



CE107

## ENGINE SPEED CONTROL APPARATUS

Compact, self-contained, bench-mounting apparatus to study basic and advanced principles of engine speed control



- Self-contained and compact bench-mounting unit to show problems of speed control in non-linear systems
- Small-scale compressed air-powered piston engine to mimic a full-size engine with realistic results
- Front panel includes a mimic diagram of the process so students can see what they are controlling
- For basic and advanced experiments with speed control and non-linearity compensation
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers

# ENGINE SPEED CONTROL APPARATUS

## DESCRIPTION

The CE107 Engine Speed Control Apparatus shows the problems of regulating the speed of rotating machines, especially problems with non-linear control systems.

It is a scale-model engine, driven by compressed air (not supplied) for safety. The basic purpose is to adjust a motorised valve to regulate the engine speed under load. A d.c. generator connects to the engine output and loads the engine.

More advanced experiments show:

- Non-linearity compensation using dither signals
- Multiple loop and minor loop feedback
- System modelling from step response information
- P+I control and root locus methods

The engine dynamics are similar to those of a typical ignition compression engine coupled to a dynamometer-controlled test bed. It is an ideal physical model to help engineering students at all academic levels to gain invaluable practical experience.

## STANDARD FEATURES

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

## LEARNING OUTCOMES

- The use of dither signals in the compensation of system non-linearities
- The measurement of system dynamics from step response information
- Inner loop feedback compensation
- P+I controller design

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  $\pm 10$  V inputs and outputs

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see separate datasheet) with editable, pre-made control experiments for use with the CE107.

## ESSENTIAL ANCILLARY

- Compressor (CE1b)

## RECOMMENDED ANCILLARIES

To accurately calibrate the engine speed in some experiments, you need:

- Optical tachometer (OT1) – a hand-held optical tachometer

or

- Stroboscope (ST1)

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## ESSENTIAL SERVICES

### ELECTRICAL SUPPLY:

90 VAC to 250 VAC, 1 A, 50/60 Hz, with earth

### COMPRESSED AIR SUPPLY:

Minimum 5 bar, maximum 10 bar, nominal 10 litres/minute

### BENCH SPACE NEEDED:

1 m x 750 mm

## OPERATING CONDITIONS

### OPERATING ENVIRONMENT:

Laboratory

### STORAGE TEMPERATURE RANGE:

-25°C to +55°C (packed)

### OPERATING TEMPERATURE RANGE:

+5°C to +40°C

### OPERATING RELATIVE HUMIDITY RANGE:

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

## SOUND LEVELS

Less than 70 dB(A)

## SPECIFICATIONS

### NETT DIMENSIONS AND WEIGHT:

540 x 330 x 420 mm; 22.5 kg

### PACKED DIMENSIONS AND WEIGHT:

0.34 m<sup>3</sup>, 46 kg (approx – packed for export)

### INPUTS (0 TO 10 VDC):

- Motorised air valve: 0 to +/- 10 VDC
- Generator load control

### OUTPUTS (0 TO 10 VDC):

- Air valve position: 0 to +/- 10 VDC
- Engine speed

### OTHER PARTS INCLUDED:

- Connecting cables
- Lubricating oil
- Hexagon tool