



Theory of Machines

TM1022**Balance of Reciprocating Masses**

A model four-cylinder engine that shows the primary and secondary forces and moments when balancing reciprocating masses



- Model four-cylinder engine assembly held on a cantilever supported on a bench mounted pillar
- Includes a Control and Instrumentation Unit to process the force and moment signals. This unit also has an electronic drive control – to adjust and display the engine speed accurately
- Shows both primary and secondary forces and moments and how to balance them
- Simulates one, two and four cylinder engines
- Variable crank angle settings and additional piston masses – for a range of tests
- Highly visual - ideal for classroom demonstrations
- Works with the oscilloscope (OS1) to show dynamic force and moment waveforms for popular engine arrangements and compare them with theory

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- An ISO 9001 certified company

TM1022

Balance of Reciprocating Masses

Description

A bench-mounting model four-cylinder engine that shows primary and secondary forces and moments in reciprocating masses and how to balance them. This product is an excellent follow-on from the Static and Dynamic Balancing equipment (TM1002).

A robust support pillar fixes to a suitable table or bench (not supplied) with a low natural frequency. The pillar holds a cantilever that holds a model four-cylinder engine. The model engine has a crankshaft, connecting rods, bushes (as big-end bearings), pistons and a cylinder block. A separate Control and Instrumentation Unit (included) controls a motor that turns the engine crankshaft.

The crankshaft has adjustable sections. Students can rotate each section relative to the others to change the crank angles. To avoid affecting the experiments, TecQuipment balance the crank sections for all crank angles, even allowing for the connecting rods.

The crankshaft includes a sensor that works with the Control and Instrumentation Unit to measure and display engine speed. It also helps to give a trigger output at top dead centre of the first piston. Each piston includes a tapped hole to allow students to add weights (included) to vary its mass.

The supporting pillar fixes to a workbench, so the engine's centre of mass is on the cantilever axis. Strain gauges on the cantilever detect the bending and torsional strains. The gauges connect to the Control and Instrumentation Unit that calibrates and processes their signals and gives outputs for the oscilloscope (OS1).

Students first find the engine's resonant speeds. They then experiment with different engine arrangements to understand balancing and how to allow for unbalanced reciprocating masses.

A removable transparent guard with a safety interlock protects students from the moving crankshaft.

Standard Features

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

Essential Ancillaries

- Oscilloscope (OS1) – needed to see the dynamic force and moment waveforms and amplitudes

Experiments

- Primary and secondary forces and moments in popular engine configurations - one, two and four cylinder.
- Primary and secondary forces and moments for different crank settings.
- The effect of adding additional mass to one or more pistons for any chosen crank setting.
- Comparing calculated forces and moments with actual results.

Essential Services

Bench space needed:

1000 mm x 1000 mm (allowing for the oscilloscope)

Note - the bench must be strong and heavy - and have a low natural frequency

Electrical supply (TM1022):

220 VAC to 240 VAC phase to neutral or phase to phase
50 Hz to 60 Hz at 1.5 A

Note: Please state your electrical supply type on order.

*Ask our sales department about the electrical supply for the Optional Oscilloscope (OS1)

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

Sound Levels

Less than 70 dB(A) in normal use

Specifications

Nett dimensions and weights:

Engine, support pillar and cantilever: 35 kg

Dimensions of the engine, pillar and cantilever when fixed to a suitable table: 400 mm x 300 mm x 410 mm

Control and instrumentation unit: 180 mm x 360 mm x 400 mm and 8 kg

Packed dimensions and weight (total):

0.16 m³ and 50 kg

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