



The background of the slide features a complex technical diagram in a light purple color. It includes several interlocking gears of various sizes, some with dashed outlines. There are also several arrows: a large downward-pointing arrow on the right side, a horizontal arrow pointing left at the top, and three vertical arrows pointing downwards in the center. A grid of small squares is visible on the left side, and a series of small circles is arranged in a horizontal line in the center. The overall aesthetic is clean and professional, typical of a technical or educational presentation.

# Process Control

# Process Control

Level & Flow process control

Temperature process control

Level, Flow & temperature process control

Pressure process control

Distributed control

Industrial process control

PID control

Process Instrumentation

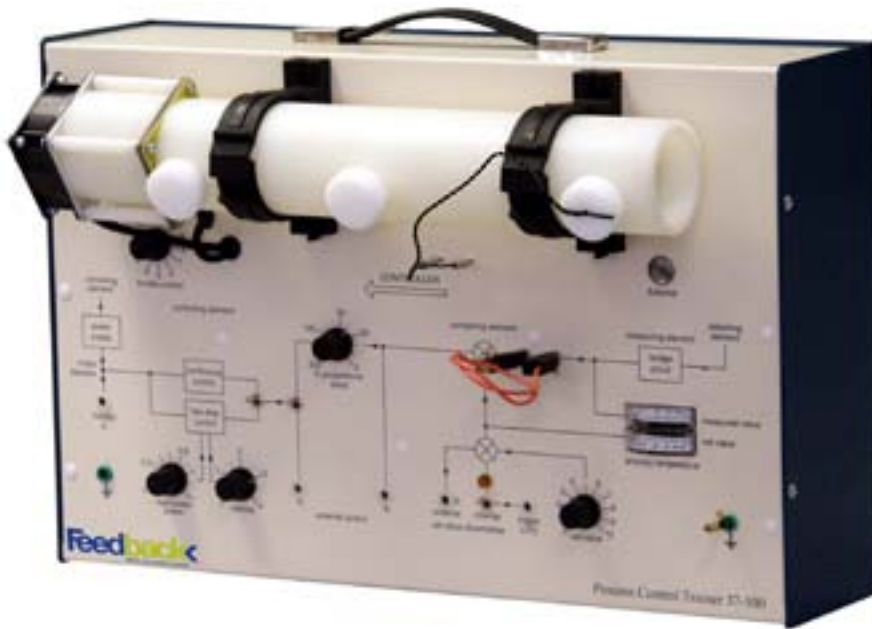
Fault finding

Process control applies the principles of automatic control to a physical process. Many industrial activities rely on process control in areas as diverse as mining and petrol refining to pharmaceuticals and semiconductor production. It relies on being able to make measurements so an understanding of process control requires students to grasp not only control topics, such as open and closed loop systems, but also those relating to measurements such as errors, noise, accuracy and uncertainties.

Modern process control design has to consider also energy use and raw material conservation. There are a wide range of process control applications but share common methods and underlying theoretical concepts.

Feedback's process control products have been designed to teach these shared concepts whilst addressing advanced control theory. The assignments focus on 'hands-on' learning so students are equipped with the knowledge and confidence to work on a wide variety of industrial systems.

Using these products, students will become familiar with designing, using and maintaining systems that contain a wide range of implementation such as industrial process controllers, current loops, PLCs, sensors and computer control.



The 37-100 Process Control Trainer teaches the basic ideas of process control to technicians, process operators and control engineers.

The instrument comprises a heating element controlled by a thyristor circuit which feeds heat into an airstream circulated by an axial fan along a polypropylene tube. A thermistor detector, which may be placed at one of three points along the tube length, senses the temperature at that point. The volume of air flow is controlled by varying the speed of the fan.

A change in setting represents a supply side disturbance and the effects are easily demonstrated.

The detector output is amplified to provide both an indication of the measured temperature and a feedback signal for comparison with a set value derived from a separate control.

A comparison of these signals generates a deviation signal which is applied to the heater control circuit such that the controlled condition is maintained at the desired value. Two step (ON/OFF) and Proportional band control is standard.

## Features

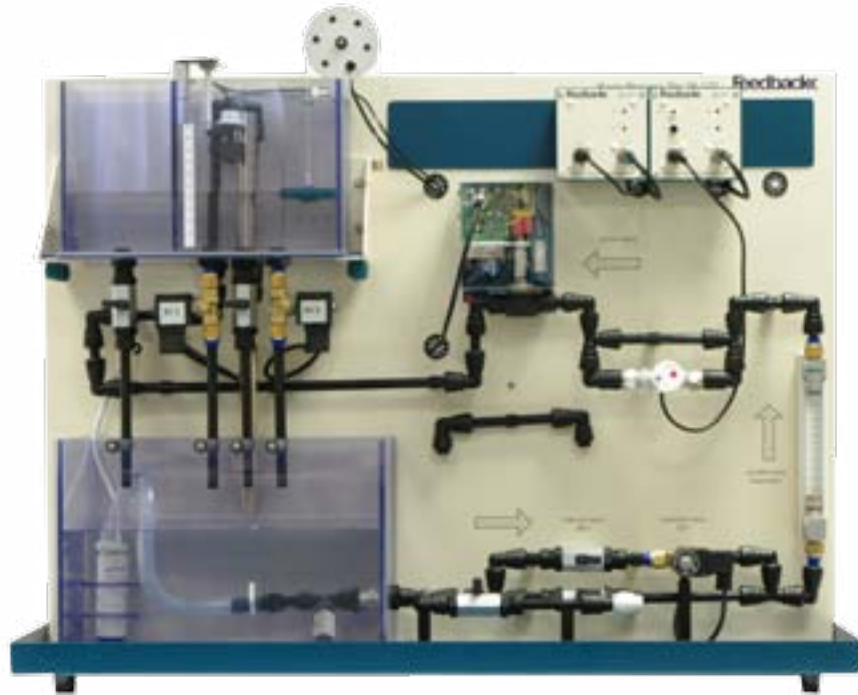
- A practical process in miniature
- Closed and open-loop continuous control as well as two-step control
- Fast response times
- Thermal time constants and time transport lag
- Easy-to-read metering

## Subject Areas

- Distance/Velocity Lag
- Transfer Lag
- Calibration
- Two-step Control
- Proportional Control System Response
- Frequency Response

# 38-001 SYSTEM

## Level & Flow control



### Features

- Contains a selection of level and flow sensors & indicators
- Flow controlled by linear motorised control valve
- On/Off and proportional control
- P, PI and full PID control with autotune facility
- Couples with Temperature Trainer for dual loop control
- Espial teaching software

### Subject Areas

- Flow, Level, Controller & Interface familiarisation and calibration
- Float level transmitter
- Pulse flow transmitter
- On-Off control
- Study of P, PI and PID control of Level and Flow
- PID controllers
- Advanced process control

The Level/Flow Process Trainer is a single loop system allowing the study of the principles of process control, using liquid level and flow rates as the measured process variables. The system is a completely self-contained, low pressure flowing water circuit supported on a benchtop-mounted panel, making it suitable for individual student work or for group demonstrations.

It comprises a dual compartment process tank, linked to a sump tank by manual and solenoid operated valves. Water is pumped through the system, via a variable area flow meter and motorised control valve. Level is measured in the process tank. Flow is measured through an optical pulse flowmeter.

The 38-300 Process Controller is fitted with an ABB industrial controller and configured by the user to provide a range of control functions from 2-state control to 3-term PID control.

The system is furnished with the 38-200 Process Interface which provides all of the necessary power outlets for the Process Trainer, sensors and Process Controller.

It accepts up to four 4-20 mA transmitter signal inputs and allows signal patching so that different control schemes can be quickly configured. It also provides a 4-20 mA. current source, two current to voltage converters and a voltage comparator with adjustable hysteresis which can be used to provide a simple 2-state control loop in addition to the main controller loop.

The ABB Industrial Process Controller 38-300, is microprocessor based and is easily configured by the user to provide a range of control functions from 2-state control to 3-term PID control.



The Temperature Training System uses water as the process fluid which allows the study of the principles of process control using primary and secondary circuit temperatures as the process variables to be controlled.

Both circuits pass through the heat exchanger and the secondary circuit contains a fan-assisted cooling radiator.

The Trainer can be used with a cold mains water supply through the Auxiliary Temperature Control Pack 38-480 which is supplied as part of the system.

This comprises a motorised control valve, a flow meter and a signal conditioning unit. Alternatively the Temperature Trainer can be connected to the Level & Flow Process Trainer, which then supplies the cold water circuit. This combination allows more complex control systems to be investigated.

A Forced Air Cooler 38-610 is also available. It accelerates the process dynamics using a constant input temperature, allowing a high temperature differential to be monitored for longer periods.

### Subject Areas

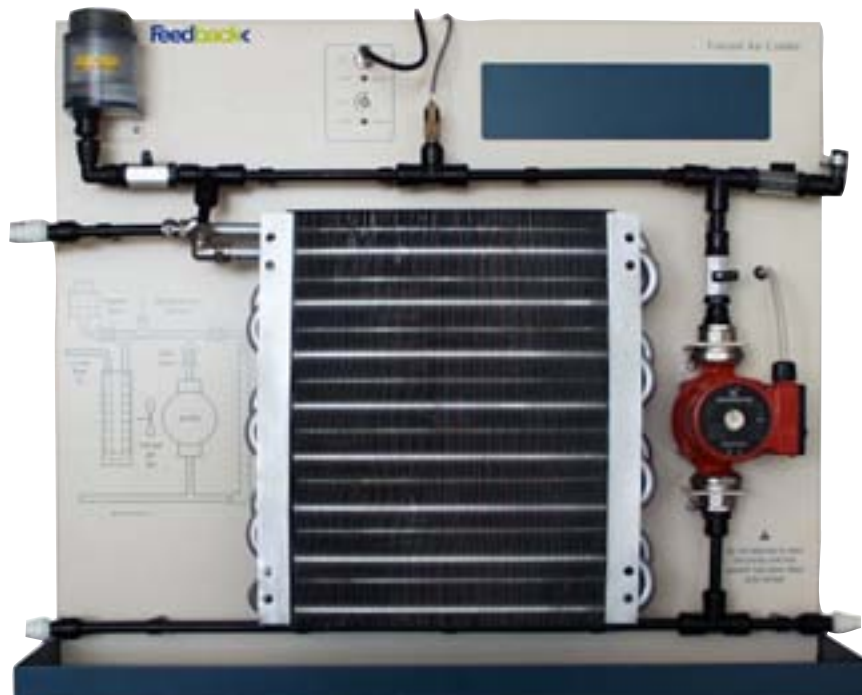
- Temperature familiarisation and calibration
- Interface familiarisation and calibration
- Controller familiarisation and calibration
- Pulse flow transmitter
- On-Off control
- Study of P, PI and PID control of temperature and flow
- Manual flow control
- Temperature process control
- Complex control loops
- Dual loop (process) control - using Level/Flow and temperature trainers
- Remote set point control
- Set point ratio control
- Cascade control
- Feed-forward control

### Features

- Temperature monitored in primary & secondary circuits, flow also monitored
- P, PI and PID control with autotune facility
- Primary circuit flow controlled by motorised control valve
- Primary circuit heater and pump
- Secondary circuit fan-assisted cooling radiator
- Modern push fittings
- Water used as the process fluid
- Operates from mains water supply
- Espial teaching software

## 38-610

### Forced Air Cooler



The 38-610 Forced Air Cooling Unit is designed to extend the operating range of the Feedback Temperature Control Rig and allow the direct control of its operating characteristics.

The 38-610 consists of an electric pump, fan and radiator unit to cool the circulating water. The speed of the fan and the pump are controlled by 4-20 mA signals.

This equipment is designed to be used with the Temperature Trainer, or between the Temperature and Level and Flow Trainers to maintain a constant fluid input temperature.

#### Features

- Enables quick response times in temperature reduction
- Variable speed fan
- Variable speed pump

#### Subject Areas

- Familiarisation
- Use as a manually controlled cooler
- Temperature control by varying fan speed
- Temperature control by varying pump speed





The combined Level/Flow and Temperature Process Control System is self-contained and has all of the features of the individual Level/Flow and temperature systems plus Remote Set Point Control.

Remote Set-Point Control can be affected with the PROCON Level/Flow and Temperature Process Control System by using two Process Controllers.

The 4-20mA Analogue Remote Set-Point input allows various forms of cascade control to be implemented between linked or interactive control loops.

The process set-point can be Local and Remote or Dual, selected from the front panel, or in response to a logic input. When Dual Set-Point is selected the function can be ratio or bias action.

A Programmable Logic Controller (PLC) 38-350 is also available. It can be used with the Process Interface 38-200 to provide an alternative control method with on/off elements to the standard Process Controller 38-300.

For continuous use it is recommended that the 38-610 is used in conjunction with this system.

## Features

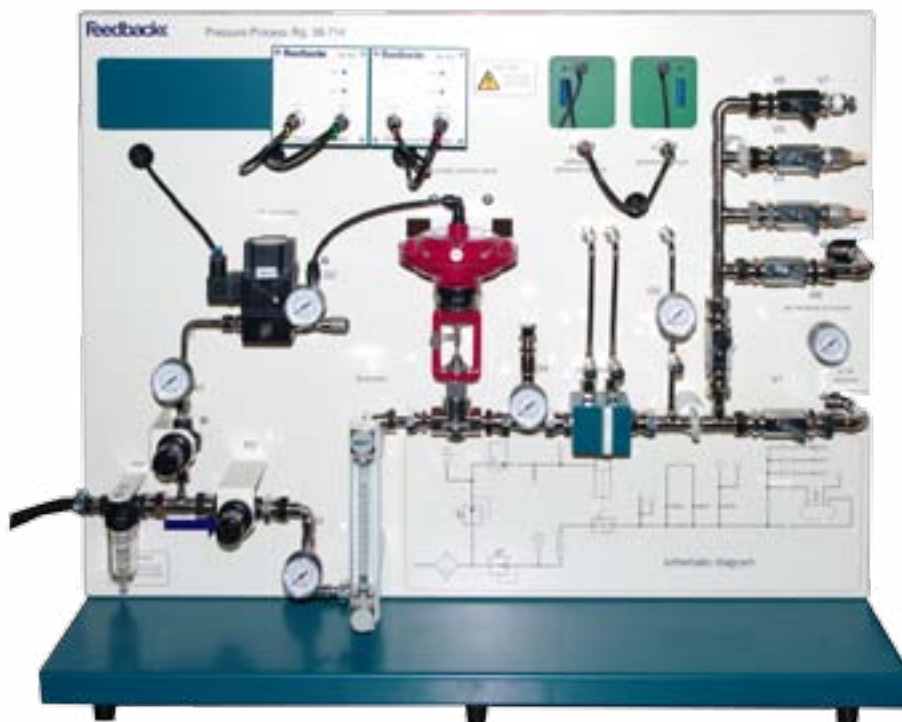
- Level, flow and temperature sensors and indicators
- Primary and secondary flow control by linear motorised control valves
- On/off & proportional control
- P, PI and full PID control with autotune control
- Dual loop cascade control
- Industrial process controllers
- Espial teaching software

## Subject Areas

- Remote set point control
- Set point ratio control (Dual Loop)
- Cascade control
- Feed-forward control

# 38-004 SYSTEM

## Pressure Process Control



### Features

- Safe low pressure operation
- Fully gauged for pressure and flow rate
- Differential and Gauge pressure sensors
- Current controlled (4-20mA) pneumatically operated control valve
- Standard industrial components
- Self-sealing outlets for manometer
- Safety valves fitted as standard
- Air used as the process fluid

The Pressure Training System is a single loop pneumatic control system. It enables the study of the principles of both pressure regulation of a process and the control of flow in a pressurised system.

The System comprises a low pressure air circuit supported on a panel for use on a benchtop, making it suitable for individual student work or for group demonstration. The Pressure Trainer requires a compressed air supply at a recommended input pressure of 40psi.

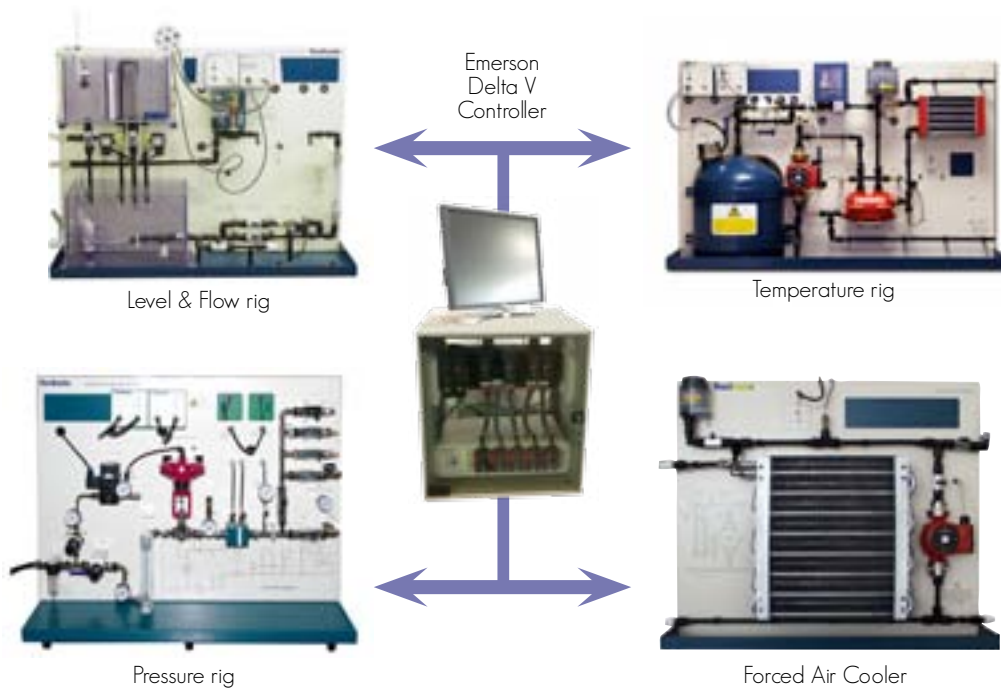
An input filter/drier is used to clean the supplied air. Separately regulated branches provide air for the process and for valve control.

The process branch comprises a regulator, a variable area flow meter, a pneumatically operated control valve, an orifice block with changeable orifice plates and both differential and point of measure pressure sensors. Optional Accessory: Air Compressor 38-820.

### Subject Areas

- Pressure safety, familiarisation and calibration
- I/P converter and Pneumatic control valve operation
- Controller familiarisation and calibration
- Automatic control systems
- Serial communication
- Pressure sensor, transmitter and I/P converter - Linearity and Hysteresis
- Pneumatic control valve - characteristics at different pressure ranges
- System response and Air receiver
- Principles of Proportioning valve and proportional process control
- Study of P, PI and PID control of Pressure
- Calibration of the differential pressure sensor & transmitter





The Feedback Distributed Control System (DCS) trainer is a complete training solution that combines the operations of Emerson's Delta V, with an assortment of our proprietary training rigs. The training rigs offer a range of processes:

- **Level and Flow**
- **Temperature**
- **Pressure**
- **Forced Air Cooling**

These may be combined to produce a multi-process, multi-loop system. The trainer is supplied complete with the PC, software, controller and I/O modules that are needed to monitor and control the process rigs.

A control cabinet houses the components that provide the interface between the PC and the rigs. The control cabinet is easily connected to the PC and rigs using the supplied cables.

The valves, transducers and transmitters associated with the training equipment are standard industrial components that operate using simple 4-20 mA current loop control, and 24 V d.c.

#### Features

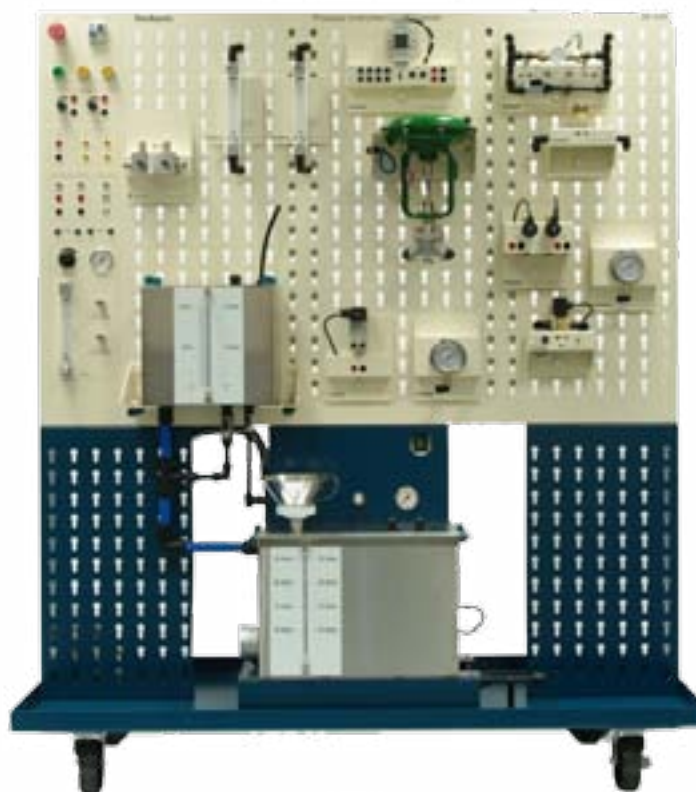
- Totally self-contained with all power supplies and fluid sources
- Industrial control devices and sensors
- PC programmable devices
- 4-20mA Current Loops
- Practicals (hands-on experience) within each assignment
- Fully developed curriculum
- Objectives for each assignment

#### Subject Areas

- DCS background theory
- An introduction to Delta V
- Trainer configuration
- Basic on/off control
- Advanced on/off control
- Levels and alarms
- Sequential function charts
- PID control

# 38-025 SYSTEM

Process Instrumentation Trainer



## Features

- Totally self-contained with all power supplies and fluid sources
- Industrial control devices and sensors
- PC programmable devices
- Modular and versatile
- Allows calibration & testing of process transmitters
- 4-20 mA current loops
- Mobile wheeled trolley
- Fully developed curriculum
- PID Controller

Modern process devices are becoming increasingly complex and functionally very powerful. To introduce students to these devices and give them experience in the selection and utilisation of them, Feedback designed the Process Instrumentation Trainer.

The sensors, actuators and PC programmable devices are all typical industrial units. The training system has been specifically designed to give students hands-on experience of setting-up, calibration and use of such devices.

Based on a mobile trolley that incorporates all electrical, water (including a water heater) and air controls, the system provides a totally self-contained unit.

The punched front panel provides a construction area that allows devices to be fixed to it via a series of keyhole slots. The instrumentation devices are mounted on robust carriers that allow them to be located and locked onto the front panel. Optional Accessory: Air Compressor 38-540-AC.

## Subject Areas

- 4-20 mA Current Loops
- 4-20 mA Programmable display
- Capacitive Level Sensor and Transmitter
- Temperature Sensors and Transmitter
- Flow Meter and Pulse Flow Sensor
- Introduction to Control Valves
- Pressure Devices
- Current to Pressure (I-P) Converter
- The Orifice Block
- Universal Transmitter
- Process Controller



The Industrial Process Trainer has been designed to teach a methodical approach to fault diagnosis in industrial processes. The methodologies taught within the system are equally relevant to any student or trainee studying fault diagnosis. Faults can be introduced by the instructor via switches concealed behind a locked compartment, to which the student does not have access.

These switches provide both short circuits and open circuits and can also switch in or out circuit elements to simulate a variety of fault conditions. Additional faults can be inserted into the process through the replacement of working components with faulty ones, e.g. faulty flow switches; faulty relays; faulty solenoid coils and faulty control valve electronic circuit board.

The process involves initially filling a header tank with water and then cycling the level between a set upper and lower limit, whilst simultaneously creating a demand from the header tank via two on/off solenoid drain valves into a sump tank. Flow is produced by a pump and controlled by relay operated on/off solenoid valves.

Designed for students studying industrial process maintenance, it can also be used as a process trainer in its own right, using either Industrial Process Controllers or Programmable Logic Controllers (PLCs).

A PLC interface board 34-252-1 is available for users to connect their own PLC and develop their own programs.

### Subject Areas

- Introduction to the system
- Fault finding methodologies
- Fault analysis flow charts
- Fault finding from circuit diagrams
- Fault identification to Line Replaceable Unit level
- Simple electronic fault finding
- Diagnostic tools
- Maintenance procedures
- Process control techniques
- Fault finding processes controlled from electronic controllers
- Interfacing to Programmable Logic Controllers (PLCs)

### Features

- Teaches fault diagnosis and fault finding methodologies
- Capable of being externally controlled using Process Controllers and PLCs
- Self contained process
- Wide range of easy to apply faults
- Mechanical, electrical & electronic faults can be applied