communication
- Main power supply and pushbutton for pump

**SCADA System**
- HMI graphic software
- Data acquisition
- LCD touch panel
- WiFi

**Pressure Transducer**
- Output: 4 – 20 mA
- Measurement range: 0 – 7bar

**Level tank**
- Diameter: 50mm
- Height: 100mm
- Material: Stainless steel
- Capacity: 100 Litres
- Level sight glass

Requirements

- Power Supply: 110 VAC /50 Hz
- Air Supply: 50 psig / 10 scfm

Documentation

System includes 2 sets each of:
- Equipment operation manual
- Instrumentation manufacturer manual
- Student experiment manual
- Instructor experiment manual
- Installation manual
- Instrument calibration training manual (HART)
- Instrument calibration standard operating procedures (SOP)

**JobMaster Process Control Trainers**
- Process Control - Level
- Process Control - Pressure
- Process Control - Temperature
- Process Control - Flow
- Process Control - Chemical Analytical
- Process Control - Instrumentation
Skills Acquired

1. Control System Setup
   - Wiring to PID controller
   - PID Controller operation
   - Configure the PID controller
   - Configure PLC/SCADA system (optional)
   - Configure DCS System (optional)

2. Process Control Tuning
   - P
   - I
   - D
   - P+I, P+D, P+I+D

3. Process Control Optimization
   - Ziegler Nichols tuning method
   - Cohan Coon tuning method
   - IMC tuning method

Curriculum Outline

Fundamentals of Level Measurement
1. Introduction to Instrumentation
2. Evolution of Process Instrumentation
3. Liquid Level Process Variables
   - Instrument Categories and Type
     - Local or Field
     - Indicating
     - Transmitting
     - Recording
     - Controlling
4. Process variable relationship
   - Relationship Between pressure and liquid level
5. Understand the level process variables and instrument
   - Introduction to Level
   - What is Level
   - Level Measurement categories and methods
   - Interface levels
   - Density and Hydrostatic Head pressure
   - Understand the Head Pressure
   - Level Sensing/Measurement Instruments
     - Gauge/Sight Glass
     - Flat Glass level gauges
     - Float gauges
     - Tape gauges
     - Differential Pressure
     - Bubbler
     - Displacers

Fundamentals of Flow Measurement
1. Introduction to Instrumentation
2. Evolution of Process Instrumentation
3. Liquid Flow Process Variables
   - Instrument Categories and Type
     - Local or Field
     - Indicating
     - Transmitting
     - Recording
     - Controlling
4. Process variables and instrument Flow
   - Introduction to Flow
     - What is Flow
     - Flow Measurement categories and methods
     - Fluid Properties
     - Reynolds Number
     - Flowmeter Selection
     - Classes of Flowmeters
   - Differential Pressure Flowmeters
     - Orifice Plate
     - Venturi Tube
   - Flow Sensing/Measurement Instruments
     - Flowmeters
     - Flowmeters
     - Flowmeters
     - Flowmeters

Fundamentals of Pressure Measurement
1. Introduction to Instrumentation
2. Evolution of Process Instrumentation
3. Air Pressure Process Variables
   - Instrument Categories and Type
     - Local or Field
     - Indicating
     - Transmitting
     - Recording
     - Controlling
4. Process variables and instrument Pressure
   - Introduction to Pressure
     - What is Pressure
     - Pressure Measurement categories and methods
     - Types of Pressure
5. Pressure Sensing/Measurement Instruments
   - Bourdon gauges
   - diaphragm gauges
   - spring gauges
   - piezoelectric gauges
   - Barometer
   - Pitot Tube
   - Manometer
   - Resonant
   - Magnetic

Fundamentals of PLC/DCS
1. Introduction to PLC/DCS
   - What is PLC/DCS
   - PLC/DCS History
   - PLC/DCS Evaluation
   - PLC/DCS Advantages
   - PLC/DCS Operation Concept
2. PLC/DCS System Overview
   - PLC/RTUs
   - PLC/DCS Masters
   - Project build-up, PLC Connection, variable simulation
3. PLC/DCS Basic functionality
   - PLC/DCS Explorer
   - PLC/DCS Configuration
   - PLC/DCS Graphic Designer
   - Editor for menus and toolbars
   - Centrally changeable objects (Faceplates)
   - PLC/DCS Alarm Logging Editor
   - PLC/DCS Tag Logging Editor
4. PLC/DCS Data Acquisition
5. PLC/DCS Data Communication
6. PLC/DCS Control
7. Which Industries implement PLC/DCS systems

Integrated Process Control
1. Introduction to Process Control and Control Loop
   - Definitions
   - Process variables (PV)
   - Set point (SP)
   - Manipulated Output (O, MV)
2. Control Loops
   - Open Loop
   - Closed Loop
3. Control Loop Components and Signals
   - Sensors and transmitter
   - Controller
   - Final Control Elements
     - Transmitter/Converting and Transmitting
     - Transducer/Converting
     - Pneumatic Signal
     - Electronic Signal
     - Loop Error
     - live Zero
4. Controller Characteristic
   - Auto/Manual Switch
   - Setpoint
   - Local/remote Switch
   - Direct Acting/Reverse Acting
   - P, I, and D
5. Controller Switching
   - Auto to Manual Mode
   - Manual to Automatic Mode
6. Types of Controller
   - Local Controller
   - Remote Controller
7. Final Control Element overview
   - Control valves
   - Electric Motor
8. Dynamic and Control
   - Load change
   - Lag Time
   - Dead Time
   - Reset Windup
9. Controller and Control Actions/Modes
   - Feedback Control
   - Direct or reverse acting controllers
   - On/Off control
   - Proportional/Integral/Derivatives
10. Process recording
    - Offset
    - Trend
    - Steady State
11. Tuning Mode (Gain and Reset)
    - P, I, D, PID
12. Combined control action
    - P+I, P+D, P+I+D
13. Troubleshooting
    - Cycling, Offset, Displacers