



## ≡ COUPLED TANKS APPARATUS

CE105/CE105MV

A self-contained, benchtop apparatus to demonstrate basic and advanced principles of control of single and coupled tanks, including the study of static and dynamic systems.



### KEY FEATURES

- Self-contained and compact benchtop unit that mimics a real industrial process
- Option for second pump with second flow meter to allow multi-variable (MV) operation (CE105MV)
- Level control of one and two tanks
- Front panel includes mimic diagram of the process so students can see what they are controlling
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers
- Includes rotameter-type flow meter so students can see the flow rate



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## DESCRIPTION

The Coupled Tanks Apparatus investigates basic and advanced control engineering principles. This includes the study of static and dynamic systems. It is also an ideal system to use with other control strategies such as fuzzy logic.

The CE105 shows fluid transport and liquid level control problems in process control.

The basic control problem is to regulate the liquid level in one of the tanks by varying the speed of the circulating pump. The user guide includes experiments that cover system modelling using static and transient measurements, steady-state error analysis, transient response studies and Ziegler/Nichols tuning methods.

Each tank has a level sensor that gives output signals proportional to the water level in each tank. A scale on each tank allows students to check the level-sensor calibration.

A variable-speed pump forces water into the left-hand tank. A valve connects this tank to a second tank, if needed, for two-tank experiments. A rotameter-type flow meter shows the flow rate. An electronic flow meter measures the flow rate.

The CE105MV Multi-Variable Coupled Tanks Apparatus gives extra experiments. It is similar to the CE105 but with a second pump and flow meter. This pump forces water into the right-hand tank and works independently of the other pump. This gives more advanced experiments into the principles of multi-variable control (both pumps work together to give the correct levels in the two tanks simultaneously).

## STANDARD FEATURES

- Supplied with comprehensive user guide
- Five-year warranty
- Made in accordance with the latest European Union directives
- ISO9001 certified manufacturer

## LEARNING OUTCOMES

- Calibration of transducer and actuator circuits
- System dynamics in process systems
- Design and operation of analogue proportional, proportional + integral, or proportional + integral + differential control controllers
- Steady-state errors and closed-loop transient responses
- Ziegler/Nichols controllers tuning rules
- Multivariable control
- Step-change tuning
- State feedback
- Flow control

The flexible design of the equipment allows the user to develop many other analysis and control exercises to suit their needs. It is good for extended or advanced control experiments, and is ideal for student project work.

## ESSENTIAL BASE UNIT

- Controller (CE120): A controller with analogue and digital controls and instruments **OR**
- Digital Interface (CE122): An interface which connects between most products in the Control Engineering range and a suitable computer (not included) **OR**
- Other suitable controller with 10 V inputs and outputs

Both the CE120 and the CE122 include TecEquipment's CE2000 Control Software (see separate datasheet) with editable, pre-made control experiments for use with the CE105.

## ESSENTIAL SERVICES

### ELECTRICAL SUPPLY:

Single Phase, 90- 250 VAC, 50/60 Hz, 400 mA

### BENCH SPACE NEEDED:

1 m x 750 mm

## OPERATING CONDITIONS

### OPERATING ENVIRONMENT:

Laboratory

### STORAGE TEMPERATURE RANGE:

-25°C to +55°C (when packed for transport)

### OPERATING TEMPERATURE RANGE:

+5°C to +40°C

### OPERATING RELATIVE HUMIDITY RANGE:

80% at temperatures < 31°C decreasing linearly to 50% at 40°C

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## SPECIFICATIONS

TecQuipment is committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice.

### NETT DIMENSIONS AND WEIGHT:

545 x 320 x 685 mm  
24 kg empty; 29 kg with water

### APPROXIMATE PACKED DIMENSIONS AND WEIGHT:

0.09 m<sup>3</sup>, 31 kg (approx – packed for export)

### INPUTS (0-10 VDC):

- Pump 1 speed
- Pump 2 speed (MV only)

### OUTPUTS (0-10 VDC):

- Flow 1
- Level 1
- Flow 2 (MV only)
- Level 2

### OTHER PARTS INCLUDED:

- Connecting cables
- Liquid colouring

## SOUND LEVELS

Less than 70 dB(A)