TECQUIPMENT ACADEMIA

60 TECQUIPMENT 1958 2018 YEARS OF SUPERIOR QUALITY

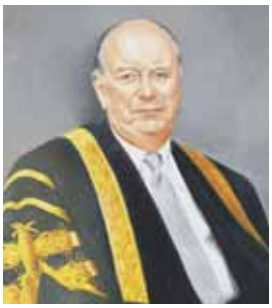
FIVE YEAR QUALITY TECQUIPMENT SINCE 1958 WARRANTY

PRODUCT CATALOGUE 2018
ENGINEERING EXCELLENCE IN EDUCATION

TECQUIPMENT HERITAGE

1958

TecQuipment was founded in 1958 by engineering pioneer Sir Joseph Pope, Professor of Mechanical Engineering at the University of Nottingham, and renowned clock maker Mr William Cope.



SIR JOSEPH POPE

MR WILLIAM COPE

1960s

TecQuipment began exporting across the world.

1970s

The company moved to new premises in Long Eaton, Nottinghamshire UK. This remains the global headquarters.

1980s

Expanded exports to countries including Turkey, Greece and Mexico. In recognition for excellent international trade, the company received a Queen's Award.

1990s

To expand the product range, TecQuipment acquired JJ Lloyds, Gilkes, Nickersons, Locktronics and Plint. During this decade the Structures range of products was launched and exports increased to countries including Saudi Arabia, Libya and Kuwait.

00s

As the digital age established itself, TecQuipment introduced its digital data acquisition module, VDAS®, that allows students to capture data from experiments on a computer. It was a decade of focusing on across-the-range product modernisation.

In 2008 the TecQuipment educational products company that we know today was bought out by Simon Woods, the current Managing Director.

2010s

Major global market expansion, with sales to more than 1500 customers in over 100 countries.

2018

60th anniversary

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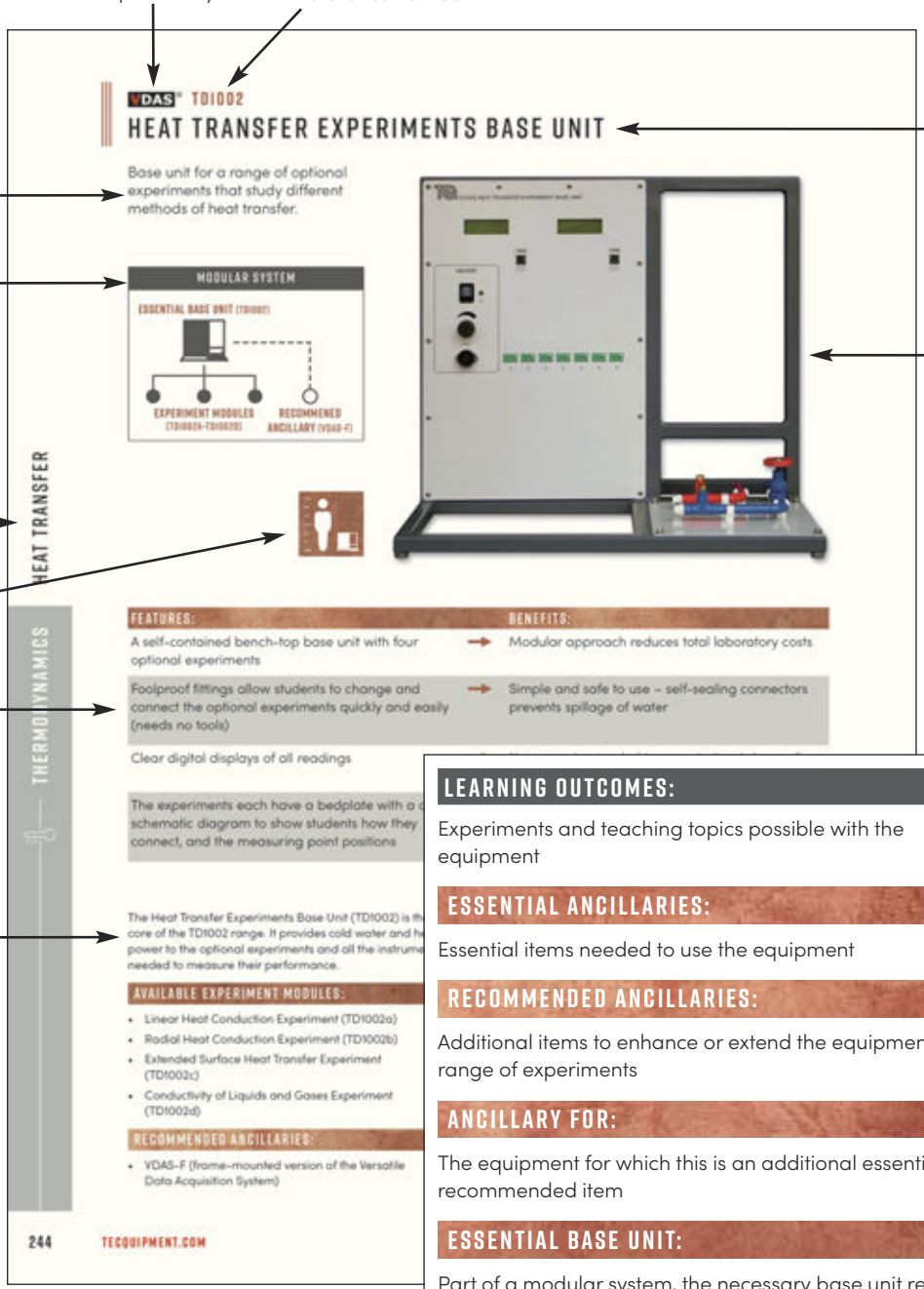
USING THIS CATALOGUE

We have specially designed each page in this guide to help you find the information you need quickly and easily. The different areas are explained below.

Our datasheets contain a full description and technical specification for each of our products. Download them at: TECQUIPMENT.COM



LEARNING OUTCOMES:

Experiments and teaching topics possible with the equipment

ESSENTIAL ANCILLARIES:

Essential items needed to use the equipment

RECOMMENDED ANCILLARIES:

Additional items to enhance or extend the equipment's range of experiments

ANCILLARY FOR:

The equipment for which this is an additional essential or recommended item

ESSENTIAL BASE UNIT:

Part of a modular system, the necessary base unit required to work with the equipment to make a complete system

AVAILABLE EXPERIMENT MODULES:

Experiments available which work with the base unit to form a modular teaching system

ALTERNATIVE PRODUCTS:

Alternative, matching or similar TecQuipment products

These headings are designed to make it easy to select all the necessary products for your teaching needs

60 YEARS OF EXPERIENCE

Welcome to the TecQuipment catalogue. For full details on each item, visit the TecQuipment webpage and download the supporting datasheet that includes the complete specification.

> During our 60 years we have endeavoured to be the market leader within the educational products industry. Only through our pursuit of excellence, high quality and support have we been able to inspire generations of engineers. We look forward to continuing our partnership with academics across the world as we develop the engineering talent of the future.
>
> **SIMON WOODS, MANAGING DIRECTOR**

60 YEARS OF SUPERIOR QUALITY

In our 60th year, we are proud to be working with over 1,500 customers in more than 100 countries across the globe. The TecQuipment brand is synonymous with high quality and consistency, which gives us confidence in providing a five-year warranty across the entire range. Such is the longevity of TecQuipment products, laboratories around the world are still using equipment manufactured in the 1960s.

MARKET LEADING DELIVERY TIME-SCALES

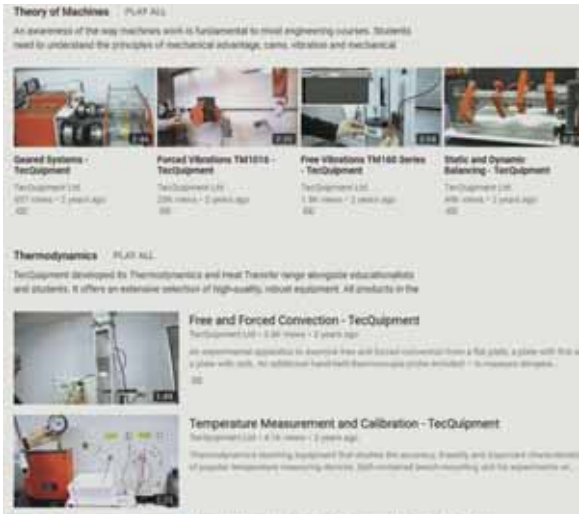
We understand that delivering in a timely manner is very important. To give us the flexibility to provide market leading delivery time-scales, TecQuipment products are produced, assembled and tested on-site in our UK manufacturing facility.

ONGOING COMMITMENT TO IMPROVING EDUCATION

We maintain a commitment to the future of progressing higher education teaching and understand that the way students are learning and being taught continues to change. With this in mind, we are continually striving to seek methods of supporting the educator, to be more effective in teaching the students of today and tomorrow.

PEER COMMUNITY

There are many ways that peers can interact on the TecQuipment social media pages: search TecQuipment on Facebook, LinkedIn, Twitter and Instagram. Why not check out the latest product movies on YouTube as well.



OUR PRODUCTS AND INDUSTRY

TECQUIPMENT RANGE	SUBJECT AREA	INDUSTRY															
		AEROSPACE	AGRICULTURE	AUTOMOTIVE	CHEMICAL/PHARMA	CIVIL ENGINEERING	CONSTRUCTION	DEFENCE	FOOD AND DRINK	MARINE	METALS	MINING	OIL AND GAS	POWER	RAIL	RENEWABLES	UTILITIES
AERODYNAMICS	Subsonic Wind Tunnels	✓		✓		✓	✓	✓						✓		✓	✓
	Supersonic Wind Tunnels	✓		✓				✓					✓		✓		
	Special Purpose Wind Tunnels	✓		✓	✓	✓	✓	✓					✓		✓		
CONTROL ENGINEERING		✓		✓	✓			✓	✓	✓			✓		✓		
PROCESS CONTROL					✓				✓				✓	✓			✓
ELECTRICAL POWER					✓	✓		✓	✓	✓			✓	✓	✓	✓	✓
ENGINEERING SCIENCE	Forces and Moments	✓				✓	✓			✓							
	Materials Testing	✓		✓		✓	✓								✓	✓	
	Vibration, Friction, Energy			✓						✓					✓		
	Simple Machines	✓		✓		✓	✓						✓		✓		
	Mechanisms	✓		✓			✓			✓					✓		
FLUID MECHANICS	Flow and Pressure	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
	Friction	✓	✓	✓	✓	✓	✓		✓	✓			✓				✓
	Open Channel		✓			✓				✓				✓		✓	✓
	Hydrostatics	✓	✓		✓	✓	✓	✓	✓	✓		✓		✓			✓
	Hydrology	✓	✓			✓	✓					✓					✓
	Fluid Power	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓
MATERIALS TESTING AND PROPERTIES	Basic Properties	✓		✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	
	Strain Gauging	✓		✓	✓	✓	✓				✓	✓	✓	✓		✓	
	Destructive Testing	✓		✓		✓	✓	✓			✓	✓	✓		✓		
STATICS FUNDAMENTALS						✓	✓							✓			
STRUCTURES	Beams	✓	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓		
	Failure	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓		✓
	Arches, Bridges, Trusses	✓	✓		✓	✓	✓		✓			✓		✓	✓	✓	✓
THEORY OF MACHINES	Friction	✓	✓	✓		✓	✓				✓	✓		✓	✓	✓	
	Motion	✓		✓		✓		✓		✓	✓	✓	✓	✓	✓	✓	
	Vibration	✓		✓		✓				✓	✓	✓	✓	✓	✓	✓	✓
THERMODYNAMICS	Fundamentals	✓			✓	✓	✓	✓	✓		✓	✓	✓			✓	
	Heat Transfer/Exchange	✓		✓	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓
	Steam					✓			✓		✓		✓	✓	✓		✓
	Compressors	✓	✓		✓	✓	✓	✓		✓		✓	✓				
ENGINES	Internal Combustion Engines	✓		✓				✓		✓			✓	✓			
	Gas Turbines	✓			✓			✓		✓			✓	✓	✓		✓
ENVIRONMENTAL CONTROL		✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓		✓
SOLAR ENERGY						✓	✓							✓		✓	

ENGINEERING SCIENCE

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> “
>
> I am very pleased to find the highly innovative and professional approach of TecQuipment Ltd in designing and manufacturing a variety of equipment for engineering and technical education at all levels. Such equipment is very useful to develop conceptual skills in students.
>
> **DR ING V P SINGH**
> SHRI VAISHANV INSTITUTE OF TECHNOLOGY AND SCIENCE, INDORE, INDIA

ENGINEERING SCIENCE

The Engineering Science (ES) range of products is a system of experiment kits that covers many of the underlying mechanical engineering topics that students need to be familiar with, including:

- FORCES AND MOMENTS
- MATERIALS TESTING
- VIBRATION, FRICTION AND ENERGY
- SIMPLE MACHINES
- MECHANISMS

The system is suitable for use on courses from foundation level up to hands-on technology familiarisation programmes at post-graduate level.

The kits are high quality, robust, very visual and meant for hands-on learning. They can be used to make the vital link between theory and real systems and practical applications.

This is a modular system based around a robust, re-usable work panel onto which students set up and perform their experiments. This means you can order as much or as little as you like, and a comprehensive system can be built up over a period of time.

IDEAL FOR CURRICULA BASED ON EDUCATING STUDENTS IN FOUR SPECIFIC DISCIPLINES – SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS – IN COLLEGES AND SCHOOLS. THE ES RANGE, WITH ITS HANDS-ON APPROACH AND DETAILED NOTES ON EXPERIMENTS, PROVIDES THE PERFECT LINK BETWEEN THEORY AND REAL-WORLD APPLICATIONS.

TECQUIPMENT'S ENGINEERING SCIENCE RANGE IS THE FOUNDATION OF STEM EDUCATION.

COMPREHENSIVE EXPERIMENT KITS

- Each kit offers multiple experiments – with over 60 experiments for the 18 kits, it is outstanding value for money.
- All the kits are safe and simple to use – ideal for minimal supervision at many levels of education.

LONG-LASTING WORK PANEL

- Rugged, compact and easy to use – the Engineering Science work panel comes with over 1000 pages of worksheets, notes and lecturer material in PDF format.

CONVENIENT STORAGE

- Kits are housed in tough, stackable trays.
- A purpose-built mobile storage unit offers you the flexibility to expand your range.

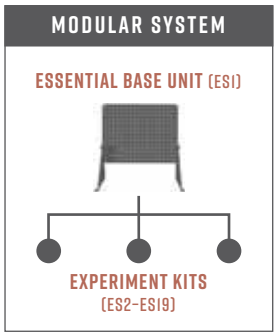
FLEXIBLE ORDERING

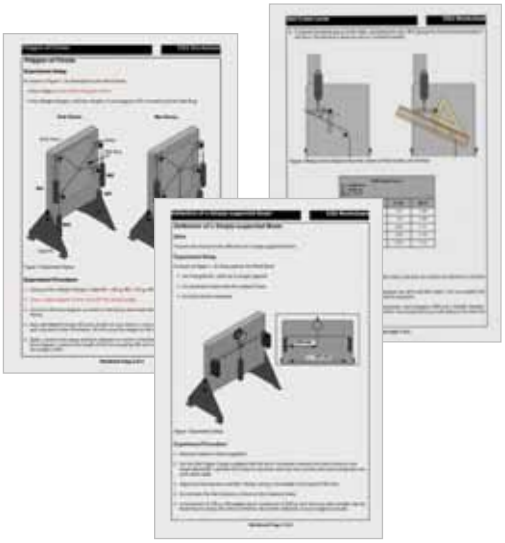
- Start with one panel and one experiment, a bundle or buy the whole range – TecQuipment's Engineering Science range can be completely tailored to your needs and budget.

ES1

WORK PANEL

Multiposition work panel for use with TecQuipment's Engineering Science kits.





OVER 1000 PAGES OF TEACHING MATERIAL FOR ALL THE EXPERIMENTS IN THE RANGE

- Perfect size for both experiments and simple classroom demonstrations
- Supplied with digital copy of all teaching material needed for the full Engineering Science range
- Stable and multipositional – can be used in many different ways to suit the experiments or demonstrations
- Solid, thick perforated metal plate for long life and choice of fixing positions for the experiments
- Simple thumbscrews for safe, quick and easy assembly

For use with TecQuipment's Engineering Science kits, the work panel fits on any standard desk or bench top. Students, teachers or lecturers fit the parts of their kit to the Work Panel (ES1) to study or demonstrate an engineering science topic.

AVAILABLE EXPERIMENT KITS:

- Forces Kit (ES2) 8
- Moments Kit (ES3) 9
- Deflection of Beams and Cantilevers Kit (ES4) 11
- Torsion of Circular Sections Kit (ES5) 10
- Tensile Tester Kit (ES6) 12
- Simple Harmonic Motion Kit (ES7) 14
- Friction and Inclined Plane Kit (ES8) 15
- Potential and Kinetic Energy Kit (ES9) 16
- Pulley Kit (ES10) 18
- Drive Systems Kit (ES11) 19
- Cam, Crank and Toggle Kit (ES12) 22
- Gear Trains Kit (ES13) 20
- Simple Mechanisms Kit (ES14) 23
- Bar Linkages Kit (ES15) 24
- Centrifugal Force Kit (ES16) 21
- Rotational Friction Kit (ES17) 17
- Additional Mechanisms Kit (ES18) 25
- Spring Tester Kit (ES19) 13

ES2

FORCES KIT

Demonstrates how to find the centre of gravity of shapes and the relationship between angles and coplanar forces.

LEARNING OUTCOMES:

- Centres of gravity
- Force triangles
- Force polygons and Bow's Notation
- Linked polygons (non-concurrent forces)

This kit includes a set of different plastic shapes for experiments in centres of gravity of two-dimensional objects. It also includes pulleys, weights and a magnetic protractor for experiments in concurrent and non-concurrent coplanar forces and angles.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Equilibrium of Forces (STF4) 181

SPECIAL OFFER

FORCES AND MOMENTS BUNDLE (ESBI)

This basic experiment bundle includes:

- Forces Kit (ES2)
- Moments Kit (ES3)
- Two Engineering Science Work Panels (ES1)

ES3

MOMENTS KIT

Demonstrates the relationship between distances and forces in rigid beams and levers.

LEARNING OUTCOMES:

- Principle of moments
- Beam balances
- 1st, 2nd and 3rd order levers
- Bell crank lever
- Beam reactions

This kit includes a rigid beam for experiments in the principle of moments, extending to levers and beams. It demonstrates the three main lever types (1st, 2nd and 3rd order) and includes an 'L' shaped plate for experiments in bell crank levers. A pulley allows extra experiments with moments caused by oblique forces.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Equilibrium of a Beam (STF5) 181

ALWAYS HERE TO HELP

Whether you have a technical enquiry, need spare parts or support material, you can contact our Customer Care team at:

CUSTOMER.CARE@TECQUIPMENT.COM

ES5

TORSION OF CIRCULAR SECTIONS KIT

Demonstrates the torsion in circular section specimens of different materials and lengths.

LEARNING OUTCOMES:

- Specimen length and angle of twist
- Specimen material and angle of twist (Modulus of Rigidity)
- Specimen 'J' value and angle of twist

This kit includes different circular section specimens and adjustable chucks for experiments in torsion. Students fix the specimens in the chucks and apply weights to a lever arm. The arm applies a moment (torque) to one end of the specimen. A scale on the arm shows the angle of twist.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Torsion Testing Machine – 30 Nm (SM1001) 157
- Torsion of Circular Sections (STR6) 207
- Torsion Testing Components (TE16b) 150

DATASHEETS ONLINE

Download comprehensive product datasheets for full technical specifications.

TECQUIPMENT.COM

ES4

DEFLECTION OF BEAMS AND CANTILEVERS KIT

Demonstrates the deflection of beams of different materials and dimensions, held on different supports.

LEARNING OUTCOMES:

- Beam length and deflection
- Beam material and deflection (Young's modulus)
- Beam 'I' value and deflection
- Beam supports (cantilever, propped cantilever, fixed beam and simply supported) and deflection

This kit includes different beams and fixing blocks. The fixing blocks work as clamps or knife-edge supports. They hold the beams in different ways, such as a cantilever, simply supported, fixed (encastre) and a propped cantilever.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Stiffness – Bending and Torsion (TE16) 150
- Beam and Leaf Spring (SM1000g) 164
- Beam Apparatus (SM1004) 173
- Deflection of Beams and Cantilevers (STR4) 198
- Continuous and Indeterminate Beams (STR13) 200

ES6

TENSILE TESTER KIT

Demonstrates the principles of tensile tests on specimens of different materials.

LEARNING OUTCOMES:

- Tensile tests (to destruction) of different materials
- Finding the tensile strength of a material
- Material behaviour in the elastic and plastic region
- Creating a force and extension chart

SPECIAL OFFER

MATERIALS TESTING BUNDLE (ESB2)

This experiment bundle includes:

- Deflection of Beams Kit (ES4)
- Torsion of Circular Sections Kit (ES5)
- Tensile Tester Kit (ES6)
- Spring Tester Kit (ES19)
- Four Engineering Science Work Panels (ES1)

This kit includes specimens of different materials to show students the principles of tensile tests. Students use the tensile tester to stretch the specimens to destruction, while measuring the extension and force.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

RECOMMENDED ANCILLARIES:

- Tensile Test Specimens (MTT) 28

ALTERNATIVE PRODUCTS:

- Universal Testing Machine (SM1000) 162
- Bench-top Tensile Testing Machine (SM1002) 160
- Materials Laboratory with Data Capture (MF40) 165

ES19

SPRING TESTER KIT

Demonstrates the characteristics of coiled springs and how to test them.

LEARNING OUTCOMES:

- Hooke's law and compression spring tests
- Hooke's law and extension spring tests
- Parallel and series spring tests

This kit includes different coiled springs for experiments in spring testing. These include extension springs, compression springs, parallel springs and springs that can connect in series.

Students test the springs to prove Hooke's law and find their spring rate, comparing it with given manufacturers' values. They also test springs in parallel and series to see how this affects the overall spring rate.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Hooke's Law and Spring Rate (SM110) 149
- Coil Spring (SM1000f) 164

BE SOCIAL

Be part of the conversation, follow, like and comment.

ES7

SIMPLE HARMONIC MOTION KIT

Demonstrates simple harmonic motion (oscillation) in springs and pendulums, and its usefulness.

LEARNING OUTCOMES:

- Simple harmonic motion of simple, bifilar and trifilar pendulums of different lengths and masses
- Simple harmonic motion of a spring with different masses, and a simple spring rate test
- Simple harmonic motion of a compound pendulum
- Simple harmonic motion and gravity using a Kater's pendulum

This kit includes different pendulums and a spring to show students the principles and uses of simple harmonic motion. Students test different pendulums and a spring to see how different factors, such as mass or pendulum length, affect simple harmonic motion and the period of oscillation.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Simple and Compound Pendulums (TM161) 225
- Filar Pendulums (TM162) 226

ES8

FRICTION AND INCLINED PLANE KIT

Demonstrates the frictional and other forces on bodies and between different surfaces on a flat or inclined plane.

LEARNING OUTCOMES:

- Forces on an inclined plane
- Rolling and sliding friction on different surfaces
- Kinetic and static sliding friction between different surfaces
- Surface angle and friction between different surfaces

This kit includes parts for experiments in friction and forces on a flat or inclined plane. The plane has an inclinometer and adjustment to allow the student to set the plane to any angle between zero and 90 degrees. The parts include different friction surfaces, a roller set, a rolling car or sled with adjustable mass, and a simple roller.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ES9

POTENTIAL AND KINETIC ENERGY KIT

Demonstrates the difference between potential and kinetic energy and how it can change from one to the other.

LEARNING OUTCOMES:

- Kinetic and potential energy in a pendulum
- Elastic potential energy in a spring
- Kinetic energy in a flywheel

This kit includes a pendulum, a spring and a flywheel for experiments in potential and kinetic energy. Students test each part to discover the difference between potential and kinetic energy and the transfer of energy from one form to another.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Geared Systems Test Stand (TM1018a) 218

ES17

ROTATIONAL FRICTION KIT

Demonstrates how rotational friction affects the efficiency of popular machine elements.

LEARNING OUTCOMES:

- Efficiency of a screw jack
- Efficiency of a wedge
- Efficiency of different bearings

This kit includes a screw jack (or 'jackscrew'), a wedge and different bearings. It helps students understand how rotational friction affects the efficiency of popular machine elements and bearing materials. It shows why engineers choose some materials and devices above others for any given application.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

SPECIAL OFFER

VIBRATION, FRICTION AND ENERGY KIT BUNDLE (ESB5)

This experiment bundle includes:

- Simple Harmonic Motion Kit (ES7)
- Friction and Inclined Plane Kit (ES8)
- Potential and Kinetic Energy Kit (ES9)
- Rotational Friction Kit (ES17)
- Four Engineering Science Work Panels (ES1)

ES10

PULLEY KIT

Demonstrates the mechanical advantage of different combinations of pulleys and a simple wheel and axle.

LEARNING OUTCOMES:

- Simple pulleys – fixed, movable and compound
- The wheel and axle
- The Weston differential pulley

This kit includes a wheel and axle with single, double and triple wheel or 'sheave' pulleys for experiments in mechanical advantage. Students test fixed, movable and compound pulleys attached to load and effort weights to test their mechanical advantage.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ES11

DRIVE SYSTEMS KIT

Demonstrates the advantages and disadvantages of three popular drive systems: belt, chain and a universal coupling.

LEARNING OUTCOMES:

- Power transfer, efficiency and direction in a belt drive
- Power transfer and efficiency in a chain drive
- Input and output relationships of a universal coupling
- Friction and angle of lap on a pulley

This kit includes three different drive systems to show their relative advantages and disadvantages.

Students test a universal coupling, a belt drive and a chain drive to see how they work and how they differ in the way they transfer motion (power).

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Geared Systems (TM1018) 217

SPECIAL OFFER

SIMPLE MACHINES KIT BUNDLE (ESB3)

This experiment bundle includes:

- Pulley Kit (ES10)
- Drive Systems Kit (ES11)
- Gear Trains Kit (ES13)
- Centrifugal Force Kit (ES16)
- Four Engineering Science Work Panels (ES1)

ES13

GEAR TRAINS KIT

Demonstrates the characteristics of the most popular gear sets.

LEARNING OUTCOMES:

- Characteristics of spur gears, including single and compound gear trains and the 'idler' gear
- Characteristics of a bevel gear
- Characteristics of a worm drive

This kit includes a selection of different gears for experiments to find their unique characteristics.

The gears include spur gears, a bevel gear and a worm drive. The spur gears have two sets of teeth on the same shaft, allowing extra experiments in compound gear trains. Students test each set of gears to see how it works and note the differences in characteristics (such as efficiency, gear ratio and mechanical advantage) of each set.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Geared Systems (TM1018) 217

STOCK PRODUCTS READY TO DELIVER

A stock of TecQuipment's most popular products are available in our warehouse ready for speedy delivery. Contact us today to find out more.

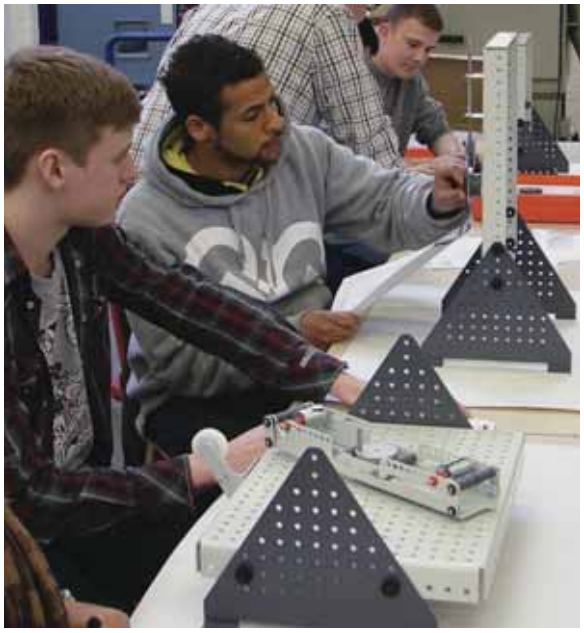
ES16

CENTRIFUGAL FORCE KIT

Demonstrates the relationship between centrifugal force, radius and velocity of rotating masses.

LEARNING OUTCOMES:

- Relationship between centripetal force, radius and velocity of different rotating masses.



This kit includes a manually rotated frame with a low-friction cantilever linkage. The frame has mounting positions for adjustable masses and a spring that applies a fixed frictional force value to a rotating drum. The range of mounting positions and masses allows many variations of the experiment to help students understand the relationships between the variables of speed, mass and radial position.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

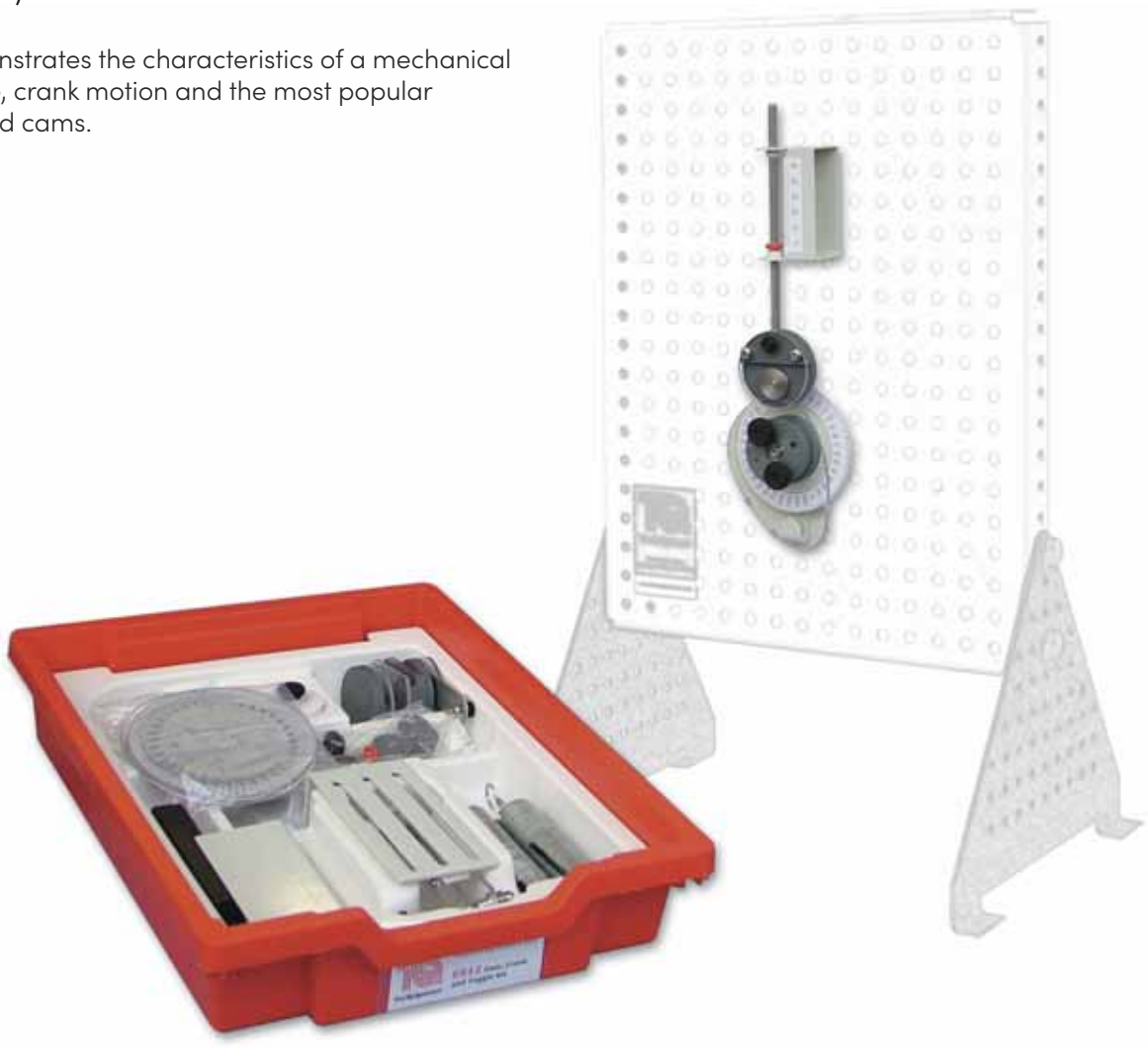
ALTERNATIVE PRODUCTS:

- Centrifugal Force (TM1005) 222

ES12

CAM, CRANK AND TOGGLE KIT

Demonstrates the characteristics of a mechanical toggle, crank motion and the most popular shaped cams.



LEARNING OUTCOMES:

- Displacement and angle characteristics of pear, heart, round and spiral cams
- Characteristics of a mechanical toggle
- Turning moments and forces during crank motion

This kit includes a crank and slider to show the relative forces during crank motion. It also includes four popular cam shapes to show their different characteristics. Another set of parts in the kit shows the characteristics of a mechanical toggle.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

ALTERNATIVE PRODUCTS:

- Cam Analysis Machine (TM1021) 215

DATASHEETS ONLINE

Download comprehensive product datasheets for full technical specifications.

TECQUIPMENT.COM

ES14

SIMPLE MECHANISMS KIT

Demonstrates how three popular mechanisms convert motion.

LEARNING OUTCOMES:

- Conversion of motion using the 'Scotch yoke' (or 'slotted link')
- Conversion of motion using the quick return mechanism
- Conversion of motion using the crank and slider

This kit includes three popular mechanisms for experiments in conversion of motion from linear to rotary or rotary to linear. These include the Scotch yoke (sometimes called 'donkey crosshead' or 'slotted link'), the crank and slider, and the quick return mechanism. Students test each mechanism to see how it works and note the differences in the way that each mechanism converts the motion.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

SPECIAL OFFER

MECHANISMS KIT BUNDLE (ESB4)

This experiment kit bundle includes:

- Cam, Crank and Toggle Kit (ES12)
- Simple Mechanisms Kit (ES14)
- Bar Linkages Kit (ES15)
- Additional Mechanisms Kit (ES18)
- Four Engineering Science Work Panels (ES1)

ES15

BAR LINKAGES KIT

For students to assemble and understand different bar linkage mechanisms.

LEARNING OUTCOMES:

- Four-bar linkages – crank rocker, double rocker, draglink and parallelogram
- Straight line linkages – Watt's straight line, Chebyshev, Peaucellier-Lipkin, Hart's inversor, Robert's and Hoeken's
- Pantograph
- Ackermann steering

This kit includes a selection of over 20 perforated bars of different lengths and pivots or 'joints' to allow students to create an unlimited choice of linkages.

Students assemble the bars and joints in any arrangement and note how the linkage converts movement from one form to another (for example: rotary motion to linear motion). Bar linkages are one of the most basic mechanisms used in mechanical engineering.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

PRECISION-ENGINEERED EQUIPMENT

All products manufactured and processes used are checked, tested and audited to ensure the products you receive are of the highest quality.

ES18

ADDITIONAL MECHANISMS KIT

Demonstrates how two popular mechanisms convert motion.

LEARNING OUTCOMES:

- Conversion of motion using the Geneva mechanism
- Conversion of motion using a ratchet

This kit includes two popular mechanisms for experiments in conversion of motion from one form to another. These include the Geneva mechanism (sometimes called the Maltese cross mechanism or crank and star), and a ratchet mechanism. Students test each mechanism to see how it works and note the differences in the way that each mechanism converts the motion.

ESSENTIAL BASE UNIT:

- Work Panel (ES1) 7

BUNDLES

ENGINEERING SCIENCE FULL SET (ESF)

A mobile trolley with a complete set of TecQuipment's Engineering Science kits and three Work Panels.

- A mobile and compact trolley holding a full set of TecQuipment's Engineering Science kits (ES2 to ES19) and three Work Panels (ES1) for over 60 experiments in fundamental engineering science topics
- All the parts needed in one mobile frame – one person can move a full set of kits from one room to another
- Includes a Spares Kit (ESX) to replace common parts that could become lost from experiments during use
- Spare empty trays to store additional material such as coursework, worksheets or guidance notes
- Strong, lockable wheels on the trolley allow easy movement but also hold the trolley stable when needed – making it an ideal demonstration table

This full set allows at least three sets of students to work with any three of the Engineering Science experiments at the same time, while storing the other kits tidily and efficiently. Alternatively, lecturers or teachers may set up one experiment as a demonstration on the mobile trolley while two groups of students do experiments at their desks.

FORCES AND MOMENTS KIT BUNDLE (ESB1)

- Forces Kit (ES2)
- Moments Kit (ES3)
- Work Panel (x2)

MATERIALS TESTING KIT BUNDLE (ESB2)

- Deflection of Beams and Cantilevers Kit (ES4)
- Torsion of Circular Sections Kit (ES5)
- Tensile Tester Kit (ES6)
- Work Panel (x4)

SIMPLE MACHINES KIT BUNDLE (ESB3)

- Pulley Kit (ES10)
- Drive Systems Kit (ES11)
- Gear Trains Kit (ES13)
- Centrifugal Force Kit (ES16)
- Work Panel (x4)

MECHANISMS KIT BUNDLE (ESB4)

- Cam, Crank and Toggle Kit (ES12)
- Simple Mechanisms Kit (ES14)
- Bar Linkages Kit (ES15)
- Additional Mechanisms Kit (ES18)
- Work Panel (x4)

VIBRATION, FRICTION AND ENERGY KIT BUNDLE (ESB5)

- Simple Harmonic Motion Kit (ES7)
- Friction and Inclined Plane Kit (ES8)
- Potential and Kinetic Energy Kit (ES9)
- Rotational Friction Kit (ES17)
- Work Panel (x4)

SUPPORT EQUIPMENT

Support equipment for use with TecQuipment's Engineering Science range.

- Supporting products for TecQuipment's Engineering Science kits
- A set of five spare trays and lids (ETL) – useful for safely storing ancillaries or printed material such as lecturer guides or worksheets
- A compact mobile frame (EST) that stores up to 24 trays safely and tidily, while allowing one person to move all 24 trays from one room to another

STORAGE UNIT (EST)

For use with the Engineering Science kits, TecQuipment offers these supporting products as a useful resource for lecturers or teachers.

STORAGE UNIT (EST)

A mobile trolley for use with the Engineering Science kits. This trolley allows lecturers or teachers to safely and tidily store up to 24 trays in one mobile unit.

TRAYS AND LIDS (ETL)

A set of five trays and lids. Identical to those used for the kits, so they fit and stack in the same way.

PACKED AND READY FOR SHIPMENT

First-class products deserve first-class packing and shipping. You can be confident your order will arrive safely and on time.

SPARES AND CONSUMABLES

Spares and consumables for use with TecQuipment's Engineering Science range.

SPARE PARTS KIT (ESX)

- Spares and consumable products for TecQuipment's Engineering Science kits
- Useful to replace any parts that become lost from the experiment kits during use, or to increase the variation of experiments
- Additional Tensile Test Specimens (MTT) for the Tensile Tester Kit (ES6)
- Additional Weight Sets (WT and WTL) and Stopwatch (SW1) – useful spares for both the Engineering Science range and other TecQuipment products
- A tray of spares (ESX) containing the most common parts of the Engineering Science kits

TecQuipment offers these spares and consumables mainly for the Engineering Science range. However, the stopwatch and weight sets also work as spares for other TecQuipment product ranges.

SPARE PARTS KIT (ESX)

This kit includes spares of the most common parts used in the other Engineering Science kits, including fixings, weights, hooks and cord.

STOPWATCH (SW1)

An easy-to-use, accurate, hand-held digital stopwatch. Replaces any lost from the kits or allows more students to share experiments.

WEIGHT SETS (WT AND WTL)

Slotted masses that fit onto TecQuipment's weight hangers. They will work as general-purpose weights and spares for those in several other TecQuipment products, such as the Structures range.

WT – A set of 10 g masses and weight hangers

WTL – A set of 1 g masses

TENSILE TEST SPECIMENS (MTT)

Specimens made from a choice of four different materials for use with the Engineering Science Tensile Tester (ES6).

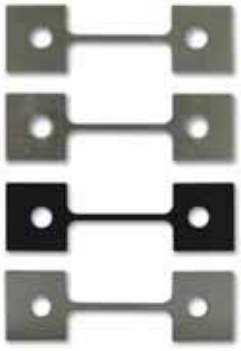
MTTA – Aluminium

MTTD – Duralumin

MTTP – PVC

MTTS – Mild Steel

Note: TecQuipment supplies all specimens individually, but a minimum order charge applies.



AERODYNAMICS

SUBSONIC WIND TUNNELS	31
SUBSONIC WIND TUNNEL INSTRUMENTS AND ACCESSORIES	50
SPECIAL PURPOSE WIND TUNNELS	52
SUPERSONIC NOZZLE	55
SUPERSONIC WIND TUNNELS	57

"We believe that your visit to make our wind tunnel ready to train our students and staff was a great success and we thank you for the great effort you did for us. It was very effective and useful work that raised the spirits of all the Aeronautical Engineering Department staff as well as the College Administration.

DR AHMED IBRAHIM AHMED
DEAN, COLLEGE OF ENGINEERING, SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

AERODYNAMICS

MADE FOR EDUCATION AND TRAINING

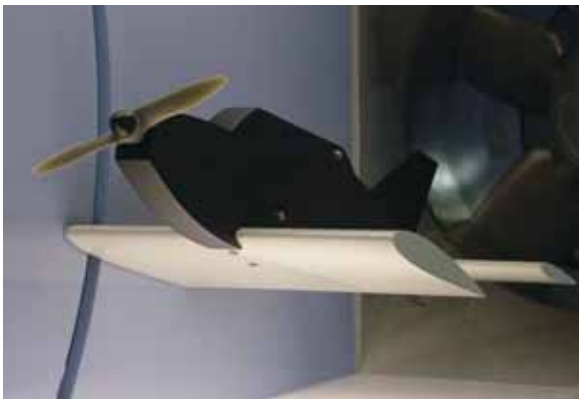
The Aerodynamics range is used by educators worldwide for research projects or teaching through first principles to advanced theories. Our wind tunnels are small enough to fit in most laboratories, while still producing results that can be scaled to match those of full size wind tunnels. The subsonic and special-purpose wind tunnels are mobile to help with laboratory layouts.

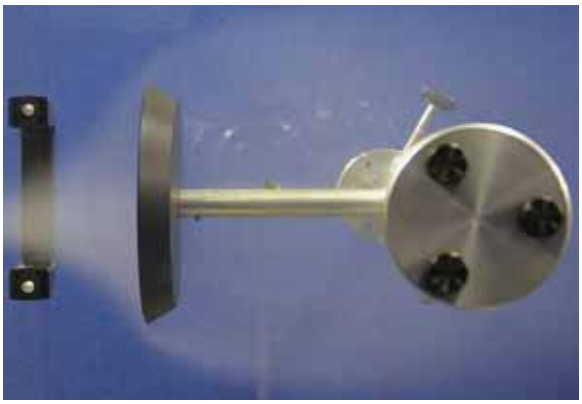
FLEXIBLE AND COMPREHENSIVE

The wind tunnels offer a comprehensive choice of equipment and models, from subsonic flow to supersonic. They allow the selection of only what is needed, reducing costs and adding flexibility.

KEY FEATURES AND BENEFITS:

- **MADE FOR TEACHING:** Realistic results yet small enough for laboratories.
- **FLEXIBILITY:** Packages of equipment can be chosen to suit budgets and needs.
- **EASY SET-UP:** It takes only minutes to change and set up an experiment.
- **HANDS-ON:** Laboratory-scale parts allow easy fitting and adjustments, for a more practical understanding.





THERE IS ALSO OUR MODULAR FLUID POWER RANGE

The Modular Fluid Power range includes products that allow demonstrations and studies of the performance of different types of 'real world' air machines (fans and compressors).

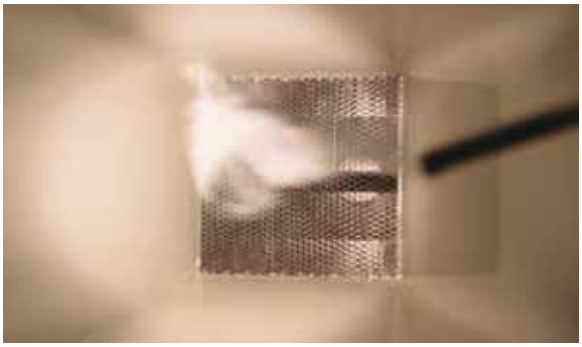
SEE PAGE 132

CENTRIFUGAL FAN MODULE (MFP106)

AUTOMATIC DATA ACQUISITION VDAS®

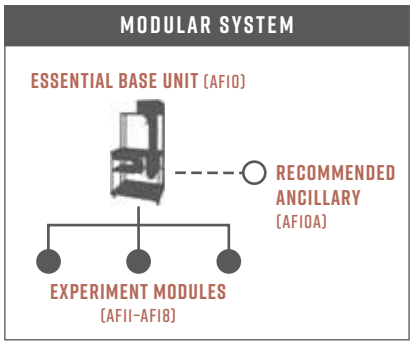
A variety of the products in this range work with TecQuipment's unique Versatile Data Acquisition System (VDAS®)

SEE PAGE 293



AF10
MODULAR AIR FLOW BENCH

A mobile bench providing the base unit for a wide range of air flow experiment modules.



SHOWN FITTED WITH ONE OF THE AVAILABLE EXPERIMENT MODULES (AF12) AND MULTI-TUBE MANOMETER (AF10A)

FEATURES:		BENEFITS:
Supports and supplies a controllable air flow to its optional experiment modules	→	Modular design saves space and reduces costs
Eight different optional experiment modules	→	Covers all aspects of a basic aerodynamics curriculum
Compact, mobile and easy to install	→	Simplifies laboratory layout
Easy set-up – just minutes to remove and fit experiment modules	→	Maximises experiment time and requires minimal supervision

The AF10 is a small-scale wind tunnel with an electric fan and adjustable air flow control. It is the essential base unit for eight different experiment modules that demonstrate key principles and phenomena of air flow.

CONTINUED ON NEXT PAGE

AVAILABLE EXPERIMENT MODULES:

- Bernoulli's Equation (AF11) 32
- Drag Force (AF12) 33
- Round Turbulent Jet (AF13) 34
- Boundary Layer (AF14) 35
- Flow Around a Bend (AF15) 36
- Coandă Effect and Jet Flow (AF16) 36
- Flow Visualisation (AF17) 37
- Tapped Aerofoil (AF18) 38

RECOMMENDED ANCILLARIES:

- Multi-tube Manometer (AF10a) 38

ALTERNATIVE PRODUCTS:

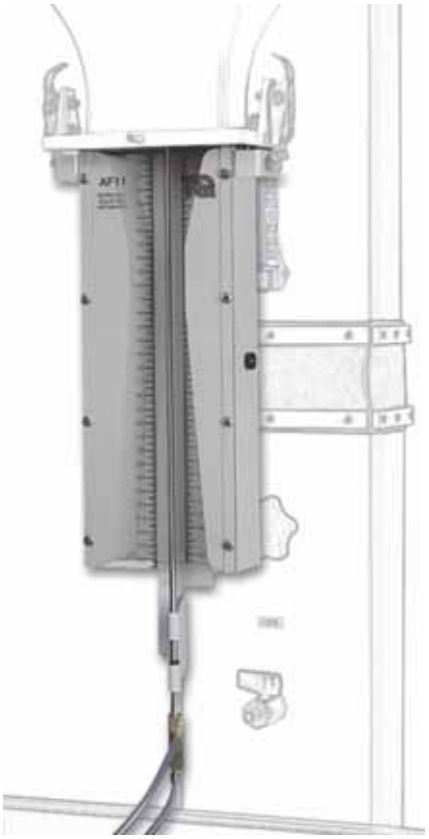
- Bench-Top Subsonic Wind Tunnel (AF1125) 39
- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- Flight Demonstration Wind Tunnel (AF41) 52
- Flow Visualisation Wind Tunnel (AF80) 54

AF11

BERNOULLI'S EQUATION

Allows students to measure the pressure distribution in a convergent-divergent duct.

- One of a series of eight experiment modules that fit to the Modular Air Flow Bench (AF10)
- Quickly and simply illustrates Bernoulli's equation for air, and its limitations due to boundary layer effects
- Quick-release couplings for rapid and reliable pressure connection to the AF10a Manometer
- Transparent front to the duct so that the profile of the test nozzle and the position of the Pitot static tube can be seen clearly



LEARNING OUTCOMES:

- Confirmation of Bernoulli's equation
- The use of a Pitot static tube and water manometer

This experiment module illustrates Bernoulli's equation as applied to a convergent-divergent duct. A Pitot static tube measures both the total pressure and the static pressure independently. The tube traverses along the axis of the duct and connects to the AF10a manometer (ancillary) via flexible tubes fitted with quick-release couplings.

ESSENTIAL BASE UNIT:

- Modular Air Flow Bench (AF10) 31

ESSENTIAL ANCILLARIES:

- Multi-tube Manometer (AF10a) 38

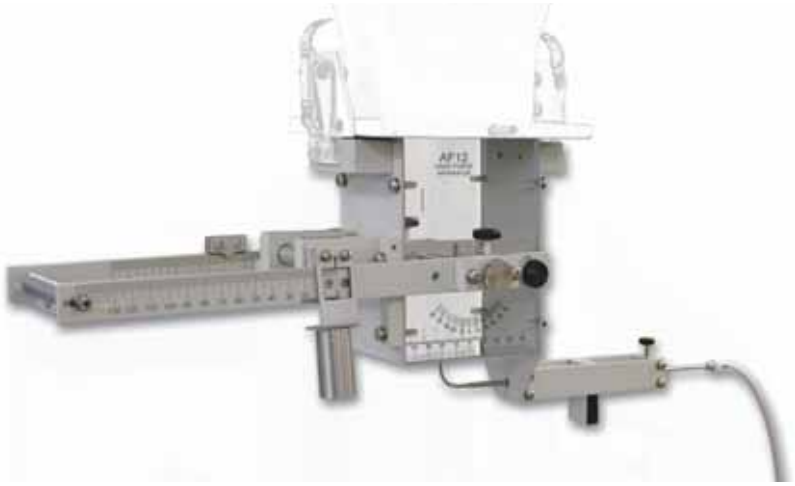
ALTERNATIVE PRODUCTS:

- Bernoulli's Theorem (H5) 95

AF12

DRAG FORCE

Allows students to investigate the direct and indirect measurement of drag on various shapes.



- One of a series of eight experiment modules that fit to the Modular Air Flow Bench (AF10)
- Compares drag for a cylinder calculated from a measured pressure distribution, and a wake traverse against that measured directly for a cylinder
- Allows comparisons of drag force between a cylinder, flat plate and aerofoil
- The test duct has transparent sides with clearly printed scales – allowing students to see the experiment and accurately position the models and the Pitot tube

This simple yet comprehensive experiment module consists of a duct with transparent front and rear. The front has scales printed on it to position the various parts during the experiments. A Pitot tube and simple mass balance are attached to the outside of the duct for wake traverse and direct drag measurements respectively.

LEARNING OUTCOMES:

- Determination of the drag coefficient by measurement of the pressure distribution around the cylinder
- Determination of the drag coefficient by wake traverse
- Determination of the drag coefficient around the cylinder by direct measurement and comparison to results obtained by pressure distribution and wake traverse
- Direct measurement and comparison of drag coefficient between a cylinder, flat plate and aerofoil

ESSENTIAL BASE UNIT:

- Modular Air Flow Bench (AF10) 31

ESSENTIAL ANCILLARIES:

- Multi-tube Manometer (AF10a) 38

ALTERNATIVE PRODUCTS:

- Cylinder Model (AF1300a) 42
- NACA 0012 Aerofoil with Tappings (AF1300b) 42
- Flat Plate Drag Model (AF1300e) 42
- Three-dimensional Drag Models (AF1300j) 42
- S1210 Aerofoil (AF1300l) 42

COME AND VISIT US

Why not visit us at the TecQuipment global headquarters in the UK, where you can get hands-on with a vast array of products, enjoy a factory tour and spend some time with our team of specialists.

Please contact us to arrange a visit.

AF13

ROUND TURBULENT JET

Allows students to investigate a jet of air as it emerges from the end of a tube.

- One of a series of eight experiment modules that fit to the Modular Air Flow Bench (AF10)
- Allows a number of tests on the velocity of a submerged jet emerging from the end of a tube
- The tube has a carefully designed inlet for best results
- Quick-release coupling fitted to the Pitot tube to allow rapid and reliable connection to the AF10a Manometer

LEARNING OUTCOMES:

- Decay of the centre-line velocity
- Velocity profile at various distances along the jet and the development of the spread of the jet
- Analysis of the velocity profiles to demonstrate how the mass flux in the jet increases, the kinetic energy flux decreases and the momentum flux remains constant along the jet length

This module consists of a tube with a specially designed rounded entry. The tube is mounted on a stiff plate with the rounded entry on one side and the exit on the other.

ESSENTIAL BASE UNIT:

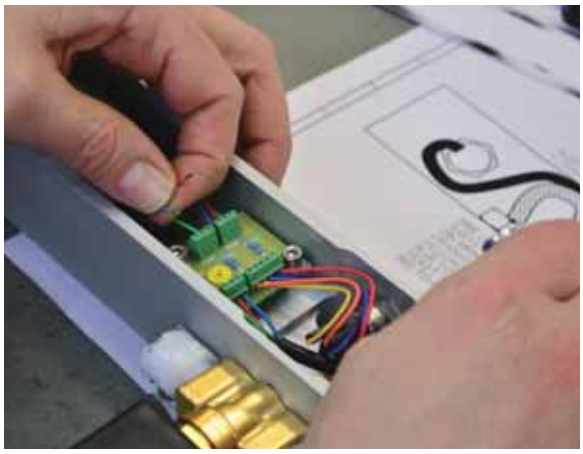
- Modular Air Flow Bench (AF10) 31

ESSENTIAL ANCILLARIES:

- Multi-tube Manometer (AF10a) 38

HIGH QUALITY - SHORT LEAD TIMES

To ensure high quality and short lead times, products are designed and manufactured in the in-house facility near Nottingham in the UK.



AF14

BOUNDARY LAYER

Allows students to investigate the boundary layer on a flat plate.

- One of a series of eight experiment modules that fit to the Modular Air Flow Bench (AF10)
- Allows a number of tests on laminar and turbulent boundary layers, with rough and smooth surfaces with different pressure gradients
- Boundary layer velocity profile is measured with a Pitot tube with a fine micrometer adjustment for best results
- Test section has a transparent front – students can see the experiment and the position of the Pitot tube clearly

LEARNING OUTCOMES:

- Measurement of the velocity profile in laminar and turbulent boundary layers
- Measurement of the velocity profile in the boundary layer formed over both rough and smooth plates
- Measurement of the velocity profile in the boundary layer at various distances from the leading edge of the plate
- Effect of the pressure gradient on the boundary layer velocity profile

This module consists of a duct in which there is situated a flat plate. The flat plate is rough on one side and smooth on the other, providing different surface conditions for the formation of a boundary layer.

ESSENTIAL BASE UNIT:

- Modular Air Flow Bench (AF10) 31

ESSENTIAL ANCILLARIES:

- Multi-tube Manometer (AF10a) 38

ALTERNATIVE PRODUCTS:

- Flat Plate Drag Model (AF1300e) 42

RIGHT PART, RIGHT PLACE, RIGHT TIME

We have a computerised stock control system to manage the 40,000 different components, ensuring the very best quality, delivery times and customer support in the industry.

AF15

FLOW AROUND A BEND

Allows students to measure the pressure distribution in a smooth rectangular bend.

- One of a series of eight experiment modules that fit to the Modular Air Flow Bench (AF10)
- Shows the pressure distribution in a smooth rectangular bend as an example of internal flow problems
- Quick-release couplings for rapid and reliable pressure measurement connection to the AF10a Manometer
- Highly visual plot of the pressure profile on the manometer

LEARNING OUTCOMES:

- Pressure distribution along the curved inner and outer walls
- Radial pressure distribution and comparison with that predicted assuming free vortex velocity distribution
- Calculation of loss coefficient (K)

This module consists of a smooth rectangular bend with ten static tapping points on both the inner and outer curved walls, plus a further nine along the radius.

ESSENTIAL BASE UNIT:

- Modular Air Flow Bench (AF10) 31

ESSENTIAL ANCILLARIES:

- Multi-tube Manometer (AF10a) 38

AF16

COANDĂ EFFECT AND JET FLOW

Allows students to investigate the Coandă effect and a fluidic flip-flop.

- One of a series of eight experiment modules that fit to the Modular Air Flow Bench (AF10)
- Shows an example of how the phenomena of fluid mechanics can be exploited to perform a useful task – a fluidic flip-flop
- Transparent fronted test duct with clearly printed scales allows the experiment to be clearly seen and components accurately positioned
- Effectively demonstrates the Coandă effect

LEARNING OUTCOMES:

- Demonstration of the Coandă effect
- Demonstration of the fluidic flip-flop

This module consists of an aerodynamically shaped nozzle from which a jet of air emerges. This flows against a wall to which it attaches.

ESSENTIAL BASE UNIT:

- Modular Air Flow Bench (AF10) 31

AF17

FLOW VISUALISATION

Allows students to "see" the air flows around various shapes by using smoke filaments.

- One of a series of eight experiment modules that fit to the Modular Air Flow Bench (AF10)
- Includes a set of differently shaped two-dimensional models
- Transparent fronted test duct, with clearly printed angular scale, allows the models to be clearly seen and accurately positioned
- Comes complete with ducting to allow the smoke to be easily and safely drawn away by the Modular Air Flow Bench

This module consists of a specially shaped duct which has a large working section with transparent window. The inlet of the duct is attached to the Air Flow Bench plenum chamber using quick-release clamps; the outlet is located into the bench exhaust.

LEARNING OUTCOMES:

- Demonstration of the flow patterns round a cylinder, flat plate, aerofoil and a sharp-edged orifice/slit

ESSENTIAL BASE UNIT:

- Modular Air Flow Bench (AF10) 31

ALTERNATIVE PRODUCTS:

- Flow Visualisation Wind Tunnel (AF80) 54

ACCOMPANYING DOCUMENT PACK

ALL THE INFORMATION YOU NEED TO GET UP AND RUNNING

With all products you receive a pack of documents containing:

- **USER MANUAL:** How to use the product along with instructions on experiment set-up and supporting enginering principles for guiding learning.
- **PACKING CONTENTS LIST:** All the parts that make up the complete product.
- **TEST CERTIFICATE:** Your peace of mind that the product has been thoroughly tested before dispatch.

AF18

TAPPED AEROFOIL

Allows students to investigate the pressure distribution around a two-dimensional aerofoil.

- One of a series of eight experiment modules that fit to the Modular Air Flow Bench (AF10)
- Provides both a visual and analytical experience for students as the manometer readings clearly show both the pattern and magnitude of the pressure distribution
- Serves as a useful companion experiment to the Drag Force Apparatus (AF12)
- Transparent front and rear to the test duct with a printed scale allows the experiment to be clearly seen and allows the aerofoil angle to be accurately set

This module consists of a duct with transparent front and rear, between which is mounted a symmetrical aerofoil with a NACA profile. The aerofoil has 12 tapping points at various chordwise positions on its surface, allowing the pressure to be measured at that point. The tapping points are permanently connected to a manifold mounted on the duct showing the tapping position and number for easy reference.

LEARNING OUTCOMES:

- The visualisation and measurement of the pressure distribution around an aerofoil section
- Lift characteristics and stall angle of an aerofoil

ESSENTIAL BASE UNIT:

- Modular Air Flow Bench (AF10) 31

ESSENTIAL ANCILLARIES:

- Multi-tube Manometer (AF10a) 38

ALTERNATIVE PRODUCTS:

- NACA 0012 Aerofoil with Tappings (AF1300b) 42

AF10A

MULTI-TUBE MANOMETER

A multi-tube inclinable manometer for use with the Modular Air Flow Bench.

- Uses water for safety and simplicity
- Inclinable for increased sensitivity
- Adjustable height datum and levelling feet
- Includes non-toxic coloured dye to see water levels clearly

The multi-tube manometer is an ancillary to the AF10 base module and its experiment modules. It fits on or near to the AF10 and connects to pressure tappings on the optional experiment modules. Some experiment modules may only have two or three pressure tappings but others use up to 12 tappings. This makes the multi-tube manometer essential to see all the pressures at the same time.

ANCILLARY FOR:

- Modular Air Flow Bench (AF10) 31
- Bernoulli's Equation (AF11) 32
- Drag Force (AF12) 33
- Round Turbulent Jet (AF13) 34
- Boundary Layer (AF14) 35
- Flow Around a Bend (AF15) 36
- Tapped Aerofoil (AF18) 38

AF1125

BENCH-TOP SUBSONIC WIND TUNNEL

Open-circuit subsonic wind tunnel for a wide range of investigations into aerodynamics.

- Selection of models included for studies of drag and pressure profiles
- Efficient and compact where laboratory space is at a premium
- Two-component balance with digital display for lift and drag measurement
- Compact, open-circuit suction design
- Transparent working section for a full view of the test area
- Electronic controller for variable air velocity

The Bench-Top Wind Tunnel offers a complete system ready for aerodynamic experimentation. A range of models and all necessary instrumentaion are included to provide accurate results, suitable for undergraduate study and research projects.

EXPERIMENT MODELS INCLUDED:

- Drag models
- Cylinder with pressure tapping
- NACA0020 aerofoil

LEARNING OUTCOMES:

A wide variety of subsonic aerodynamics experiments, including:

- Flow past bluff and streamlined bodies
- Pressure distribution around a cylinder
- Lift and drag forces

ALTERNATIVE PRODUCTS:

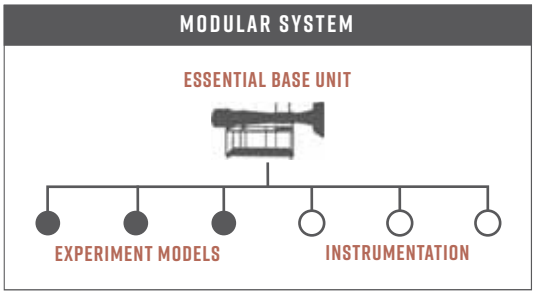
- Modular Air Flow Bench (AF10) 31
- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- Flight Demonstration Wind Tunnel (AF41) 52
- Flow Visualisation Wind Tunnel (AF80) 54
- Supersonic Wind Tunnel – Intermittent (AF300) 57
- Supersonic Wind Tunnel – Continuous (AF302) 59

VDAS® AF1300

SUBSONIC WIND TUNNEL 300 MM

An open circuit suction subsonic wind tunnel with a working section of 300 mm by 300 mm and 600 mm long.

SCREENSHOT OF THE VDAS® SOFTWARE



- Safe, compact, open-circuit suction wind tunnel – saves time and money compared to full-scale units
- Additional models and instruments available to extend the range of experiments
- Wind tunnel controls mount on a separate, free-standing instrument frame for ease of use
- Also available as a starter set (see below)

MODEL CAR IN THE SUBSONIC WIND TUNNEL

STARTER SET (AF1300S)

Included with the wind tunnel in this starter set are:

- Basic Lift and Drag Balance (AF1300z)
- Set of Three Dimensional Drag Models (AF1300j)

LEARNING OUTCOMES:

TecQuipment can also supply optional models and instruments to extend experiments, giving:

- Flow past bluff and streamlined bodies with pressure and velocity observations in the wake
- Investigations into boundary layer development
- Influence of aspect ratio on aerofoil performance
- Performance of an aerofoil with flap, influence of flap angle on lift, drag and stall
- Pressure distribution around a cylinder under sub and super-critical flow conditions
- Study of characteristics of models involving basic measurement of lift and drag forces
- Study of the characteristics of three-dimensional aerofoils involving measurement of lift, drag and pitching moment
- Study of the pressure distribution around an aerofoil model to derive the lift and comparison with direct measurements of lift
- Flow visualisation

Air enters the tunnel through an aerodynamically designed effuser (cone) that accelerates the air linearly. It then enters the working section and passes through a grille before moving through a diffuser and then to a variable-speed axial fan. The grille protects the fan from damage by loose objects. The air leaves the fan, passes through a silencer unit and then back out to the atmosphere.

AVAILABLE EXPERIMENT MODELS:

- Cylinder Model with Tapping (AF1300a) 42
- NACA 0012 Aerofoil with Tappings (AF1300b) 42
- NACA 2412 Aerofoil with Flap (AF1300c) 42
- Set of Two NACA 0012 Aerofoils (AF1300d) 42
- Flat Plate Drag Model (AF1300e) 42
- Boundary Layer Model (AF1300f) 42
- Aircraft Model - Low Wing (AF1300g) 42
- Aircraft Model - High Wing (AF1300h) 42
- Three-dimensional Drag Models (AF1300j) 42
- S1210 Aerofoil (AF1300l) 42

RECOMMENDED INSTRUMENTATION:

- Differential Pressure Transducer (AFA5) 43
- Basic Lift and Drag Balance (AF1300Z) 43
- Three-Component Balance (AF1300T) 44
- Angle Feedback Unit (AFA4) 44
- Smoke Generator (AFA10) 44
- Multi-Tube Manometer (AFA1) 50
- 32-Way Pressure Display Unit (AFA6) 51
- Pitot-Static Traverse (300 mm) (AFA7) 51
- Versatile Data Acquisition System (VDAS-F) 293

ALTERNATIVE PRODUCTS:

- Bench-Top Wind Tunnel (AF1125) 39
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- Modular Air Flow Bench (AF10) 31
- Flight Demonstration Wind Tunnel (AF41) 52
- Flow Visualisation Wind Tunnel (AF80) 54
- Supersonic Wind Tunnel – Intermittent (AF300) 57
- Supersonic Wind Tunnel – Continuous (AF302) 59

A FULLY OPERATIONAL SUBSONIC WIND TUNNEL (TABLE NOT INCLUDED)

CONTINUED ON NEXT PAGE

SUBSONIC WIND TUNNEL (AF1300) EXPERIMENT MODELS

- Simple and quick to set-up and use
- Some models include pressure tappings for pressure distribution experiments
- All models work with the other optional instruments for the AF1300 Subsonic Wind Tunnel

CYLINDER MODEL WITH PRESSURE TAPPING (AF1300A)

A cylinder model with a single pressure tapping point. The model spans the full width of the working section of the wind tunnel.

NACA 0012 AEROFOIL MODEL WITH TAPPINGS (AF1300B)

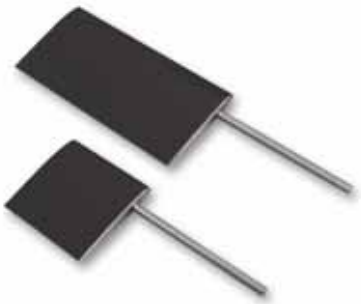
The aerofoil has 20 static pressure tappings along its chord on the upper and lower surfaces. They each connect to tubes that pass through the aerofoil and then out to clear, numbered, flexible tubes.

150 MM CHORD NACA2412 AEROFOIL WITH VARIABLE FLAP (AF1300C)

An unsymmetrical section (cambered) aerofoil with adjustable flap. The adjustable flap allows students to study the effects of control surfaces such as flaps, ailerons, elevator or rudder.

150 MM CHORD NACA0012 AEROFOILS (AF1300D)

A set of two aerofoils. One aerofoil has a span that extends the full width of the working section of the wind tunnel. This model has the characteristics of a two-dimensional aerofoil. The other aerofoil has a span that extends for half of the working section of the wind tunnel. This model has the characteristics of a three-dimensional aerofoil.



100 MM DIAMETER FLAT PLATE (AF1300E)

This model shows the flow around a bluff body mounted normal to the air flow direction, and the drag force exerted on it.

FLAT PLATE BOUNDARY LAYER MODEL (AF1300F)

Demonstrates boundary layer development and separation. The model is a flat plate that spans the full width of the wind tunnel working section. It has aerodynamically shaped blocks mounted across the plate at different distances from the leading edge.

AIRCRAFT MODEL – LOW WING (AF1300G) AND AIRCRAFT MODEL – HIGH WING (AF1300H)

Model aircraft with NACA profile wings. One has a low wing position (bottom of the fuselage), the other has a high wing position (above the fuselage).

THREE-DIMENSIONAL DRAG MODELS (AF1300J)

A set of five different shape models with identical frontal area to allow students to compare the different coefficient of drag for each shape. Includes a dummy stem for tests to cancel out the drag due to each model's support arm.

S1210 AEROFOIL (AF1300L)

An unsymmetrical aerofoil that spans the full width of the working section of the wind tunnel, for two-dimensional experiments.

VDAS® BASIC LIFT AND DRAG BALANCE (AF1300Z)

Measures lift and drag forces on models mounted in the AF1300 Subsonic Wind Tunnel.

- A two-component balance to measure the lift and drag forces on models mounted in the AF1300 Subsonic Wind Tunnel
- Transmits the force on the model directly to a strain-gauged load cell with digital display

The balance mechanism enables test models with a rigid support arm to be mounted and held securely in position in the working section of the wind tunnel. The arm transmits the force on the test model directly to a strain gauged load cell. The load cell is connected to a readout unit with a digital display, which is powered by a desktop power supply (included).

SHOWN FITTED WITH THE PROTRACTOR FROM THE AF1300 WIND TUNNEL

ANCILLARY FOR:

- Subsonic Wind Tunnel (AF1300) 40
- Cylinder Model with Pressure tapping (AF1300a) 42
- 150 mm Chord NACA0012 Aerofoils (AF1300d) 42
- 100 mm Diameter Flat Plate (AF1300e) 42
- Three-dimensional Drag Models (AF1300j) 42
- S1210 Aerofoil (AF1300l) 42

ALTERNATIVE PRODUCTS:

- Three-Component Balance (AF1300t) 44

VDAS® DIFFERENTIAL PRESSURE TRANSDUCER (AFA5)

Digital differential pressure measurement and display unit for use with the AF1300 Subsonic Wind Tunnel.

- Measures and displays differential pressures from models, Pitot-static tubes and other devices
- Quicker, easier and more versatile than using liquid manometers
- Measures differential pressures or pressure with respect to atmosphere

The Differential Pressure Transducer and readout measures and displays pressures in Pitot-static tubes and other pressure-sensing devices fitted to the AF1300 Subsonic Wind Tunnel, with respect to the atmosphere or differential pressures.

ANCILLARY FOR:

- Subsonic Wind Tunnel (AF1300) 40
- Cylinder Model (AF1300a) 42
- NACA 0012 Aerofoil Model with Tappings (AF1300b) 42
- 150 mm Chord NACA2412 Aerofoil with Variable Flap (AF1300c) 42
- Set of 2 NACA 0012 Aerofoils (AF1300d) 42
- Flat Plate Drag Model (AF1300e) 42
- Boundary Layer Model (AF1300f) 42
- Aircraft Model-Low Wing (AF1300g) 42
- Aircraft Model-High Wing (AF1300h) 42
- Three Dimensional Drag Models (AF1300j) 42
- S1210 Aerofoil (AF1300l) 42

ALTERNATIVE PRODUCTS:

- Multi-Tube Manometer (AFA1) 50
- 32-Way Pressure Display Unit (AFA6) 51

CONTINUED ON NEXT PAGE

VDAS® THREE-COMPONENT BALANCE (AF1300T)

Measures lift, drag and pitching moment of models in the AF1300 Subsonic Wind Tunnel.

- Provides a convenient support system for models to measure the lift, drag and pitching moment
- Digital display shows lift, drag and pitching moment directly
- Fully adjustable for varying the angle of incidence to the direction of air flow

The Three-Component Balance provides an easy-to-use support system for wind tunnel models. It measures lift, drag and pitching moment exerted on the model.

RECOMMENDED ANCILLARIES:

- Balance Angle Feedback Unit (AFA4) 44

ANCILLARY FOR:

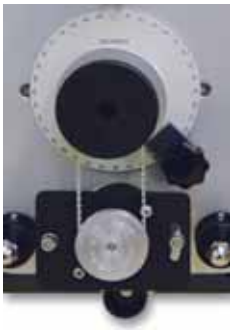
- Subsonic Wind Tunnel (AF1300) 40
- Cylinder Model with Pressure Tapping (AF1300a) 42
- 150 mm Chord NACA0012 Aerofoils (AF1300b) 42
- 150 mm Chord NACA2412 Aerofoil with Variable Flap (AF1300c) 42
- 100 mm Diameter Flat Plate (AF1300e) 42
- Aircraft Model - Low Wing (AF1300g) 42
- Aircraft Model - High Wing (AF1300h) 42
- Three-dimensional Drag Models (AF1300j) 42

ALTERNATIVE PRODUCTS:

- Basic Lift and Drag Balance (AF1300z) 43

VDAS® BALANCE ANGLE FEEDBACK UNIT (AFA4)

Measures angular positions of models mounted on the AF1300T Three-Component Balance with the Versatile Data Acquisition System (VDAS®).



The Balance Angle Feedback Unit is an ancillary for use with TecQuipment's Three-Component Balance to measure the angular position of models mounted on the balance in TecQuipment's Subsonic Wind Tunnels.

ANCILLARY FOR:

- Three-Component Balance (AF1300t) 44

SMOKE GENERATOR (AFA10)

Allows the observation of air flow in subsonic wind tunnels and other air flow situations.

A smoke generator and probe that allows students to see air flow in subsonic wind tunnels and other low flow rate air flow products.

ANCILLARY FOR:

- Subsonic Wind Tunnel (AF1300) 40
- Flight Demonstration Wind Tunnel (AF41) 52

ALTERNATIVE PRODUCTS:

- Flow Visualisation (AF17) 37
- Flow Visualisation Wind Tunnel (AF80) 54

MINIMUM INSTRUMENTS REQUIRED

MINIMUM INSTRUMENTATION REQUIRED IF NOT USING VDAS®

This table shows the minimum additional instrumentation required if choosing not to use TecQuipment's VDAS®. **NOTE:** When using AF1300 without VDAS® all data recording must be done manually.	Basic Lift and Drag Balance (AF1300z) **OR** Three-Component Balance (AF1300t)	Three-Component Balance (AF1300t)	Multi Tube Manometer (AFA1)
Cylinder Model (AF1300a)	✓		
Set of Two NACA 0012 Aerofoils (AF1300d)	✓		
Flat Plate Drag Model (AF1300e)	✓		
Three Dimensional Drag Models (AF1300j)	✓		
S1210 Aerofoil (AF1300l)	✓		
NACA 0012 Aerofoil with Tappings (AF1300b)			✓
Boundary Layer Model (AF1300f)			✓
NACA 2412 Aerofoil with Flap (AF1300c)		✓	
Aircraft Model - Low Wing (AF1300g)		✓	
Aircraft Model - High Wing (AF1300h)		✓	

It is possible to complete all AF1300 experiments without using VDAS®. However, there is a minimum additional instrumentation requirement for some experiments.

All TecQuipment electronic instruments, e.g. the 32-Way Pressure Display Unit (AFA6), have visual displays from which data can be transcribed.

Other instruments, e.g. the Multitube Manometer (AFA1), are read manually and the data transcribed.

NOTE: The AF1300 is supplied with a standard Pitot tube, a Pitot-static tube and a manometer (built into the control panel). Some or all of these instruments will be required in addition to the optional instruments listed here to complete the experiments.

SMOKE TRAIL AROUND THE LOW WING AIRCRAFT MODEL

MINIMUM INSTRUMENTATION REQUIRED IF USING VDAS®

This table shows the additional instrumentation required if using VDAS®, making the most of its data collecting abilities. **NOTE:** When using VDAS® with the AF1300, data recording is quickly and accurately achieved directly onto a suitable computer. The data can then be downloaded into a suitable software package for further evaluation and presentation if required.	Differential Pressure Transducer (AFA5)	**EITHER** Basic Lift and Drag Balance (AF1300z) **OR** Three-Component Balance (AF1300t) **WITH** Balance Angle Feedback Unit (AFA4)	Pitot-static Traverse (AFA7)	32-Way pressure Display Unit (AFA6)	Three-Component Balance (AF1300t) **WITH** Balance Angle Feedback Unit (AFA4)
Cylinder Model (AF1300a)	2	✓	✓		
Set of Two NACA 0012 Aerofoils (AF1300d)	2	✓	✓		
Flat Plate Drag Model (AF1300e)	2	✓	✓		
Three Dimensional Drag Models (AF1300j)	2	✓	✓		
S1210 Aerofoil (AF1300l)	2	✓	✓		
NACA 0012 Aerofoil with Tappings (AF1300b)	2		✓	✓	
Boundary Layer Model (AF1300f)	✓			✓	
NACA 2412 Aerofoil with Flap (AF1300c)	✓		✓		✓
Aircraft Model - Low Wing (AF1300g)	✓		✓		✓
Aircraft Model - High Wing (AF1300h)	✓		✓		✓

VDAS® AFI450S

SUBSONIC WIND TUNNEL 450 MM

An open circuit suction subsonic wind tunnel with a working section of 450 mm by 450 mm and 1000 mm long. All instrumentation required to begin experimentation is included.

- A cost effective solution when compared to full-scale wind tunnels or airborne laboratories
- Operates at meaningful Reynolds numbers
- Safe, open-circuit suction design
- Package includes an aerofoil with tappings, a three-component balance, angle feedback, dual differential pressure display, a 32-Way pressure display unit, 2 x Pitot static traverse, protractor, model holder and data acquisition (VDAS-F)
- High levels of safety
- Controls and instrumentation conveniently mount on a separate, free-standing frame

SCREENSHOT OF THE VDAS® SOFTWARE

Air passes into the wind tunnel through a honeycomb flow straightener and a grille. It then passes into an aerodynamically designed effuser (cone) that accelerates the air in a linear manner before it moves through the working section. Finally it passes through a diffuser, then into the variable speed axial fan. The grille protects the fan from damage by loose objects. The air leaves the fan, passes through a silencer unit and then back out to atmosphere.

LEARNING OUTCOMES:

A wide variety of subsonic aerodynamics experiments (some need ancillaries), including:

- Flow past bluff and streamlined bodies with pressure and velocity observations in the wake
- Investigations into boundary layer development
- Influence of aspect ratio on aerofoil performance
- Performance of an aerofoil with flap, influence of flap angle on lift, drag and stall
- Pressure distribution around a cylinder under sub and super-critical flow conditions
- Study of characteristics of models involving basic measurement of lift and drag forces
- Study of the characteristics of three-dimensional aerofoils involving measurements of lift, drag and pitching moment
- Study of the pressure distribution around an aerofoil model to derive the lift, and comparison with direct measurements of lift
- Drag force on a bluff body normal to an air flow
- Flow visualisation

INCLUDED WITH THE WIND TUNNEL:

THREE-COMPONENT BALANCE (AF1450T)

The Three-Component Balance measures lift, drag and pitching moment exerted on the model. Includes a balance angle feedback unit which measures the angular position of models mounted on the balance in the wind tunnel.

NACA 0012 AEROFOIL WITH TAPPINGS (AF1450B)

A 150 mm chord 450 mm span NACA0012 aerofoil with pressure tappings.

DUAL DIFFERENTIAL PRESSURE DISPLAY (DP6)

Measures and displays pressures in Pitot-static tubes and other pressure-sensing devices fitted to the wind tunnel, with respect to the atmosphere or differential pressures.

32-WAY PRESSURE DISPLAY UNIT (AFA6)

Measures and displays up to 32 different pressures from models, Pitot-static tubes and other measuring instruments fitted to the wind tunnel.
SEE PAGE 51

PITOT STATIC TRAVERSE x2 (AFA7)

Two traversing Pitot-static tubes with electronic position measurement for use with TecQuipment's Subsonic Wind Tunnels. **SEE PAGE 51**

PROTRACTOR

For assisting with setting up models and rotating them during experiments.

MODEL HOLDER

To hold models when the three component balance is not used. Also for use with the user's own models.

VERSATILE DATA ACQUISITION SYSTEM (VDAS-F)

A frame mounting versatile data acquisition system(VDAS®) to allow computer-based data capture. **SEE PAGE 293**

RECOMMENDED ANCILLARIES:

- MultiTube manometer (AFA1) 50
- Smoke Generator (AFA11)

AVAILABLE EXPERIMENT MODELS:

- Cylinder Model with Tapping (AF1450a)
- NACA 2412 Aerofoil with Flap (AF1450c)
- Set of 2 NACA 0012 Aerofoils (AF1450d)
- Flat Plate Drag Model (AF1450e)
- Boundary Layer (AF1450f)
- Aircraft Model – Low Wing (AF1450g)
- Aircraft Model – High Wing (AF1450h)
- Three-Dimensional Drag Models (AF1450j)
- Set of two vehicle drag models (AF1450k)
- S1210 Aerofoil Model (AF1450l)

ALTERNATIVE PRODUCTS:

- Bench-Top Wind Tunnel (AF1125) 39
- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1600S) 48
- Modular Air Flow Bench (AF10) 31
- Flight Demonstration Wind Tunnel (AF41) 52
- Flow Visualisation Wind Tunnel (AF80) 54
- Supersonic Wind Tunnel – Intermittent (AF300) 57
- Supersonic Wind Tunnel – Continuous (AF302) 59

VDAS® AF1600S

SUBSONIC WIND TUNNEL 600 MM

An open circuit suction subsonic wind tunnel with a working section of 600 mm by 600 mm and 1250 mm long. All instrumentation required to begin experimentation is included.

- A cost effective solution when compared to full-scale wind tunnels or airborne laboratories
- Operates at meaningful Reynolds numbers
- Safe, open-circuit suction design
- Package includes three-component balance, angle feedback unit, dual differential pressure display, 32-way pressure display unit, Pitot static traverse, X/Y Pitot static traverse, protractor, model holder and data acquisition (VDAS-F)
- High levels of safety

SCREENSHOT OF THE VDAS® SOFTWARE

Air passes into the AF1600 through a honeycomb flow straightener and a grille. It then passes into an aerodynamically designed effuser (cone) that accelerates the air in a linear manner before it moves through the working section. Finally it passes through a diffuser, then into the variable speed axial fan. The grille protects the fan from damage by loose objects. The air leaves the fan, passes through a silencer unit and then back out to atmosphere.

LEARNING OUTCOMES:

AF1600S is designed to be flexible and utilised for a variety of possible experiments designed by our cusomers. Typical examples include:

- Flow past bluff and streamlined bodies with pressure and velocity observations in the wake
- Investigations into boundary layer development
- Influence of aspect ratio on aerofoil performance
- Pressure distribution around a cylinder under sub and super-critical flow conditions
- Study of characteristics of models involving basic measurement of lift and drag forces
- Study of the characteristics of three-dimensional aerofoils involving measurements of lift, drag and pitching moment
- Study of the pressure distribution around an aerofoil model to derive the lift, and comparison with direct measurements of lift
- Drag force on a bluff body normal to an air flow
- Flow visualisation

INCLUDED WITH THE WIND TUNNEL:

THREE-COMPONENT BALANCE (AF1600T)

The Three-Component Balance measures lift, drag and pitching moment exerted on the model. It includes a Balance Angle Feedback Unit which measures the angular position of models mounted on the balance in the wind tunnel.

DUAL DIFFERENTIAL PRESSURE DISPLAY (DP6)

Measures and displays pressures with respect to the atmosphere or differential pressures.

32-WAY PRESSURE DISPLAY UNIT (AFA6)

Measures and displays up to 32 different pressures from models, Pitot-static tubes and other measuring instruments fitted to the wind tunnel.
SEE PAGE 51

PITOT-STATIC TRAVERSE (AFA7)

A traversing Pitot-static tube with electronic position measurement. **SEE PAGE 51**

PITOT-STATIC X/Y TRAVERSE (AF1600XY)

A traversing Pitot-static tube with electronic position measurements for both the x and y planes.

PROTRACTOR

For assisting with setting up models and rotating them during experiments.

MODEL HOLDER

To hold models when the three component balance is not used. Also for use with the user's own models.

VERSATILE DATA ACQUISITION SYSTEM (VDAS-F)

A frame mounting versatile data acquisition system (VDAS®) to allow computer-based data capture.
SEE PAGE 293

RECOMMENDED ANCILLARIES:

- Multi-Tube Manometer (AFA1) 50
- Smoke Generator (AFA11)

AVAILABLE EXPERIMENT MODELS:

- Cylinder Model (AF1600a)
- NACA 2412 Aerofoil with Flap (AF1600c)
- Set of 2 NACA 0012 Aerofoils (AF1600d)
- Boundary Layer (AF1600f)
- Aircraft Model – Low Wing (AF1600g)
- Aircraft Model – High Wing (AF1600h)
- Three-Dimensional Drag Models (AF1600j)

ALTERNATIVE PRODUCTS:

- Bench-Top Wind Tunnel (AF1125) 39
- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Modular Air Flow Bench (AF10) 31
- Flight Demonstration Wind Tunnel (AF41) 52
- Flow Visualisation Wind Tunnel (AF80) 54
- Supersonic Wind Tunnel – Intermittent (AF300) 57
- Supersonic Wind Tunnel – Continuous (AF302) 59

AFAI

MULTI-TUBE MANOMETER

A tilting 36-tube manometer for use with the AF1300, AF1450 and AF1600 Subsonic Wind Tunnels, other TecQuipment products, or as a general purpose instrument.

- Uses water as manometer fluid with colouring for ease of visibility
- Easy-to-read scale common to each manometer tube
- Preset incline levels for consistency and accuracy – up to five times magnification
- Pressure reading level preset by adjustable fluid reservoir – includes fine-adjustment hand-wheel

A 36-tube tilting manometer for measuring pressure on models in subsonic wind tunnels and fan test sets, including TecQuipment's Subsonic Wind Tunnel series. A backboard with graduated scale holds each manometer tube. For safety and convenience, the manometer uses water as the manometer fluid. This is via an adjustable reservoir with fine-adjust hand-wheel held at the side of the equipment. Water colouring is included to aid visibility.

ANCILLARY FOR:

- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- NACA 0012 Aerofoil Model with Tappings (AF1300b)
- NACA 0012 Aerofoil Model with Tappings (AF1450b)
- Flat Plate Boundary Layer Model (AF1300f) 42
- Flat Plate Boundary Layer Model (AF1450f) 42

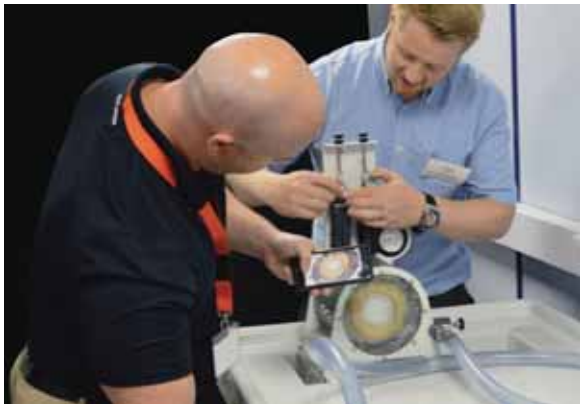
ALTERNATIVE PRODUCTS:

- Different Pressure Transducer (AFA5) 43
- Dual Differential Pressure Display (DP6) 47
- 32-Way Pressure Display Unit (AFA6) 51

COME AND VISIT US

Why not visit us at the TecQuipment global headquarters in the UK, where you can get hands-on with a vast array of products, enjoy a factory tour and spend some time with our team of specialists.

Please contact us to arrange a visit.



VDAS® AFA6

32-WAY PRESSURE DISPLAY UNIT

A 32-way pressure measurement and display unit for use with TecQuipment's Subsonic Wind Tunnels (AF1300, AF1450, AF1600).

- Measures and displays up to 32 differential pressures from models, Pitot-static tubes and other devices
- Quicker, easier and more versatile than using liquid manometers
- Measures pressures with respect to atmosphere
- Fully compatible with TecQuipment's Versatile Data Acquisition System (VDAS®) to enable accurate real-time data capture, monitoring and display on a computer

The 32-Way Pressure Display Unit is an optional ancillary to TecQuipment's modular Subsonic Wind Tunnels. It measures and displays up to 32 different pressures from models, Pitot-static tubes and other measuring instruments fitted to a wind tunnel. It is ideally suited in applications where multiple pressure measurements are required, for example in boundary layer and tapped aerofoil model investigations.

ANCILLARY FOR:

- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- NACA 0012 Aerofoil Model with Tappings (AF1300b) 42
- NACA 0012 Aerofoil Model with Tappings (AF1450b)
- Flat Plate Boundary Layer Model (AF1300f) 42
- Flat PlateBoundary Layer Model (AF1450f)

ALTERNATIVE PRODUCTS:

- Multi-Tube Manometer (AFA1) 50
- Dual Differential Pressure Transducer (DP6) 47
- Differential Pressure Transducer (AFA5) 43

VDAS® AFA7

PITOT-STATIC TRAVERSE (DIGITAL)

A traversing Pitot-static tube with electronic position measurement for use with TecQuipment's Subsonic Wind Tunnels (AF1300 / AF1450S / AF1600)

- Mounts either upstream or downstream of a test model to measure pressures across the wake of a model
- Accurate digital display of position
- Zero facility allows the starting point of an experiment to be set in any position

A Pitot-static tube that mounts in the working section of the wind tunnel, either upstream or downstream of the position of the test model. This allows students to do wake traverses, downstream of a model. The vertical position of the tube, which is adjustable, is displayed on a digital indicator.

ANCILLARY FOR:

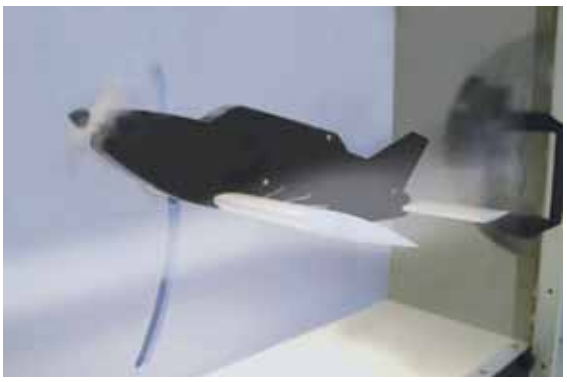
- Subsonic Wind Tunnels (AF1300, AF1450, AF1600) 42/ 46/ 48
- Cylinder Model with Tappings (AF1300a, AF1450a) 42
- NACA 0012 Aerofoil With Tappings (AF1300b, AF1450b) 42
- NACA 2412 Aerofoil With Variable Flap (AF1300c, AF1450c) 42
- NACA 0012 Aerofoils (AF1300d, AF1450d) 42
- Flat Plate Drag Model (AF1300e, AF1450e) 42
- Aircraft Model - Low Wing (AF1300g, AF1450g) 42
- Aircraft Model - High Wing (AF1300h, AF1450h) 42
- Three-Dimensional Drag Models (AF1300j, AF1450j) 42
- S1210 Aerofoil Model (AF1300l, AF1450l) 42

AF41

FLIGHT DEMONSTRATION WIND TUNNEL

A model aircraft suspended in an open-circuit wind tunnel. Includes realistic flight controls to teach a variety of principles of aircraft flight.

- Simulates take-off, level flight, cruise and landing
- Demonstrations include aerofoil lift, stall, longitudinal stability and transient motion
- Includes electronic display of air speed, attitude, altitude, pressure and lift
- Tufts on the wing clearly demonstrate the phenomenon of separation and stall
- Adjustable centre of gravity of the model



WITH THE SMOKE GENERATOR

LEARNING OUTCOMES:

A variety of practical demonstrations, 'hands-on' flight simulations, and student investigations into the behaviour of fixed-wing aircraft and wing performance, including:

- Practical investigation of longitudinal stability and control of the aircraft to demonstrate behaviour during take-off, level flight and landing
- Determination of the effect of speed on attitude for level flight and stall
- Measurement of the lift curve for the wing up to and beyond stall
- Students can adjust the centre of gravity of the model to alter its trim. They can then plot trim curves and determine the neutral point

WITH TWO-PEN CHART RECORDER (AF41A, AVAILABLE SEPARATELY):

- Demonstration of phugoid motion in terms of altitude
- Short period oscillation due to sudden disturbance can be shown by the change of incidence

WITH SMOKE GENERATOR (AFA10, AVAILABLE SEPARATELY):

- Visualisation of flow patterns past the aircraft's aerofoil and tail plane

For classroom demonstrations and student investigations into the behaviour of fixed-wing aircraft and wing performance during take-off, flight and landing.

The apparatus is an open-circuit wind tunnel with a model aircraft suspended in the working section. The model is supported by linkages that allow it to move vertically and to pitch about the quarter chord point independently.

RECOMMENDED ANCILLARIES:

- Two-Pen Chart Recorder (AF41a)
- Smoke Generator (AFA10) 46

ALTERNATIVE PRODUCTS:

- Modular Air Flow Bench (AF10) 31
- Bench-Top Subsonic Wind Tunnel (AF1125) 39
- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- Flow Visualisation Wind Tunnel (AF80) 54

AF80

FLOW VISUALISATION WIND TUNNEL

Uses smoke trails to demonstrate air flow around different shaped models.

- High-quality, vertical wind tunnel that helps students understand air flow around different shaped objects
- Ideal for small group experiments or classroom demonstrations
- Includes smoke generator and lighting to demonstrate flow clearly
- Variable air speed
- Includes a set of models with additional model set available separately

PHOTOGRAPH OF THE SMOKE TRAILS AROUND A HEMISPHERE

LEARNING OUTCOMES:

When used with the optional models, the visualisation and demonstration of:

- Boundary layers
- Separation
- Rotational flow

A vertical, suction-type wind tunnel with smoke visualisation. Allows demonstrations and student investigations into the flow of air around a wide variety of differently shaped models. A variable-speed fan mounted on top of the wind tunnel produces the air flow through the working section. Air flow is vertically upwards.

RECOMMENDED ANCILLARIES:

- Additional Model Set (AF80b), including:
  - Bend
  - Cascade corner
  - Plain corner
  - Heat exchanger tube bank

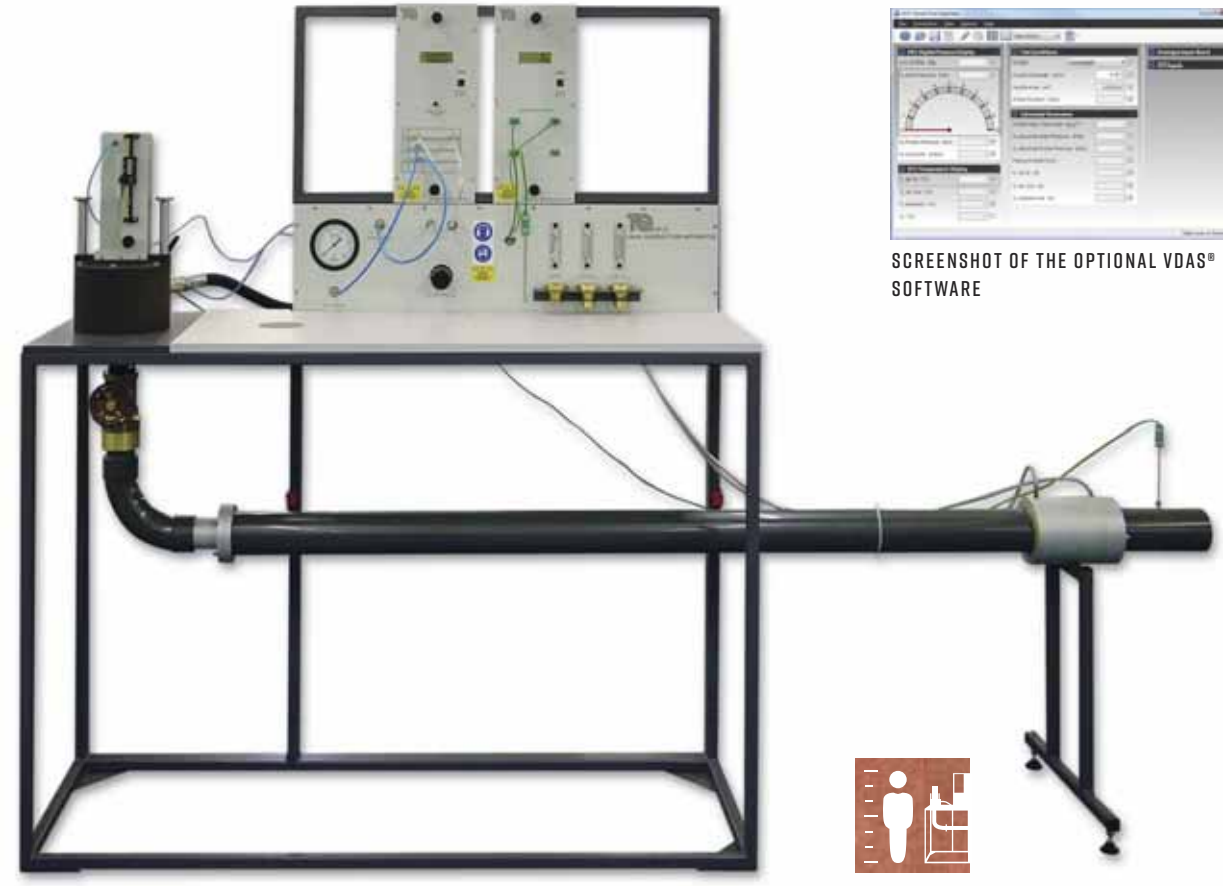
ALTERNATIVE PRODUCTS:

- Flow Visualisation (AF17) 37
- Bench-Top Subsonic Wind Tunnel (AF1125) 39
- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- Flight Demonstration Wind Tunnel (AF41) 52

VDAS® AF27

LAVAL NOZZLE FLOW APPARATUS

Demonstrates the thermodynamics and fluid mechanics of the adiabatic expansion of air through subsonic and supersonic nozzles.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Connects to suitable laboratory compressed air supply or TecQuipment's optional Compressor (AF27a)
- Includes three interchangeable, profiled and polished brass nozzles: convergent, convergent-divergent and convergent-parallel
- Electronic instruments measure and display multiple pressures and temperatures at the same time, for ease of use and for connection to TecQuipment's VDAS®
- Works with TecQuipment's Versatile Data Acquisition System (VDAS®) for instant recording of multiple readings and automatic calculations

LEARNING OUTCOMES:

- The relationship between pressure ratio and flow for convergent and convergent/divergent Laval nozzles
- The pressure profile in convergent/divergent nozzles at various pressure ratios
- Investigation of expansion with friction in a parallel passage at high subsonic velocities
- Boundary layer growth under subsonic and supersonic conditions
- The phenomenon of choked flow corresponding to sonic velocity at a nozzle throat

CONTINUED ON NEXT PAGE

The apparatus connects to TecQuipment's optional Compressor (AF27a) or a suitable laboratory supply of dry, clean compressed air.

It demonstrates the thermodynamic and fluid properties of the adiabatic expansion of subsonic and supersonic air flow through nozzles.

ESSENTIAL ANCILLARIES:

- Compressor (AF27a)

RECOMMENDED ANCILLARIES:

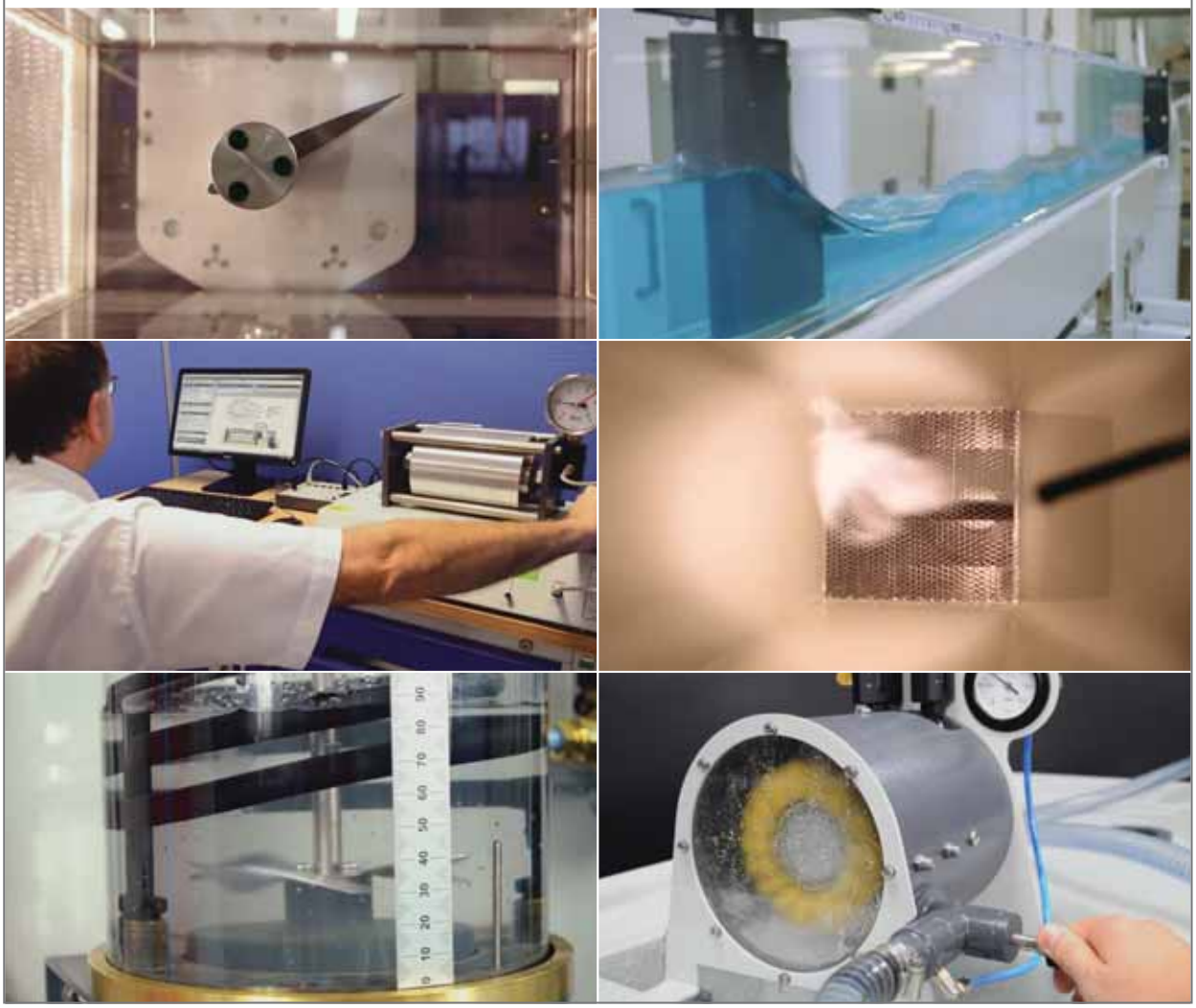
- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

ALTERNATIVE PRODUCTS:

- Supersonic Wind Tunnel – Intermittent (AF300) 57
- Supersonic Wind Tunnel – Continuous (AF302) 59

WATCH EQUIPMENT IN ACTION

Visit our YouTube channel to see demonstrations and promotional videos:
YOUTUBE.COM/C/TECQUIPMENT



VDAS® AF300

INTERMITTENT SUPERSONIC WIND TUNNEL

Investigates subsonic and supersonic air flow, including flow around two-dimensional models.

SHOWN WITH THE OPTIONAL SCHLIEREN APPARATUS (AF300A)

SCREENSHOT OF THE VDAS® SOFTWARE

- Laboratory-scale wind tunnel for subsonic and supersonic tests, nominally up to Mach 1.8
- Supplied with aerodynamic models for supersonic tests – includes model angle-feedback encoder
- Supplied with a set of different liners for controlled subsonic and supersonic air flow
- Induction flow for better air flow and accurate results

LEARNING OUTCOMES:

- Pressure distribution along a convergent/ divergent (Laval) nozzle with subsonic and supersonic air flow
- Comparison of theoretical and actual pressure distributions
- Comparison of actual and theoretical area ratios of a nozzle at supersonic air velocities (Mach numbers)
- Pressures around a two-dimensional model in subsonic and supersonic flow conditions, at different angles of incidence
- Lift coefficients for aerodynamic models in supersonic flow
- Shock waves and expansion patterns around a two-dimensional model in supersonic flow conditions (when used with the optional Schlieren Apparatus)

CONTINUED ON NEXT PAGE

An intermittent operation, induction-type supersonic wind tunnel for investigations into subsonic and supersonic flow. This includes tests on the flow around two-dimensional models at subsonic and supersonic air speeds.

A compressed air supply (AF300b, available separately) induces a flow in the working section of the wind tunnel. This gives a less turbulent and more stable flow for accurate results and comparison with theory. The essential compressed air supply includes filters and air dryers to give the dust-free and dry air source needed for good results.

ESSENTIAL ANCILLARIES:

- Air Compressor Receiver and Dryer (AF300b)
- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

RECOMMENDED ANCILLARIES:

- Schlieren Apparatus (AF300a) 58

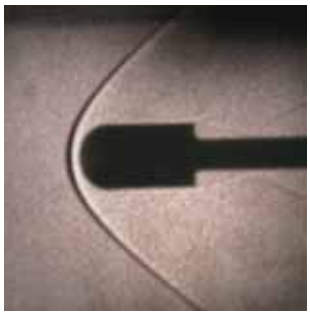
ALTERNATIVE PRODUCTS:

- Bench-Top Subsonic Wind Tunnel (AF1125) 39
- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- Laval Nozzle Flow Apparatus (AF27) 55
- Continuous Supersonic Wind Tunnel (AF302) 59

AF300A
SCHLIEREN APPARATUS

Schlieren apparatus for use with the AF300 Intermittent Supersonic Wind Tunnel.

- High-quality, laboratory-standard mirrors and lenses for clear images without distortion
- Shows supersonic air flow patterns around models
- Shows shockwaves and expansions
- Includes digital imaging equipment and TV monitor



The Schlieren apparatus allows students to see density gradients as variations in intensity of illumination. This allows them to see supersonic air flow patterns around models. It also clearly shows shockwaves and expansions for comparing positions and angles with values predicted by theory.

ANCILLARY FOR:

- Intermittent Supersonic Wind Tunnel (AF300) 57

VDAS® AF302

CONTINUOUS SUPERSONIC WIND TUNNEL

For investigations into flow around two-dimensional models at supersonic and subsonic air speeds.

VACUUM PUMP (SUPPLIED) NOT SHOWN ON IMAGE

SCREENSHOT OF THE VDAS® SOFTWARE

- A suction-type continuous-operation supersonic wind tunnel for investigations into two-dimensional air flow around models for nominal airspeeds up to Mach 1.8
- Includes high-quality optical glass windows in the working section, suitable for use with an optional Schlieren system
- Includes a selection of models for two-dimensional flow experiments and an encoder for feedback of model angle
- Supplied with a multi-pressure display unit and calibrated pressure sensors to show pressures relative to atmosphere
- Includes a vacuum pump with remote control for ease of use

CONTINUED ON NEXT PAGE

CONTINUOUS SUPERSONIC WIND TUNNEL (AF302) CONTINUED FROM PREVIOUS PAGE

A suction-type continuous-operation supersonic wind tunnel for investigations into subsonic and supersonic air flow. It also allows students to study air flow in two dimensions around aerodynamic models.

LEARNING OUTCOMES:

- Pressure distribution along a convergent/ divergent (Laval) nozzle with subsonic and supersonic air flow
- Comparison of theoretical and actual pressure distributions
- Comparison of actual and theoretical area ratios of a nozzle at supersonic air velocities (Mach numbers)
- Pressures around a two-dimensional model in subsonic and supersonic flow conditions, at different angles of incidence
- Lift coefficients for aerodynamic models in supersonic flow
- Shock waves and expansion patterns around a two-dimensional model in supersonic flow conditions (when used with the optional Schlieren Apparatus)

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

RECOMMENDED ANCILLARIES:

- Schlieren Apparatus AF302a 60

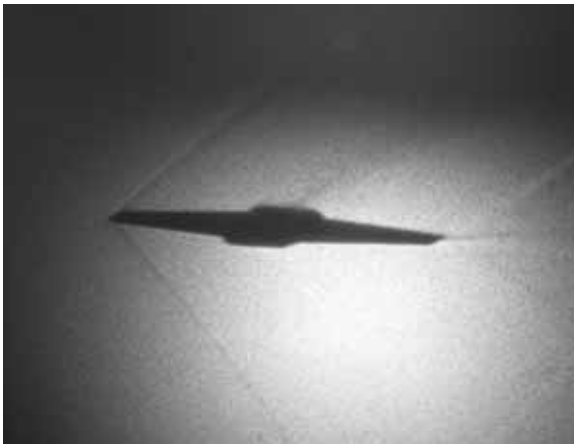
ALTERNATIVE PRODUCTS:

- Bench-Top Subsonic Wind Tunnel (AF1125) 39
- Subsonic Wind Tunnel (AF1300) 40
- Subsonic Wind Tunnel (AF1450S) 46
- Subsonic Wind Tunnel (AF1600S) 48
- Laval Nozzle Flow Apparatus (AF27) 55
- Intermittent Supersonic Wind Tunnel (AF300) 57

AF302A
SCHLIEREN APPARATUS

Schlieren apparatus for use with the AF302 Continuous Supersonic Wind Tunnel.

- High-quality, laboratory-standard mirrors and lenses for clear images without distortion
- Shows supersonic air flow patterns around models
- Shows shockwaves and expansions
- Includes digital imaging equipment and TV monitor



5 DEGREES MACH I-8 AND 5 DEGREE WEDGE

The Schlieren apparatus allows students to see density gradients as variations in intensity of illumination. This allows them to see supersonic air flow patterns around models. It also clearly shows shockwaves and expansions for comparing positions and angles with values predicted by theory.

ANCILLARY FOR:

- Continuous Supersonic Wind Tunnel (AF302) 59

CONTROL ENGINEERING

CONTROL ENGINEERING PRINCIPLES 63

"

Our students are comfortable while using products from TecQuipment in labs. Highly innovative products by TecQuipment Ltd for engineering education are ideal for engineering and technical education at all levels. Our students are regularly using this equipment for masters and doctoral research. The products are user-friendly and need minimum after-sales service.

PROFESSOR R D MISAL
DEFENCE INSTITUTE OF ADVANCED TECHNOLOGY, GIRINAGAR, PUNE, INDIA

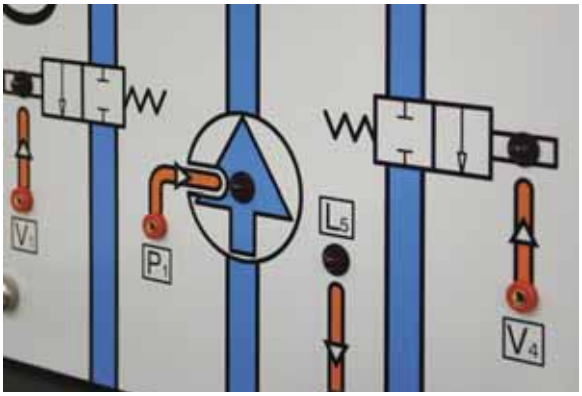
CONTROL ENGINEERING

DETAILED EXPERIMENTATION

Each unit in the Control Engineering range focuses on a specific principle. This gives students the opportunity to develop a deep understanding of each concept, naturally progressing from introductory to advanced experimentation.

EASE OF USE

The majority of the apparatus in the Control range can be connected to TecQuipment's dedicated Controllers (CE120 and CE122). The units have clear diagrams, highlighting each of the PID elements, for simple analogue or digital execution of the experiments.

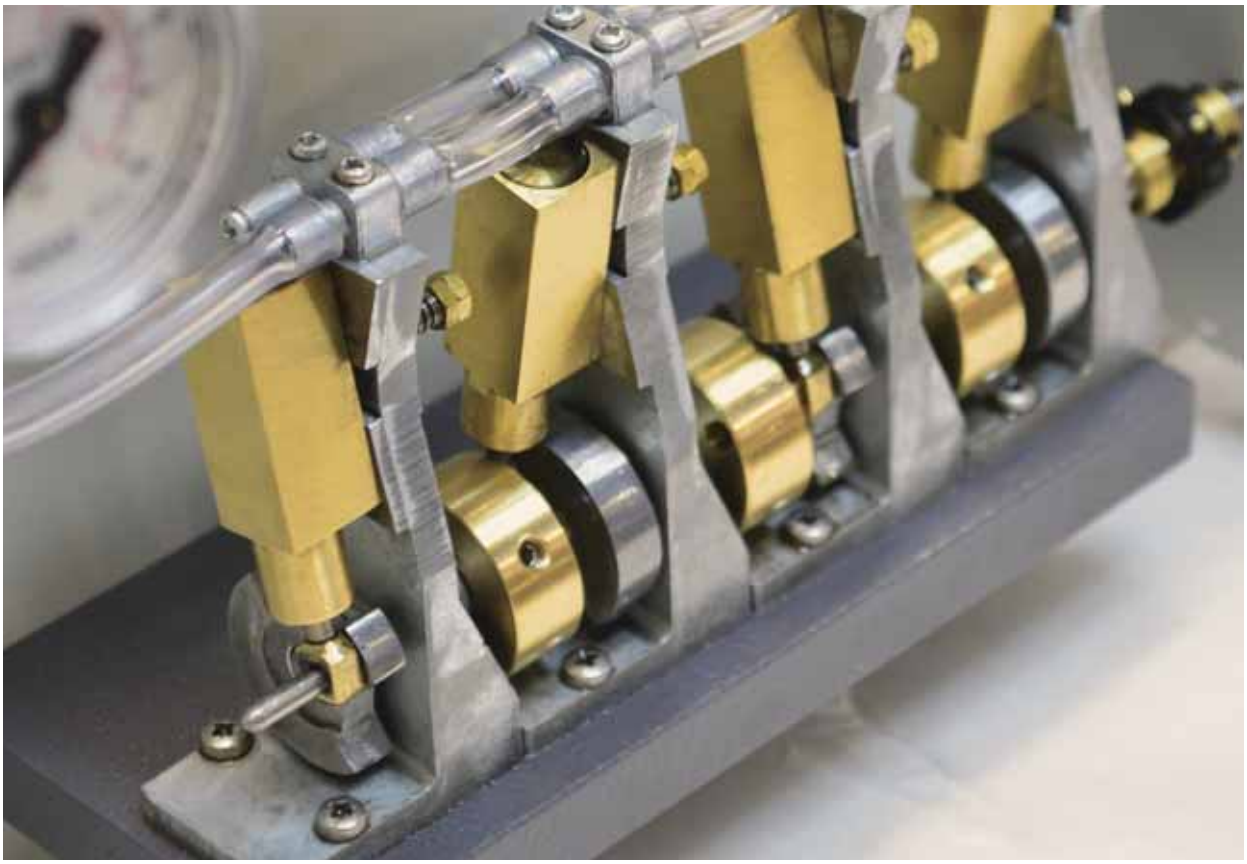


KEY FEATURES AND BENEFITS:

- **ACADEMIC AND INDUSTRIAL:** Bench-top products for academic teaching and industrial products for vocational training.
- **CHOICE:** Start with a single control scenario and build up, or choose a more complete product to suit the budget and needs.
- **SAFE AND EASY SET-UP:** Simple, low-voltage connections allow safe and quick experiment set up.
- **HANDS-ON:** Both the academic and industrial products allow easy connection and adjustments, for a more practical understanding.

POWERFUL SOFTWARE

All our Control Engineering products work with software. Most of the academic products work with TecQuipment's own CE2000 control software.

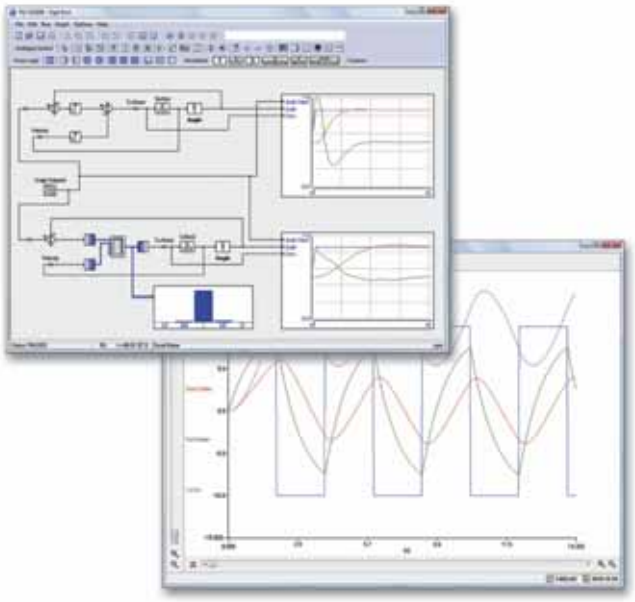


CE2000

CONTROL SOFTWARE

Icon-based software that simulates control systems and works with TecQuipment's Controller (CE120) or Digital Interface (CE122) to control and acquire data from TecQuipment's Control Engineering range.

- Software only – needs no extra circuit boards in the computer
- Includes a range of ready-made fuzzy logic and control blocks, such as proportional, integral and derivative blocks
- Collected data can be shown and printed as charts or exported for use in other programs
- Real-time display of variables by virtual meters, virtual chart recorders or virtual oscilloscopes
- Easy-to-create control circuits made by linking together drag-and-drop icons
- Users can create their own circuits and save them, or use the ready-made circuits supplied



The CE2000 is a powerful control software package with many features. It is supplied as standard with TecQuipment's Controller (CE120), Digital Interface (CE122) and Process Trainer (CE117). The software allows students and experienced control engineers to develop and test a wide selection of controllers and filters.

LEARNING OUTCOMES:

SOFTWARE ONLY:

The user guide shows students how to use the software and how to build and test common control systems, such as:

- Design and implementation of three-term controllers
- Design of controllers and filters

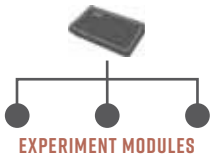
SOFTWARE AND HARDWARE (WHEN USED WITH OTHER PRODUCTS FROM THE CE RANGE):

- Thermal control (CE103)
- Level control (CE105/CE105MV)
- Ball and beam control (CE106)
- Engine speed control (CE107)
- Coupled drives control (CE108)
- Ball and hoop control (CE109)
- Servo control (CE110)
- Flow, level, pressure and temperature control (CE117)

CE120
CONTROLLER

A self-contained analogue and computer-based controller designed to support practical investigations into the basic and advanced principles of control engineering at all academic levels.

MODULAR SYSTEM



FEATURES:		BENEFITS:
Controls and monitors signals to and from selected Control Range Experiment Modules	→	Modular design saves space and reduces costs
Manual controls plus additional interface with analogue to digital and digital to analogue conversion	→	Allows 'hands-on' control arrangements, plus computer control and data acquisition, with no need to fit interface cards in the computer
Buffered, low-voltage connections	→	Safe, even for inexperienced students, with minimal supervision
Multiple summing junctions, Proportional, Integral and PID blocks	→	Allows many different control arrangements
Includes TecQuipment's CE2000 Control Software	→	Real-time control and data acquisition with more choice of control arrangements
Standard 10 VDC signals	→	May be used to control other suitable systems

LEARNING OUTCOMES:

When used with the experiment modules:

- Temperature (thermal) control
- Level control
- Engine speed control
- Servo control
- Coupled drive control
- Ball and beam control
- Ball and hoop control

This compact unit has analogue electronic circuits connected in blocks. These blocks mimic the important parts of industrial controllers. Clear diagrams on the front panel of the controller show the blocks, each of which has its own set of connection sockets. The user connects the blocks in any way that they need and then connects them to their chosen experiment module.

AVAILABLE EXPERIMENT MODULES:

- Thermal Control Process Apparatus (CE103) 66
- Coupled Tanks Apparatus (CE105/CE105MV) 67
- Ball and Beam Apparatus (CE106) 68
- Engine Speed Control Apparatus (CE107) 69
- Coupled Drives Apparatus (CE108) 71
- Ball and Hoop Apparatus (CE109) 72
- Servo Trainer (CE110) 73

ANCILLARY FOR:

- Process Trainer (CE117) 81

CE122
DIGITAL INTERFACE

A self-contained, computer-based controller designed to support practical investigations covering the basic and advanced principles of control engineering at all academic levels.

MODULAR SYSTEM

ESSENTIAL BASE UNIT (CE122)

EXPERIMENT MODULES
(CE103, CE105-CE110)

FEATURES:		BENEFITS:
Connects between a computer and selected Control Range Experiment Modules for control and monitoring of signals	→	No need to fit interface cards in your computer
Buffered, low-voltage connections	→	Safe, even for inexperienced students, with minimal supervision
Fully digital with simple set-up	→	Needs no adjustments and saves time
Includes TecQuipment's CE2000 Control Software	→	Real-time control and data acquisition with hundreds of different control arrangements
Standard 10 VDC signals	→	May be used to control other suitable systems

The Digital Interface is an alternative to the CE120 Controller, when the user only needs the interface part of the CE120. It converts analogue inputs from other equipment into digital signals for a computer. It also converts the digital signals from a computer into analogue signals to control other equipment.

AVAILABLE EXPERIMENT MODULES:

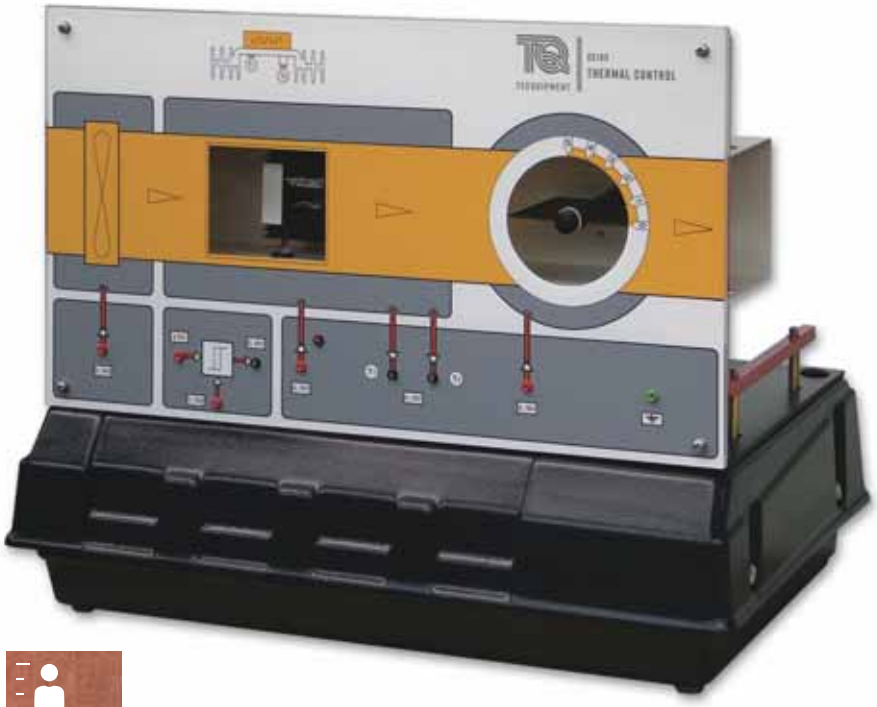
- Thermal Control Process Apparatus (CE103) 66
- Coupled Tanks Apparatus (CE105/CE105MV) 67
- Ball and Beam Apparatus (CE106) 68
- Engine Speed Control Apparatus (CE107) 69
- Coupled Drives Apparatus (CE108) 71
- Ball and Hoop Apparatus (CE109) 72
- Servo Trainer (CE110) 73

CE103

THERMAL CONTROL PROCESS APPARATUS

A compact, self-contained, bench-mounted temperature control apparatus designed to allow students at all academic levels to investigate the basic and advanced principles of control.

- Electrically-heated and air-cooled model process that mimics a real industrial process
- Includes variable hysteresis for advanced process control experiments
- Temperature sensors with different thermal contact to the process give variations in thermal inertia and time constant
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers



LEARNING OUTCOMES:

- Heat transfer
- ON/OFF control: experiment includes investigation of overshoot and undershoot, ON and OFF time ratio, rates of heating and cooling, offset and hysteresis
- Proportional, proportional + integral, or proportional + integral + differential control
- Frequency response of model process
- Thermal inertia and variable-time constants
- Multi-variable control – up to three variables can be monitored and individually controlled

The Thermal Control Process Apparatus mimics a common industrial process, including an air-conditioning plant, where a combination of adjustments can control temperature.

ESSENTIAL BASE UNIT:

- Controller (CE120) – A controller with analogue and digital controls and instruments **OR** 64
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) 65

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see page 63) with editable, pre-made control experiments for use with the CE103.

ALTERNATIVE PRODUCTS:

- Process Trainer (CE117) 81
- Temperature Process Training System (TE3300/05) 85
- Control and Instrumentation Study Station (TE37) 87

CE105/CE105MV

COUPLED TANKS APPARATUS

A self-contained, bench-mounted apparatus designed to allow students at all academic levels to investigate basic and advanced principles of open and closed-loop control of flowrate and liquid level in single and dual tank systems.

- Option for second pump with second flow meter to allow multivariable (MV) operation (CE105MV)
- Level control of one and two tanks
- 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

LEARNING OUTCOMES:

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

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.

ESSENTIAL BASE UNIT:

- Controller (CE120) – A controller with analogue and digital controls and instruments **OR** 64
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) 65

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see page 63) with editable, pre-made control experiments for use with the CE105/CE105MV.

ALTERNATIVE PRODUCTS:

- Process Trainer (CE117) 81
- Level Process Training System (TE3300/04) 84
- Control and Instrumentation Study Station (TE37) 87

CE106

BALL AND BEAM APPARATUS

A compact, self-contained, bench-mounted apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control, including control of naturally unstable systems.

- Self-contained, compact and bench-mounted unit that mimics a real control problem in unstable systems, such as missile or rocket take-off
- Highly visual apparatus, with moving ball and front panel mimic diagram of the process – students can see what they are controlling
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers
- For basic and advanced experiments with angle, velocity and position control

LEARNING OUTCOMES:

- Measurement of system dynamics by transient and closed-loop methods
- Design of analogue phase-advance compensators
- Design of state reconstructors to obtain estimates of ball velocity and position

The Ball and Beam Apparatus demonstrates the control problems of unstable systems, for example a rocket or missile during launch, which needs active control to prevent the missile going unstable and toppling over.

ESSENTIAL BASE UNIT:

- Controller (CE120) – A controller with analogue and digital controls and instruments **OR** 64
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) 65

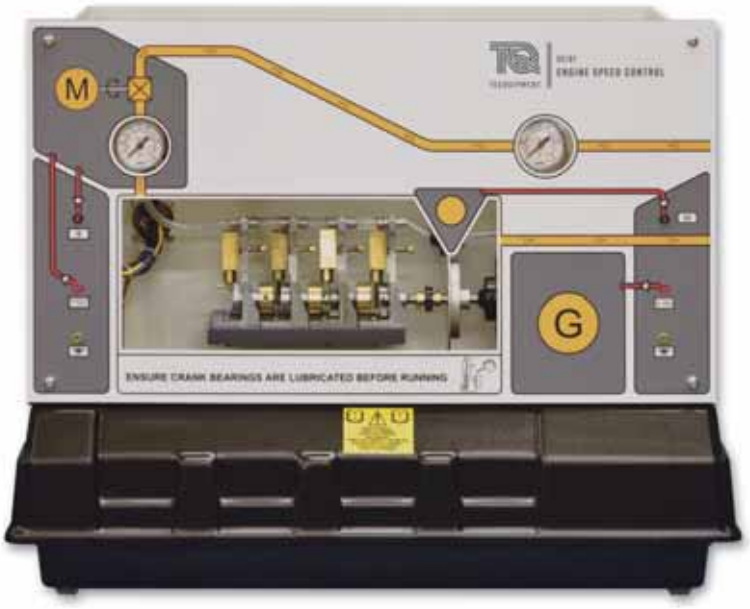
Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see page 63) with editable, pre-made control experiments for use with the CE106.

CE107

ENGINE SPEED CONTROL APPARATUS

A compact, self-contained, bench-mounted apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control, including control of non-linear systems and inner-loop feedback techniques.

- Small-scale, compressed air-powered piston engine to mimic a full-size engine with realistic results
- Demonstrates problems of speed control in non-linear systems
- Front panel includes mimic diagram of the process so students can clearly 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 controller



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

ESSENTIAL BASE UNIT:

- Controller (CE120) – A controller with analogue and digital controls and instruments **OR** 64
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) 65

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see page 63) with editable, pre-made control experiments for use with the CE107.

ESSENTIAL ANCILLARIES:

- Compressor (CE1B) 297

RECOMMENDED ANCILLARIES:

- Optical Tachometer (OT1) 297
- Stroboscope (ST1) 297

TECQUIPMENT CONTINUES TO INVEST HEAVILY IN OUR IN-HOUSE MANUFACTURING FACILITIES

CE108

COUPLED DRIVES APPARATUS

A compact, bench-mounted apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control, including control of multi-variable systems.

- Coupled drives demonstrate the problems of speed and tension control
- Mimics many industrial and household applications with realistic results
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers
- Front panel includes a mimic diagram of the process so that students can see what they are controlling

LEARNING OUTCOMES:

- Independent control of speed and tension
- Simultaneous control of speed and tension
- Practical methods of controlling multi-variable electro-mechanical systems

The CE108 Coupled Drives apparatus demonstrates the problems of controlling speed and tension in coupled drives. Many applications use coupled drives, for example: magnetic tape drives, textile machines and paper mills.

ESSENTIAL BASE UNIT:

- Controller (CE120) – A controller with analogue and digital controls and instruments **OR** 64
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) 65

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see page 63) with editable, pre-made control experiments for use with the CE108.

RECOMMENDED ANCILLARIES:

- Optical Tachometer (OT1) 297

CE109

BALL AND HOOP APPARATUS

A compact self-contained bench-mounted apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control, including systems that are naturally oscillatory.

- Demonstrates the problems of speed and position control of a mobile body or liquid in a container
- Mimics industrial, aeronautical, fluid transport and pumping system problems with realistic results
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers
- Front panel includes a mimic diagram of the process so that students can see what they are controlling

LEARNING OUTCOMES:

- The design and analysis of servo control systems for position and velocity control
- The analysis and modelling of liquid slop dynamics
- The use of 'pole zero' in the analysis of control systems

The CE109 Ball and Hoop Apparatus demonstrates the use of electromechanical servo systems for position and velocity control. It also works as a model to show liquid slop problems, for example: aircraft missile fuel storage, fuel tankers and industrial pumping systems.

ESSENTIAL BASE UNIT:

- Controller (CE120) – A controller with analogue and digital controls and instruments **OR** 64
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) 65

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see page 63) with editable, pre-made control experiments for use with the CE109.

RECOMMENDED ANCILLARIES:

- Optical Tachometer (OT1) 297
- Oscilloscope (OS1) 297

CE110

SERVO TRAINER

A compact, self-contained, bench-mounted DC servo apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control. In particular, the CE110 deals with control issues relating to position and speed control in servo systems.

- Demonstrates the problems of speed and position control of a servomotor under different loads
- Mimics industrial, transport and aeronautical problems - with realistic results
- All inputs and outputs buffered for connection to TecQuipment's optional controllers or other suitable controllers
- Front panel includes a mimic diagram of the process so that students can see what they are controlling

LEARNING OUTCOMES:

- Basic tests and transducer calibration
- Response calculation and measurement
- Proportional and proportional plus integral control of servo-system speed
- Disturbance cancelling and feedforward control
- Angular position control: proportional control and velocity feedback
- Angular position control and the influence of non-linearities
- Non-linear system characteristics

The CE110 Servo Trainer demonstrates DC servo position and speed control systems using typical industrial techniques. It has a DC servomotor, a DC generator and a flywheel mounted on a common shaft.

ESSENTIAL BASE UNIT:

- Controller (CE120) – A controller with analogue and digital controls and instruments **OR** 64
- Digital Interface (CE122) – An interface which connects between most products in the Control Engineering range and a suitable computer (not included) 65

Both the CE120 and the CE122 include TecQuipment's CE2000 Control Software (see page 63) with editable, pre-made control experiments for use with the CE110.

AERODYNAMICS LABORATORY AT THE EAST AFRICAN SCHOOL OF AVIATION

TecQuipment continues to have a strong and solid working relationship supporting The East African School of Aviation (EASA) in Nairobi Kenya, bringing aviation theory to life with aerodynamics laboratory equipment.

EASA is an international aviation centre. It provides training programmes to people across Africa that meet the needs of the global aviation industry. As a centre of excellence, they demand the latest technology for illustrating the principles of aerodynamics.

Being leaders in the field of aerodynamic training technology and with evidence of high quality and excellent customer service, TecQuipment was chosen to help kit-out their training facilities.

Following a visit to the TecQuipment headquarters and factory in the UK, the Head of Training, Mak'omondi Lucas Owino, commented:

> "We saw the things required for training and everything was in good shape and we could see that there was high quality assurance for material testing and production.
>
> We were impressed and happy that whatever TecQuipment provided was good quality and, as customers, we're very satisfied."

SUBSONIC WIND TUNNEL NEWLY INSTALLED AT EASA, NAIROBI

DELIVERING HIGH QUALITY PRODUCTS WITH EXCELLENT CUSTOMER SUPPORT

Specialist members of the customer service team regularly travel to site to install TecQuipment's laboratory equipment. In this instance, Installation, Commission and Training Manager Dave Giddings flew to Nairobi to ensure that everything was up and running as quickly as possible.

DAVE GIDDINGS WITH STAFF FROM EASA AT TECQUIPMENT'S HEADQUARTERS IN NOTTINGHAM

THE EASA AERODYNAMICS LABORATORY

The centrepieces of the EASA lab are a subsonic wind tunnel and a flight demonstration wind tunnel. To complement this, they also purchased two modular air flow benches.

SUBSONIC WIND TUNNEL 300 MM (AF1300) AND ANCILLARIES

A compact, practical open-circuit suction wind tunnel for studying aerodynamics. Plus ancillaries including the Three Component Balance, Smoke Generator, Multi-tube Manometer and a range of aerofoil, drag, boundary layer low and high wing models.

FLIGHT DEMONSTRATION WIND TUNNEL (AF41) AND DATA ACQUISITION MODULE

For classroom demonstrations and student investigations into the behaviour of fixed-wing aircraft and wing performance during take-off, flight and landing.

MODULAR AIR FLOW BENCH (AF10) AND MULTI-TUBE MANOMETER

A fully mobile bench to provide basic airflow facilities to enable a wide range of practical airflow investigations. Suitable for demonstration, laboratory and project work at a basic level.

EASA'S AERODYNAMICS LABORATORY

SHARE YOUR INSTALL – LABORATORIES FROM AROUND THE WORLD

Academics and students from across the globe are proudly sharing their latest installation pictures on social media.

SHARE YOUR PICTURES

A NEW PIECE OF EQUIPMENT

Here's a picture taken by the Universiti Teknologi Malaysia (UTM) of their latest TecQuipment install and training session.

Thanks to Jonathan Bonkoske from Texas State Technical College for their photo of their install of TecQuipment's Power Systems training equipment last week #tstcproud #technicallybetter

STUDENTS WORKING IN THE LAB

Students from the University of Louisville @UofL USA learning about flow measurement using their latest lab equipment from TecQuipment.

Salem Sayed Hegazy, Senior Lab Specialist at United Arab Emirates University demonstrates a Two-stage parallel pump experiment (H83) using VDAS® data acquisition software, recently supplied by TecQuipment #UAEUNEWS

PROCESS CONTROL ENGINEERING

DIGITAL CONTROL	79
PROCESS CONTROL	81

> Just wanted to say what a great guy Dave Giddings (TecQuipment's ICT Manager) is. Thank you for sending him. I was very impressed with his work ethic and expertise. Also, he is very good interacting with the customer. You probably know all this already but I just wanted to say it!
>
> **CARY STOVER**
> BUCKEYE EDUCATIONAL SYSTEMS

PROCESS CONTROL ENGINEERING

MADE FOR ACADEMIC AND INDUSTRIAL TRAINING

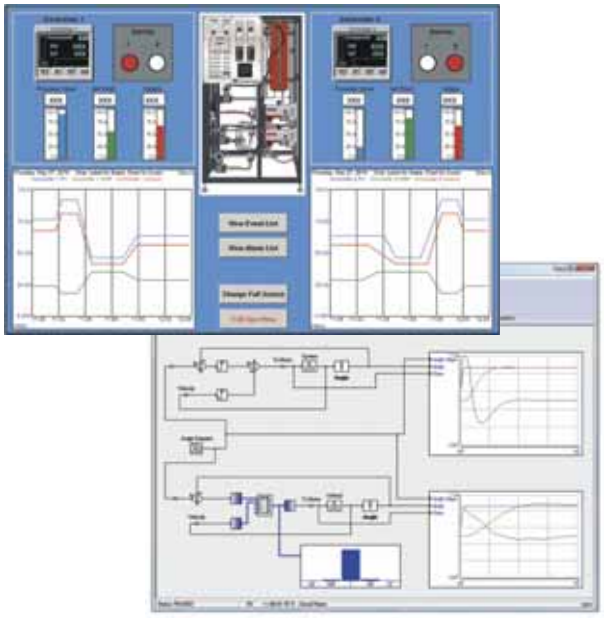
The Process Control Engineering range extends from bench-top products made for demonstrating control principles, to equipment using industrial parts for vocational training.

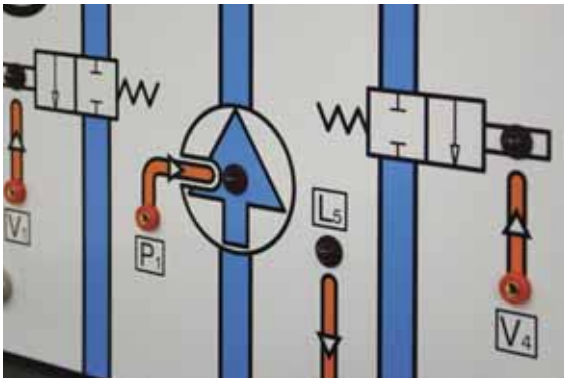
ACADEMIC AND INDUSTRIAL SOFTWARE

All our Process Control products work with software. Most of the academic products work with TecQuipment's own CE2000 control software. The more industrial products work with industrial process or PLC control software.

KEY FEATURES AND BENEFITS:

- **ACADEMIC AND INDUSTRIAL:** Bench-top products for academic teaching and industrial products for vocational training.
- **HANDS ON:** All the products allow easy connection and adjustments, for a more practical understanding of principles.
- **INDUSTRIAL COMPONENTS:** Realistic student experience, with the use of industry-standard instrumentation.





CONNECTIVITY

The Process Training system (TE3300) can be used individually, to study control elements in isolation. They can also be connected to other units in the system, to introduce more complexity and wider experimentation capability.

PLC TRAINER (CE123)

Uses an industry standard PLC to control the PLC Process using ladder logic programming running on a PC. For use with the PLC Process (CE111).

MODULAR SYSTEM

ESSENTIAL BASE UNIT (CE123)

EXPERIMENT MODULE
(CE111)

- Includes PLC software to program the controller, and ready-made programs to match experiments given in the user guide
- Introduces ladder logic programming
- Works with TecQuipment's PLC Process (CE111) to show students how to control a common industrial process, but in safe conditions
- Uses an industry-standard controller to give students realistic industrial experience
- Includes manual override switches to introduce faults for fault-finding training

LEARNING OUTCOMES:

- Simple programming
- Ladder logic operations
- Timers, counters and monitoring
- Editing and adding comments in a PLC program
- Special ladder logic instructions

The PLC Trainer shows students how to use a programmable logic controller. It also works with TecQuipment's PLC Process (CE111) to help students study how to use programmable logic controllers to control a process.

AVAILABLE EXPERIMENT MODULES:

- PLC Process (CE111) 80

TALK TO OUR EXPERTS

Our dedicated Sales team can help you choose the equipment best suited for your needs, answer your questions and progress your order.

CE111

PLC PROCESS

Compact, self-contained, bench-mounting liquid fl ow and level process, for use with TecQuipment's CE123 PLC Trainer.

- Allows basic and advanced studies of programmable logic controllers (PLCs) in industrial applications
- Demonstrates control of liquid flow, volume and level in two tanks
- Includes a selection of fully controllable valves to give many different liquid level and flow control experiments, including batch processing
- Front panel includes mimic diagram of the process so students can clearly see what they are controlling

LEARNING OUTCOMES:

When used with the CE123:

- Basic programming of a PLC
- Basic level control
- Tank filling sequence
- Simulated batch processing (sequencing)
- Ladder logic programming
- Editing and adding comments in a PLC program

The open structure of the CE111 and CE123 allows the user to create additional experiments to suit their needs.

TecQuipment's PLC Process gives students and engineers practical experience of the principles and application of programmable logic controllers (PLCs). The object is to connect and program an external, programmable logic controller to monitor and control the level and flow rate of water in a two-tank system.

ESSENTIAL BASE UNIT:

- PLC Trainer (CE123) 79

CE117

PROCESS TRAINER

Self-contained, fully integrated bench-mounting teaching apparatus that allows process control experiments in flow, level, pressure and temperature.

- Includes four basic process control methods in one compact unit
- Supplied with TecQuipment's CE2000 software for supervisory control of the process with data acquisition
- Mimics common industrial parts and processes with realistic results
- Ideal for classroom demonstrations and student experiments
- Includes experiments from basic control to advanced control methods, including ratio control, cascade control, interactive control and feedforward control

LEARNING OUTCOMES:

- Proportional, Integral and Derivative (PID) control
- Control of flow
- Control of level
- Control of pressure
- Control of temperature
- Ratio control
- Cascade control
- Multi-loop control
- Interacting control loops

TecQuipment's Process Trainer is an educational package that mimics industrial process engineering. The fully integrated, self-contained teaching apparatus gives a comprehensive range of process control experiments, from basic to advanced.

Using water as the working fluid, the equipment allows safe, practical experiments on control of flow, liquid level, temperature and pressure. Students can study each of these separately or in combinations.

ALTERNATIVE PRODUCTS:

- Thermal Control Process Apparatus (CE103) 66
- Coupled Tanks Apparatus (CE105/CE105MV) 67
- Pressure Process Training System (TE3300/02) 82
- Flow Process Training System (TE3300/03) 83
- Level Process Training System (TE3300/04) 84
- Temperature Process Training System (TE3300/05) 85
- Control and Instrumentation Study Station (TE37) 87

TE3300/02

PRESSURE PROCESS TRAINING SYSTEM

For a wide range of practical experiments in pressure control.

- Demonstrates automatic control of pressure in an accumulator using proportional, proportional plus integral, and proportional, integral plus derivative (PID) control
- Uses industry-standard parts making it ideal for industrial, vocational and academic training
- Demonstrates operation, calibration and tuning of controllers, transmitters, converters and valves
- Connects to the Flow Process Training System (TE3300/03) for cascade control
- Connects to the Computer Control System (TE3300/06) for distributed control

LEARNING OUTCOMES:

- Proportional, integral and derivative control
- Setting up and demonstrating automatic control
- The principles of loop control and the calibration and tuning of controllers, transmitters, converters and valves
- Cascade control of flow and pressure (when used with the TE3300/03 Flow Process Training System)
- Distributed control (when used with the TE3300/06 Computer Control System)

ESSENTIAL ANCILLARIES:

- Service Module (SM3300)

RECOMMENDED ANCILLARIES:

- Flow Process Training System (TE3300/03) 83
- Computer Control System (TE3300/06) 86

ANCILLARY FOR:

- Flow Process Training System (TE3300/03) 83

ALTERNATIVE PRODUCTS:

- Process Trainer (CE117) 81
- Control and Instrumentation Study Station (TE37) 87

The Pressure Process Training System is a compact and mobile unit for a wide range of experiments in pressure control. It gives students a greater understanding of the stability of simple control systems.

The self-contained unit can do many experiments, and can be connected to other products in the TE3300 range for extra experiments. For cascade control of flow and pressure, it can link to the optional Flow Process Training System (TE3300/03). For distributed control, it can connect to the optional Computer Control System (TE3300/06).

TE3300/03

FLOW PROCESS TRAINING SYSTEM

For a wide range of practical experiments in flow control.

- Demonstrates automatic control of flow using proportional, proportional plus integral, and proportional plus integral plus derivative (PID) control
- Uses industry-standard parts making it ideal for industrial, vocational and academic training
- Demonstrates operation, calibration and tuning of controllers, transmitters, converters and valves
- Connects to the Pressure Process (TE3300/02) and Level Process (TE3300/04) Training Systems for cascade control
- Connects to the Computer Control System (TE3300/06) for distributed control

The Flow Process Training System is a compact and mobile unit for a wide range of experiments in flow control. It gives students a greater understanding of the stability of simple control systems.

The self-contained unit can do many experiments, and can be connected to other products in the TE3300 range for extra experiments. For cascade control of flow and pressure, it can link to the optional Pressure Process Training System (TE3300/02). For cascade control of flow and level, it can link to the optional Level Process Training System (TE3300/04). For distributed control, it can connect to the optional Computer Control System (TE3300/06).

ESSENTIAL ANCILLARIES:

- Service Module (SM3300)

RECOMMENDED ANCILLARIES:

- Pressure Process Training System (TE3300/02) 82
- Level Process Training System (TE3300/04) 84
- Computer Control System (TE3300/06) 86

ANCILLARY FOR:

- Pressure Process Training System (TE3300/02) 82
- Level Process Training System (TE3300/04) 84

ALTERNATIVE PRODUCTS:

- Process Trainer (CE117) 81
- Control and Instrumentation Study Station (TE37) 87

LEARNING OUTCOMES:

- Proportional, integral and derivative control
- Setting up and demonstrating automatic control
- The principles of loop control and the calibration and tuning of controllers, transmitters, converters and valves
- Calibration of an orifice flow meter with a differential pressure transmitter
- Quadratic flow laws and square root extraction
- Cascade control of pressure and flow, and level and flow (when used with the TE3300/02 and TE3300/04)
- Distributed control (when used with the TE3300/06 Computer Control System)

TE3300/04

LEVEL PROCESS TRAINING SYSTEM

For a wide range of practical experiments in level control.

- Demonstrates automatic control of level using proportional, proportional plus integral, and proportional plus integral plus derivative (PID) control
- Uses industry-standard parts making it ideal for industrial, vocational and academic training
- Demonstrates operation, calibration and tuning of controllers, transmitters, converters and valves
- Connects to the Flow Process Training System (TE3300/03) for cascade control
- Connects to the Computer Control System (TE3300/06) for distributed control

The Level Process Training System is a compact and mobile unit for a wide range of experiments in flow control. It gives students a greater understanding of the stability of simple control systems.

The self-contained unit can do many experiments, and can be connected to other products in the TE3300 range for extra experiments. For cascade control of flow and level, it can link to the optional Flow Process Training System (TE3300/03). For distributed control, it can connect to the optional Computer Control System (TE3300/06).

ESSENTIAL ANCILLARIES:

- Service Module (SM3300)

RECOMMENDED ANCILLARIES:

- Flow Process Training System (TE3300/03) 83
- Computer Control System (TE3300/06) 86

ANCILLARY FOR:

- Flow Process Training System (TE3300/03) 83

ALTERNATIVE PRODUCTS:

- Coupled Tanks Apparatus (CE105/CE105MV) 67
- Process Trainer (CE117) 81
- Control and Instrumentation Study Station (TE37) 87

LEARNING OUTCOMES:

- Proportional, integral and derivative control
- Setting up and demonstrating automatic control
- The principles of loop control and the calibration and tuning of controllers, transmitters, converters and valves
- Wet and dry leg operation of a differential pressure transmitter
- Operation of a level-control system
- Cascade control of level and flow (when used with the TE3300/03 Flow Process Training System)
- Distributed control (when used with the TE3300/06 Computer Control System)

TE3300/05

TEMPERATURE PROCESS TRAINING SYSTEM

For a wide range of practical experiments in temperature control.

- Demonstrates automatic control of temperature using proportional, proportional plus integral, and proportional plus integral plus derivative (PID) control
- Uses industry-standard parts making it ideal for industrial, vocational and academic training
- Demonstrates operation, calibration and tuning of temperature transmitters and thermocouples
- Includes delay coil to mimic realistic time lag due to a process
- Connects to the Computer Control System (TE3300/06) for distributed control

The Temperature Process Training System is a compact and mobile unit for a wide range of experiments in temperature control. It gives students a greater understanding of the stability of simple control systems.

The self-contained unit can do many experiments, and can be connected to the optional Computer Control System (TE3300/06) for distributed control.

RECOMMENDED ANCILLARIES:

- Computer Control System (TE3300/06) 86

ALTERNATIVE PRODUCTS:

- Thermal Control Process Apparatus (CE103) 66
- Process Trainer (CE117) 81
- Control and Instrumentation Study Station (TE37) 87

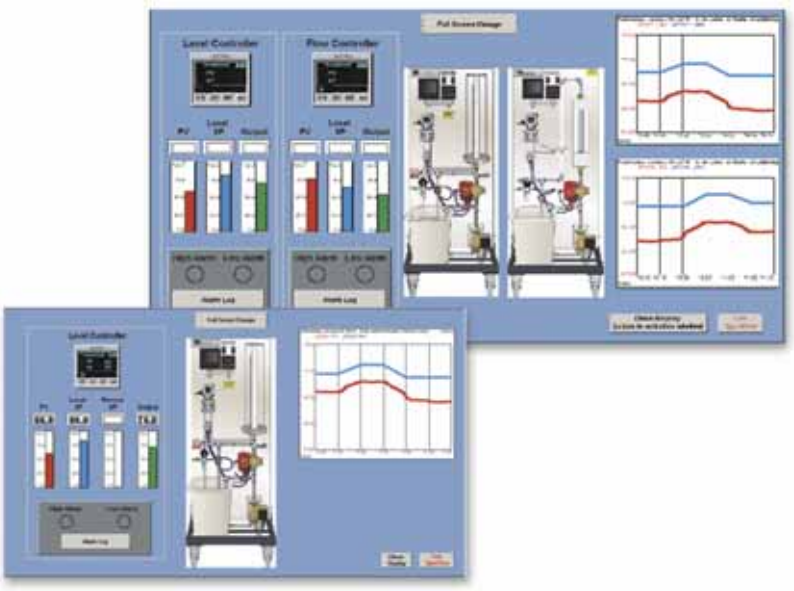
LEARNING OUTCOMES:

- Proportional, integral and derivative control
- Setting up and demonstrating automatic control
- The principles of loop control and the calibration and tuning of temperature transmitters and thermocouples
- Operation of a temperature control system
- Distributed control (when used with the TE3300/06 Computer Control System)

TE3300/06
COMPUTER CONTROL SYSTEM

Connects to the TE3300 Process Control modules for remote control and monitoring of processes (distributed control).

- Industry-standard software
- Colourful, easy-to-use on-screen mimics of the processes
- Includes high-specification computer, large monitor, keyboard and mouse
- Real-time displays of variables



LEARNING OUTCOMES:

When used with the TE3300 Process Control modules, computer control and monitoring of:

- Pressure process (TE3300/02)
- Flow process (TE3300/03)
- Level control process (TE3300/04)
- Temperature process (TE3300/05)
- Cascaded flow and pressure (TE3300/02 and TE3300/03)
- Cascaded flow and level (TE3300/03 and TE3300/04)

The Computer Control System (TE3300/06) is a computer control package for use with modules from TecQuipment's TE3300 Process Control range. It allows remote control and data acquisition from the controller of each process. This system will also control and collect data from the controllers of TE3300 modules when connected in cascade.

ANCILLARY FOR:

One or more modules from the TE3300 Process Control range:

- Pressure Process Training System (TE3300/02) 82
- Flow Process Training System (TE3300/03) 83
- Level Process Training System (TE3300/04) 84
- Temperature Process Training System (TE3300/05) 85

COMMITMENT TO SUPERIOR QUALITY

All TecQuipment products are designed, manufactured and tested to the highest of quality standards.

TE37

CONTROL AND INSTRUMENTATION STUDY STATION

Uses industry-standard parts to demonstrate process control of pressure, flow, level and temperature.

- Patch panel with leads for quick and simple connection between instruments, valves and controls
- Optional distributed computer control
- Gives academic and vocational study for process control engineers and plant technicians
- Includes hidden switches to create faults for fault-finding training
- Fully programmable controllers with local and remote set points, and fully programmable proportional, integral and derivative control

LEARNING OUTCOMES:

- Setting up process transmitters
- Level, pressure, flow and temperature control
- Cascade control
- Coupled and decoupled interactive control
- Ratio control
- Feedforward control
- Feedforward-feedback control
- Split range control
- Fault-finding

The Control and Instrumentation Study Station uses industry-standard parts to teach industrial process control. It is an excellent tool to help train plant technicians and process control engineers.

Hot and cold water supplies connect to the study station. Two valves (operated by compressed air) control the flow of the water supplies into a process vessel.

ESSENTIAL ANCILLARIES:

- Service Module (SM37) – This module connects to a suitable cold-water supply and provides hot and cold water at the correct flow and pressure for the Study Station. It includes an air compressor and storage vessel to supply compressed air to the Study Station valves.

RECOMMENDED ANCILLARIES:

- Distributed Control System (TE37DCS) 88

ALTERNATIVE PRODUCTS:

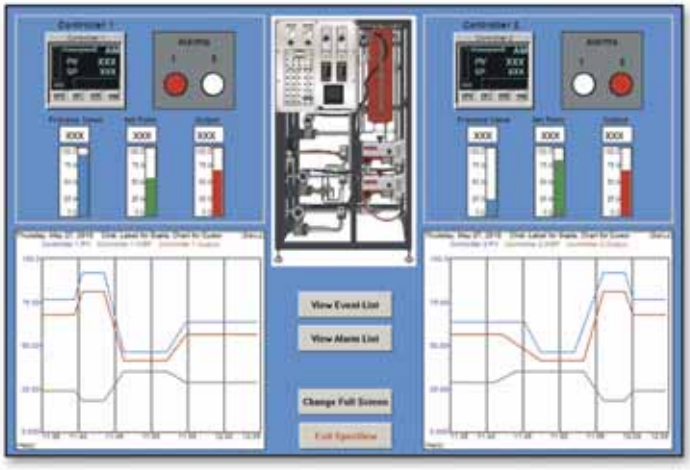
- Thermal Control Process Apparatus (CE103) 66
- Coupled Tanks Apparatus (CE105/CE105MV) 67
- Process Trainer (CE117) 81
- Pressure Process Training System (TE3300/02) 82
- Flow Process Training System (TE3300/03) 83
- Level Process Training System (TE3300/04) 84
- Temperature Process Training System (TE3300/05) 85

TE37DCS

DISTRIBUTED CONTROL SYSTEM

Connects to the TE37 Control and Instrumentation Study Station for remote control and monitoring of processes.

- Industry-standard supervisory control and data acquisition (SCADA) software, with colourful, easy-to-use on-screen mimics of the processes
- Improves students' understanding of industrial process control
- Mimics and controls both controllers of the TE37
- Includes high-specification computer, large monitor, keyboard and mouse



A computer-control package for use with TecQuipment's Control and Instrumentation Study Station (TE37), this product allows remote control and data acquisition. This package remotely controls and collects data from both controllers.

When used with TecQuipment's study station (TE37), computer control improves the students' experience of industry-standard process control.

ANCILLARY FOR:

- Control and Instrumentation Study Station (TE37) 87

LEARNING OUTCOMES:

When used with the Control and Instrumentation Study Station (TE37), the remote control and monitoring of control processes including:

- Level
- Pressure
- Temperature
- Cascade control
- Coupled interactive control
- Decoupled interactive control
- Ratio control
- Feedforward control
- Feedforward-feedback control
- Split range control

PRODUCT DEVELOPMENT

The information contained in this publication has been carefully prepared and is correct at the time of printing. TecQuipment is, however, committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice to ensure it continues to meet your needs.

For the latest information on all our products please visit our website at: TECQUIPMENT.COM

FLUID MECHANICS

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"

We are extremely satisfied with the TecQuipment Fluids and Thermodynamics equipment: it is well presented, works well and the students are able to operate it easily. The best feature is that the user guides are of a very high quality, with excellent theory sections and experiment guides. The support from TecQuipment introducing the equipment and installing it has been excellent too.

RICHARD ALBANY-WARD
SCHOOL OF SCIENCE AND TECHNOLOGY, UNIVERSITY OF NORTHAMPTON

FLUID MECHANICS

OVER 60 YEARS OF EXPERIENCE

The Fluid Mechanics range includes modern versions of the first products developed by TecQuipment 60 years ago. These products established our reputation for quality, safety, reliability and service. Recent customer service enquiries have shown that some universities and colleges still use products that we made decades ago, proving that they are still as popular as ever. TecQuipment has added to and improved on the original range, in line with customer demands and the latest teaching techniques. It now offers a large choice of experiments, enough to suit a complete course in fluid mechanics.

MODULAR AND FREE-STANDING

To save space, water and costs, the Fluid Mechanics range includes experiment modules that work with our mobile Digital Hydraulic Bench (H1F). The range also includes some free-standing products to demonstrate more specialised fluid experiments, such as hydrostatics and hydrology.

FLOW OVER A 'VEE' NOTCH WEIR

KEY FEATURES AND BENEFITS:

- **LONGEVITY:** Long-lasting equipment to teach principles that do not go out of date.
- **WATER AND SPACE SAVING:** Many experiments work with the self-contained, mobile hydraulic bench to save water and laboratory space.
- **LARGE CHOICE OF EXPERIMENTS:** A huge range of experiments for a complete course in fluid mechanics, from simple flow and pressure measurements to advanced studies of vortices and open-channel flow.

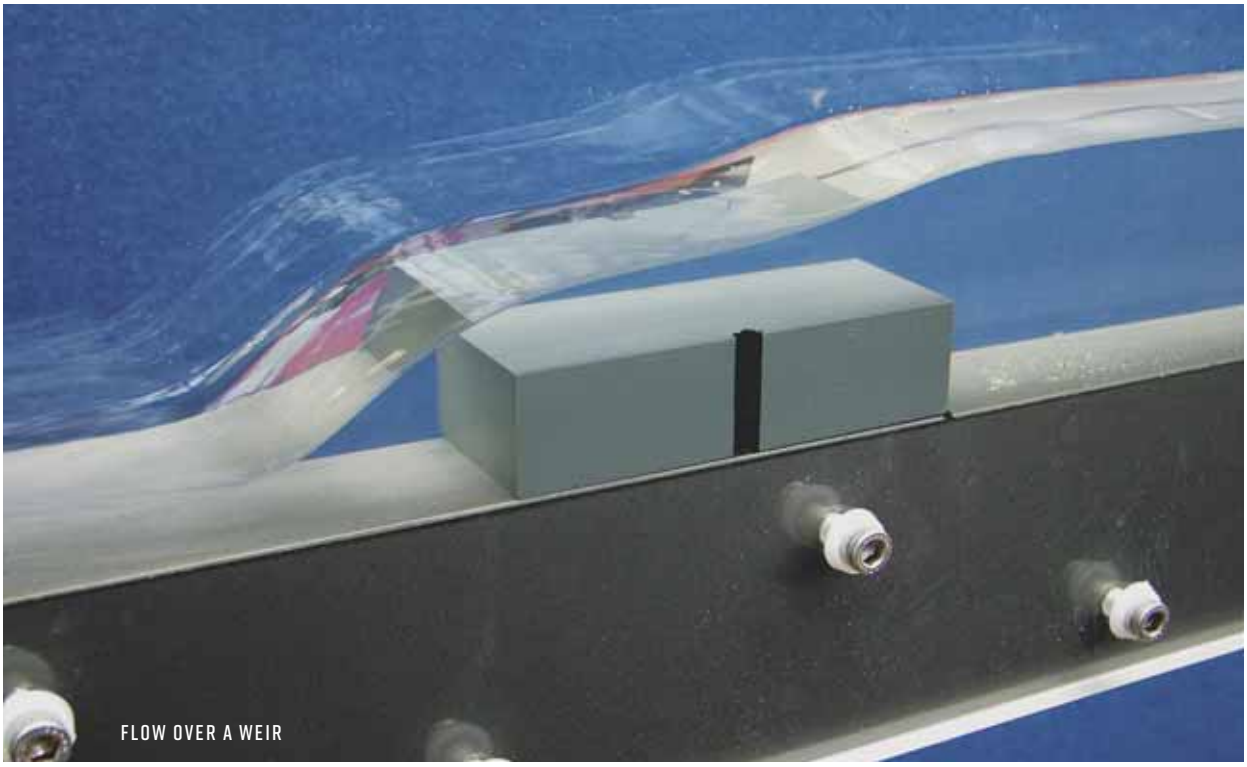
MODULAR FLUID POWER RANGE

The Fluid Mechanics range includes a sub-section of Modular Fluid Power products **(PAGES 132-146)** to demonstrate real-world applications of fluid mechanics. They include pumps and turbines, which also provide a link to renewable energy.

AUTOMATIC DATA ACQUISITION VDAS®

Each product in this range works with TecQuipment's unique Versatile Data Acquisition System (VDAS®).

SEE PAGE 293



FLOW OVER A WEIR

HIF

DIGITAL HYDRAULIC BENCH

Provides a controlled recirculating water supply and accurate flowmeter for hydraulic and fluid mechanics experiments.

DIGITAL FLOW DISPLAY

THE DIGITAL HYDRAULIC BENCH SHOWN WITH THE JET TRAJECTORY AND ORIFICE FLOW (H33) EXPERIMENT MODULE

FEATURES:		BENEFITS:
Supplies and measures water flow to over 15 different experiment modules	→	Saves space and reduces costs
Electronic flowmeter and digital display	→	Accurate measurements and quicker experiments
Self-contained with recirculating water circuit	→	Needs no external water supply and saves mains water
Fully mobile unit with a flat top to hold several experiment modules	→	Makes best use of laboratory space
Fibreglass construction	→	Strength, easier transport and long life

This product supplies a controlled flow of water to a wide variety of laboratory experiment modules (available separately). The body of the bench forms a reservoir or 'sump tank' with a submersible pump. Once filled, the bench needs no external water supply.

AVAILABLE EXPERIMENT MODULES:

BENCH-MOUNTED:

- Flow Through an Orifice (H4) 105
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H3A

CALIBRATION OF A BOURDON PRESSURE GAUGE

Demonstrates how a Bourdon tube pressure gauge works and how to calibrate it.

- Demonstrates 'dead weight' calibration of a Bourdon gauge
- Bourdon gauge has transparent dial so students can see how it works
- Suitable for group demonstrations and student experiments
- Self-contained – needs no extra services

LEARNING OUTCOMES:

- Function, operation and calibration of a Bourdon tube pressure gauge

Many engineering applications use the Bourdon gauge. TecQuipment's Calibration of a Pressure Gauge experiment allows students to study Bourdon tube theory. They see the working mechanism, calibrate the gauge and compare theoretical results to experimental results.

ALTERNATIVE PRODUCTS:

- Pressure Measurement Bench (H30) 97
- Hydrostatics and Properties of Fluids (H314) 120

PRECISION-ENGINEERED EQUIPMENT

All products manufactured and processes used are checked, tested and audited to ensure the products you receive are of the highest quality.

H6

DISCHARGE OVER A NOTCH

For study of weirs as flow regulation and measurement devices.

- Portable, corrosion-resistant glass-fibre channel for ease of use and long life
- Includes one rectangular and two V-shaped notches for basic experiments
- Two additional weirs included for more advanced experiments
- Adjustable depth gauge for precise measurement of water level
- Works with TecQuipment's Digital Hydraulic Bench for easy installation

LEARNING OUTCOMES:

Comprehensive study of flow over weirs, including:

- Investigation of head against discharge
- Coefficient of discharge for notches
- Rectangular and different angled V-notches

The Discharge Over a Notch apparatus demonstrates clearly the use of weirs as simple flow regulators. It allows students to do tests on relationships between upstream water level and weir discharge for different shaped notches. They can then compare their results with theory.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Flow Channels 113–117

SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY

30
20
10
DATUM

H5

BERNOULLI'S THEOREM

Allows students to study Bernoulli's theorem by measuring the complete static head distribution along a horizontal Venturi tube.

- Eleven pressure tappings along the tube
- Direct measurement of static heads
- Complete pressure distribution clearly visible
- Compact and simple to operate
- Works with TecQuipment's Digital Hydraulic Bench for easy installation

LEARNING OUTCOMES:

Comprehensive study of a Venturi meter and Bernoulli's theorem, including:

- Direct measurement of the static head distribution along a Venturi tube
- Comparison of experimental results with theoretical predictions
- Measurement of the meter coefficient of discharge at various flow rates

The Venturi tube in TecQuipment's Bernoulli's Theorem is typical of meters used throughout industry. However, it has many more pressure tappings, connecting to water manometers, which allow full study of the pressure distribution along the convergent-divergent passage.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Bernoulli's Equation (AF11) 32
- Flow Measurement Methods (H10) 96
- Flow Meter Calibration (H40) 98
- Fluid Friction Apparatus (H408) 103

H10

FLOW MEASUREMENT METHODS

Demonstrates typical methods of measuring the flow of an incompressible fluid and shows applications of Bernoulli's equation.

- Includes Venturi meter, orifice plate and rotameter
- Works with TecQuipment's Digital Hydraulic Bench for easy installation
- Direct measurement of head loss
- Three different flow meters which work with Bernoulli's equation
- Multi-tube manometer demonstrates pressure at various points

Students measure flow using a Venturi meter, an orifice plate meter and a rotameter. Students find and compare the head losses associated with each meter, as well as those arising in a rapid enlargement and a 90-degree elbow.

LEARNING OUTCOMES:

Study of Bernoulli's equation, flow measurement and losses, including:

- Application of the Bernoulli equation for incompressible fluids
- Direct comparison of flow measurement using a Venturi meter, orifice plate and rotameter
- Comparison of pressure drops across each flow-measurement device
- Comparison of pressure drops across a sudden enlargement and a 90-degree elbow

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Bernoulli's Theorem (H5) 95
- Flow Meter Calibration (H40) 98
- Fluid Friction Apparatus (H408) 103

H30

PRESSURE MEASUREMENT BENCH

Enables a range of practical investigations into manometer and Bourdon gauge pressure measurement techniques.

- Provides practical investigations for pressure measurement using inclined and U-tube manometers, and Bourdon-type vacuum and pressure gauges
- Enables instant comparison of measurement methods
- Includes separate Bourdon gauge with dead-weight calibration apparatus, and Bourdon tube mechanism clearly visible
- Fully self-contained, bench-top apparatus
- Suitable for group demonstrations and individual student experiments

LEARNING OUTCOMES:

A range of investigations into common pressure-measurement techniques, including:

- Comparison of pressure measurement by manometer and Bourdon gauge
- Calibration of a pressure gauge
- Determination of gauge errors as a function of true pressure

TecQuipment's Pressure Measurement Bench enables students to fully investigate and compare the operation and characteristics of inclined and U-tube manometers, and Bourdon-type vacuum and pressure gauges.

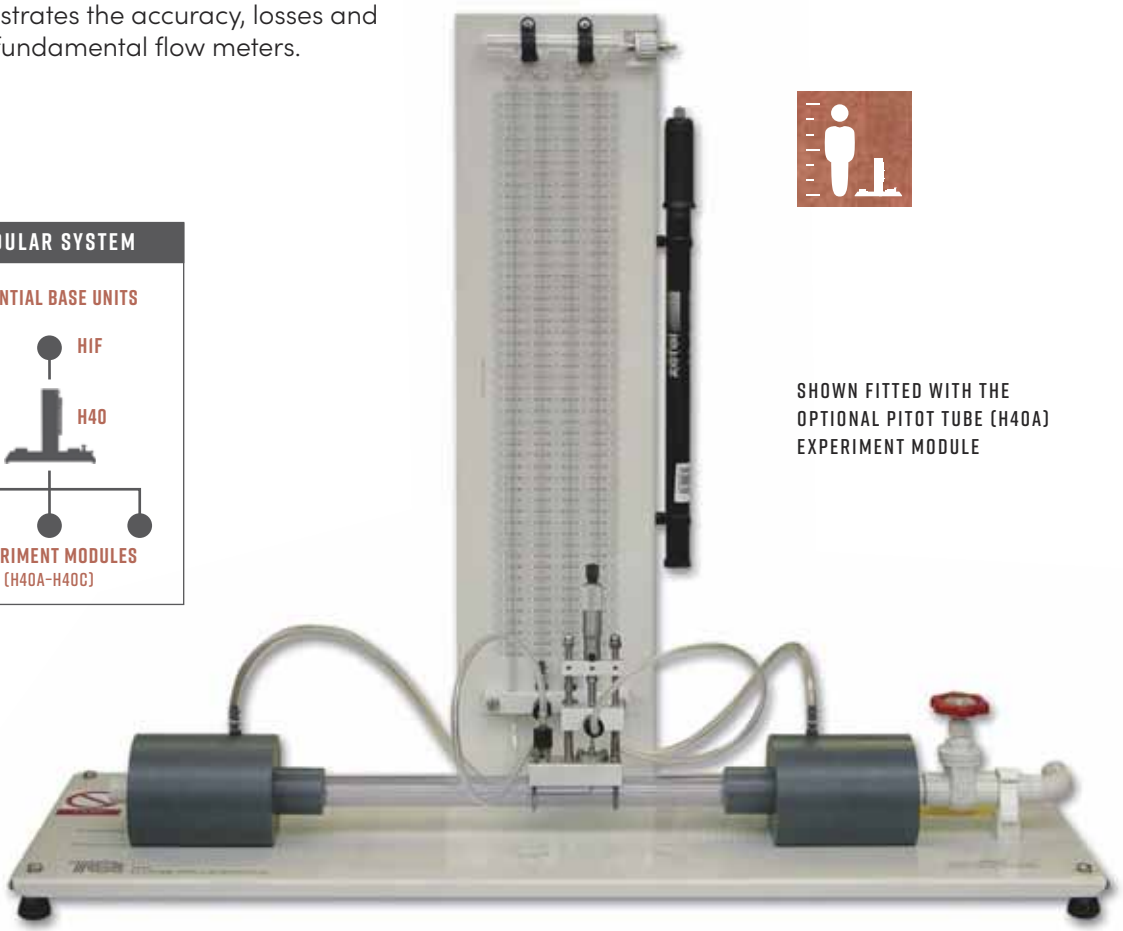
ALTERNATIVE PRODUCTS:

- Calibration of a Bourdon Pressure Gauge (H3a) 92
- Hydrostatics and Properties of Fluids (H314) 120

H40

FLOW METER CALIBRATION

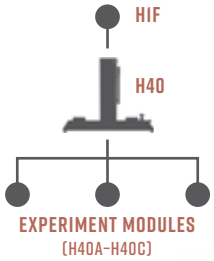
A compact unit that compares and demonstrates the accuracy, losses and use of fundamental flow meters.



SHOWN FITTED WITH THE OPTIONAL PITOT TUBE (H40A) EXPERIMENT MODULE

MODULAR SYSTEM

ESSENTIAL BASE UNITS



FEATURES:		BENEFITS:
Supports and measures pressures in its optional Experiment Modules	→	Saves space and reduces costs
Nozzle flow meter included as standard	→	Allows tests 'out of the box'
Optional Pitot, Venturi and Orifice flow meters	→	For comparisons of accuracy, losses, and tests of velocity profile and boundary layer effect
Unique 'quick-change' adaptors and self-sealing pressure connections	→	Maximise experiment time and reduce water spills
Works with TecQuipment's Digital Hydraulic Bench (H1F)	→	Easy installation and accurate external flow measurement

LEARNING OUTCOMES:

- Accuracy of nozzle flow meters
- Losses and k value
- Calculation of the coefficient of discharge

For use by a wide range of engineering students, the Flow Meter Calibration apparatus compares and demonstrates the accuracy and use of fundamental flow meters.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

AVAILABLE EXPERIMENT MODULES:

- Pitot Tube (H40a) 99
- Venturi Flow Meter (H40b) 99
- Orifice Flow Meter (H40c) 99

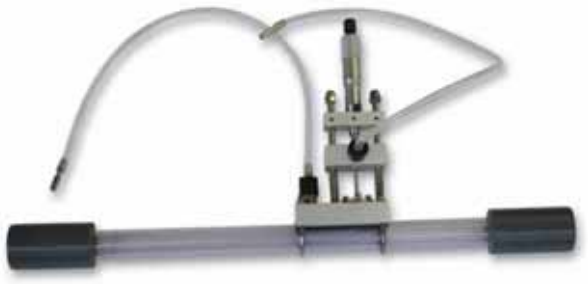
ALTERNATIVE PRODUCTS:

- Bernoulli's Theorem (H5) 95
- Flow Measurement Methods (H10) 96
- Fluid Friction Apparatus (H408) 103

H40A
PITOT TUBE

Pitot tube flow meter for use with the Flow Meter Calibration unit (H40).

- Demonstrates the accuracy and use of a Pitot tube flow meter
- Demonstrates the boundary layer effect and the fluid velocity profile
- Micrometer head for precise adjustment



LEARNING OUTCOMES:

- Accuracy of Pitot tube flow meters
- Losses and k value
- Calculation of the coefficient of discharge
- Velocity profile

ESSENTIAL BASE UNIT:

- Flow Meter Calibration (H40) – with H1F 98

H40B
VENTURI FLOW METER

Venturi flow meter for use with the Flow Meter Calibration unit (H40).

- Demonstrates the accuracy and use of a Venturi flow meter
- Demonstrates how a flow constriction affects pressure
- ISO standard dimensions for more predictable results

LEARNING OUTCOMES:

- Accuracy of Venturi flow meters
- Losses and k value
- Calculation of the coefficient of discharge

ESSENTIAL BASE UNIT:

- Flow Meter Calibration (H40) – with H1F 98

H40C
ORIFICE FLOW METER

Sharp-edged orifice flow meter for use with the Flow Meter Calibration unit (H40).

- Demonstrates the accuracy and use of a sharp-edged orifice flow meter
- Demonstrates how an orifice affects pressure
- ISO standard dimensions for more predictable results

LEARNING OUTCOMES:

- Accuracy of orifice flow meters
- Losses and k value
- Calculation of the coefficient of discharge

ESSENTIAL BASE UNIT:

- Flow Meter Calibration (H40) – with H1F 98

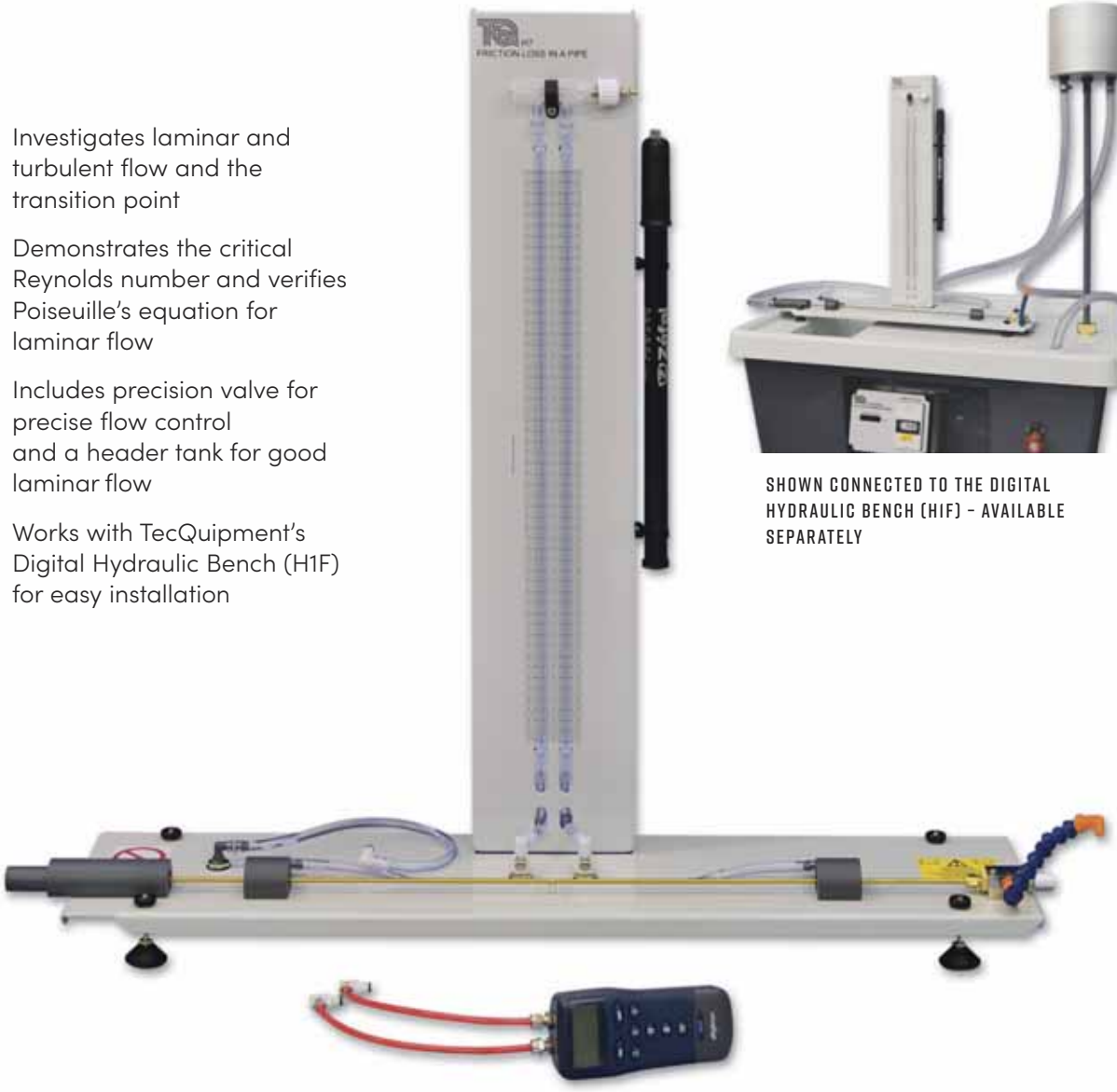
H7

FRICTION LOSS IN A PIPE

For direct measurement of friction loss in a small-bore horizontal pipe during both laminar and turbulent flow.

- Investigates laminar and turbulent flow and the transition point
- Demonstrates the critical Reynolds number and verifies Poiseuille's equation for laminar flow
- Includes precision valve for precise flow control and a header tank for good laminar flow
- Works with TecQuipment's Digital Hydraulic Bench (H1F) for easy installation

SHOWN CONNECTED TO THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY



LEARNING OUTCOMES:

Study of friction loss in a pipe, including:

- Investigations of laminar and turbulent flows
- Demonstration and measurement in the change of the laws of resistance (friction factor) from laminar to turbulent flow
- Finding the critical Reynolds number
- Verifying Poiseuille's equation and the coefficient of viscosity for water in the laminar flow region

The Friction Loss in a Pipe apparatus allows students to study the change in the laws of resistance for laminar to turbulent flow and find the critical Reynolds number. The apparatus demonstrates the flow transition point from laminar to turbulent, and is ideal for demonstrations as well as student experiments.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Losses in Piping Systems (H16) 101
- Fluid Friction Apparatus (H408) 103
- Osborne-Reynolds Apparatus (H215) 104
- Pipework Energy Losses (H34) 102

H16

LOSSES IN PIPING SYSTEMS

Demonstrates pressure losses in several small-bore pipe circuit components, typical of those found in central heating installations.

- Includes two colour-coded water circuits
- Works with TecQuipment's Digital Hydraulic Bench for easy installation
- Includes different pipe bends and valves for students to compare losses
- Fitted with a range of piezometers and a pressure gauge to give accurate pressure measurement
- Optional 'roughened pipe' ancillary to investigate flow characteristics in a roughened pipe

The Losses in Piping Systems apparatus comprises a vertical panel with two separate hydraulic circuits, colour-coded for clarity. Each circuit includes various pipe system components. The unit has wheels for mobility.

LEARNING OUTCOMES:

A comprehensive range of investigations into losses in a variety of pipes and pipe system components, including:

- Straight pipe loss
- Sudden expansion
- Sudden contraction
- Bends with different radii
- Valves
- Elbows
- Flow in a roughened pipe – needs the optional Roughened Pipe (H16p)

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

RECOMMENDED ANCILLARIES:

- Roughened Pipe (H16p)

ALTERNATIVE PRODUCTS:

- Friction Loss in a Pipe (H7) 100
- Pipework Energy Losses (H34) 102
- Fluid Friction Apparatus (H408) 103

H34

PIPEWORK ENERGY LOSSES

Compares pressure losses and k value of popular fittings in small-bore pipework.

- Compact, easy to fit and easy to use
- Includes three different bends: mitre, elbow and large radius
- Compares losses in a sudden enlargement (or expansion) and a contraction
- Includes a multi-tube piezometer for fundamental, accurate pressure measurements
- Works with TecQuipment's Digital Hydraulic Bench

LEARNING OUTCOMES:

Measurement and comparison of losses in:

- Mitre bend
- Elbow bend
- Large radius bend
- Sudden expansion
- Sudden contraction

This compact bench-top apparatus uses smooth, industry-standard plastic pipe, commonly used in domestic and other small-bore water systems.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Friction Loss in a Pipe (H7) 100
- Losses in Piping Systems (H16) 101
- Fluid Friction Apparatus (H408) 103

H408

FLUID FRICTION APPARATUS

Demonstrates flow and losses in different pipes, fittings and valves. Shows popular flow measurement instruments.

- A space-saving vertical panel that works with TecQuipment's Digital Hydraulic Bench for easy installation
- Includes experiments on roughened pipes
- Uses Bernoulli's equation
- Demonstrates how to use Venturi and orifice meters to measure flow
- Includes a traversing Pitot tube to measure the velocity profile

TecQuipment's Fluid Friction Apparatus allows students to study flow, flow measurement techniques and losses in a wide variety of pipes and fittings. The equipment has three water circuits with instruments, pipes and pipe system components.

LEARNING OUTCOMES:

- Use of the Pitot-static tube
- Flow measurement using a Venturi meter and an orifice meter
- Smooth pipes
- Artificially roughened pipe
- Straight pipe loss
- Sudden expansion and contraction
- Bends and elbows
- Valves
- In-line strainer

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Losses in Piping System (H16) 101
- Pipework Energy Losses (H34) 102
- Flow Meter Calibration (H40) 98
- Flow Measurement Methods (H10) 96
- Bernoulli's Theorem (H5) 95
- Friction Loss in a Pipe (H7) 100

H215

OSBORNE-REYNOLDS APPARATUS

Free-standing apparatus that gives a visual demonstration of laminar and turbulent flow.

- Constant head reservoir and flow-smoothing parts for a smooth flow
- Uses dye injector system to demonstrate flow patterns
- Investigates Reynolds number at transition
- Optional heater module available for tests at different viscosities

DYE STREAM SHOWING LAMINAR FLOW

OPTIONAL HEATER MODULE (H215A)

LEARNING OUTCOMES:

- Demonstration of transition between laminar and turbulent flow
- Determination of transition Reynolds numbers and comparison with accepted values
- Investigation of the effect of varying viscosity, and demonstration that the Reynolds number at transition is independent of viscosity

The apparatus consists of a precision-bore glass pipe (test tube) held vertically in a large shroud. The shroud is open at the front and the inside surface is light coloured. This allows the students to see the flow clearly.

ESSENTIAL ANCILLARIES:

- Stopwatch (SW1) – To measure flow rates 28

RECOMMENDED ANCILLARIES:

- Heater Module (H215a) – Free-standing unit to vary and control the water temperature and hence its viscosity

ALTERNATIVE PRODUCTS:

- Friction Loss in a Pipe (H7) 100
- Viscosity and Particle Drag (H410) 121

H4

FLOW THROUGH AN ORIFICE

Demonstrates flow through different orifices for different flow rates.

- Direct measurement of total head, head loss and diameter of jet
- Vertical water jet
- Integral Pitot traverse tube
- Sharp-edged orifice included
- Works with TecQuipment's Digital Hydraulic Bench for easy installation

NOW INCLUDES SET OF ORIFICES

LEARNING OUTCOMES:

Investigations into a variety of orifices over a range of flow rates, including:

- Determination of contraction and velocity coefficients
- Calculation of discharge coefficient
- Determination of actual discharge coefficient, and comparison with calculated values
- Determination of the various coefficients over a range of flow rates to demonstrate the influence of Reynolds number
- Study of the characteristics of different orifices, using a set of four circular orifices (nozzles). Each has the same minimum throat diameter but a different length. Each has a different approach and discharge section. Also included are additional square and triangular orifices.

TecQuipment's Flow Through an Orifice apparatus allows students to measure:

- Decrease in flow
- Contraction of the stream
- Energy loss

observing measurements as water leaves an orifice. Students can also use the apparatus to study different shapes of orifice (extra orifices are available separately).

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Jet Trajectory and Orifice Flow (H33) 107

SHOWN FITTED TO THE DIGITAL HYDRAULIC BENCH (H1F) – AVAILABLE SEPARATELY

H8

IMPACT OF A JET

Investigates the force generated by a jet striking plates (representing turbine vanes).

- Includes flat and hemispherical plates
- Extra angled and conical plates
- Ideal for demonstrations as well as in-depth experiments
- Works with TecQuipment's Digital Hydraulic Bench for easy installation

120° CONICAL PLATE AND 30° ANGLED PLATE

LEARNING OUTCOMES:

Measurement of the impact force and comparison with momentum change of four different plates:

- Flat plate
- Hemispherical plate
- Inclined flat plate
- 120° conical plate
- 30° angled plate

To understand correctly how a turbine (a Pelton wheel for example) works, students need to understand how jet deflection produces a force on turbine vanes. They also need to understand how this force affects the rate of momentum flow in the jet.

The Impact of a Jet apparatus demonstrates the force produced by a jet of water as it strikes a flat plate or hemispherical cup, which can be compared to the momentum flow rate in the jet. To extend the range of investigations, the 120° conical plate and 30° angled plate are included.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Pelton Turbine (H19) 126
- Pelton Wheel (Turbine) (MFP101b) 135

SHOWN FITTED TO THE DIGITAL HYDRAULIC BENCH (H1F) – AVAILABLE SEPARATELY

H33

JET TRAJECTORY AND ORIFICE FLOW

Demonstrates vertical flow and horizontal jet trajectory through different orifices (nozzles).

- Determination of the contraction and velocity coefficients
- Calculation of the discharge coefficient
- Determination of the actual discharge coefficient by measurement of flow rate
- Demonstrates the influence of Reynolds number
- Determination of discharge characteristics (jet trajectory) for an orifice mounted in the side of a vertical tank

The apparatus allows students to measure:

- Decrease in flow
- Contraction of the stream
- Energy loss

observing as water discharges from four vertically mounted, interchangeable nozzles with different throat (orifice) designs. It also allows students to study the trajectory profiles of water jets from the nozzles when mounted horizontally.

SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) – AVAILABLE SEPARATELY

LEARNING OUTCOMES:

- Determination of the contraction and velocity coefficients
- Calculation of the discharge coefficient
- Determination of the actual discharge coefficient by measurement of flow rate
- Demonstrates the influence of Reynolds number
- Determination of discharge characteristics (jet trajectory) for an orifice mounted in the side of a vertical tank

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Flow Through an Orifice (H4) 105

H13

VORTEX APPARATUS

An experimental apparatus to allow the visualisation and investigation of the phenomena of free and forced vortices.

SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY

- Transparent vessel – users can see the vortices from all angles
- Includes a traverse probe to measure water surface profile
- Low-voltage variable speed motor for safety
- Ideal for classroom demonstrations as well as laboratory experiments
- Works with TecQuipment's Digital Hydraulic Bench (H1F)

LEARNING OUTCOMES:

- Determination of the surface profile of a forced vortex
- Determination of the surface profile of a free vortex
- Determination of the total head variation in a forced vortex
- Comparison of results with theoretical predictions

The Vortex Apparatus enables students to produce both free and forced vortices, and measure the vortex water surface profile.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ACCOMPANYING DOCUMENT PACK

ALL THE INFORMATION YOU NEED TO GET UP AND RUNNING

With all products you receive a pack of documents containing:

- **USER MANUAL:** How to use the product along with instructions on experiment set-up and supporting enginering principles for guiding learning.
- **PACKING CONTENTS LIST:** All the parts that make up the complete product.
- **TEST CERTIFICATE:** Your peace of mind that the product has been thoroughly tested before dispatch.

H400

CAVITATION IN A VENTURI

Demonstrates the causes and effects of cavitation, and how the Venturi meter works.

- Also allows practical and effective study of flow and pressure in a Venturi meter
- Ideal for classroom demonstrations and student experiments
- Fully self-contained recirculating apparatus – no additional water supply needed
- Includes full instrumentation, for pressure, flow and temperature measurement

CAVITATION IN THE VENTURI

LEARNING OUTCOMES:

Investigations into cavitation and the Venturi, including:

- Flow and pressure in the Venturi
- Demonstrations of cavitation
- How to predict the onset of cavitation

The causes and effects of cavitation are one of the most important subjects in any course on fluid mechanics. In severe cases, cavitation will damage machines and hydraulic systems. Designers and engineers must be aware of cavitation when they create a new design or installation.

TecQuipment's Cavitation Demonstration Unit is a purpose-designed teaching unit which enables efficient and effective investigations into the causes and effects of cavitation. It also allows students to understand the Venturi by studying upstream and throat pressures.

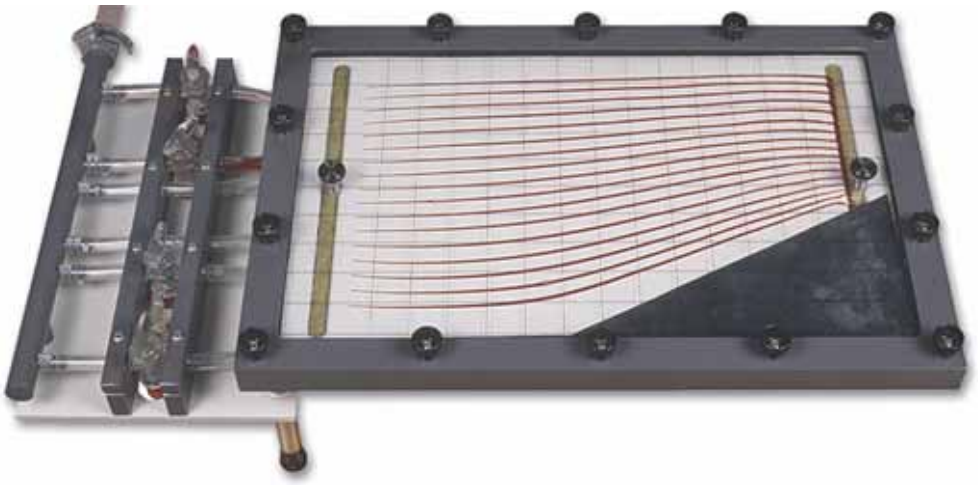
RECOMMENDED ANCILLARIES:

- Stroboscope (ST1) 297

H9

HELE-SHAW APPARATUS

A powerful method of demonstrating potential flow in fluid dynamics.



- Visually effective demonstration of a wide variety of flow patterns around different shapes
- Models easily cut from sheet (included) – almost any shape possible
- Ideal introduction to incompressible potential flow (aerodynamics)
- Source and sink points provided
- Can demonstrate soil seepage problems

TecQuipment's Hele-Shaw Apparatus produces streamlines in a laminar, steady flow. It allows students to study various source and sink arrangements, and look at flow around an unlimited variety of different shaped models. The apparatus can represent water seepage through solids, and can simulate any process satisfying the Laplace equation in two dimensions. Thus lecturers can also use it to represent flow in other branches of engineering, such as aerodynamics or electricity and heat flow.

LEARNING OUTCOMES:

Various flow visualisation experiments in two dimensions, including sink and source points and flow around models, for example:

- Sources and sinks in a uniform stream
- Doublet in a uniform stream
- Flow around a cylinder (disc) and an aerofoil
- Flow through an orifice and a diffuser
- Flow through a heat exchanger
- The momentum equation
- Laminar flow relationship for flow between two parallel plates
- Mean velocity equations (including seepage in soils)
- Potential flow relationships

RECOMMENDED ANCILLARIES:

- Header Tank (H9a) – A wall-mounted tank with a float valve, overflow and a flow-control valve and pipework

ALWAYS HERE TO HELP

Whether you have a technical enquiry, need spare parts or support material, you can contact our Customer Care team at:

CUSTOMER.CARE@TECQUIPMENT.COM

VDAS® H405

PIPE SURGE AND WATER HAMMER

Illustrates pipe surge and water hammer effects in pipes.

SHOWN WITH A HYDRAULIC BENCH AND VDAS®

- Multiple pipes and valves provide two different experiments in one product
- Two pressure sensors in the water hammer test pipe to help calculate velocity of sound in pipes
- Transparent surge tower so students can see what is happening
- Works with TecQuipment's VDAS® for real-time display of the pressure surges and acoustic waves

LEARNING OUTCOMES:

Investigations into the transient effects of pipe surge and water hammer caused by changing flow rates in pipes including:

- Demonstration and analysis of pipe surge
- Demonstration and analysis of water hammer
- Determination of frictional head loss between reservoir and surge tower
- Determination of pressure profiles
- Determination of velocity of sound in the test pipe

TecQuipment's Pipe Surge and Water Hammer apparatus demonstrates the transient effects of pipe surge and water hammer caused by changing flow rates in pipes.

The apparatus has two separate test pipes: one for water hammer investigations and one for surge investigations. A header tank supplies both test pipes, and includes an internal overflow weir to keep a constant head.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – bench-mounted version (VDAS-B) 293

  NOTE: This equipment needs VDAS® MkII and will not work with earlier versions of VDAS®. If unsure, contact TecQuipment or local agent for advice.

ALTERNATIVE PRODUCTS:

- Water Hammer Apparatus (TE86) 112

TE86

WATER HAMMER APPARATUS

A compact unit that demonstrates the water hammer effect.

- Illustrates the propagation of shock waves at sonic velocity in water
- Demonstrates how to calibrate an electronic pressure transducer
- Includes an electric valve to stop flow instantly
- Contains over 60 m of pipe in one compact unit to save space
- Includes mechanical and electronic pressure measurement
- Includes connectors for extra (optional) equipment for transient measurements

LEARNING OUTCOMES:

- Water hammer
- Propagation of shock waves in water
- Velocity of sound in a water filled pipe
- Transducer calibration

The apparatus is made up of a coil of copper pipe 60 m long. The inlet connects to a water supply and the discharge end has a solenoid valve.

ESSENTIAL ANCILLARIES:

- Dual Beam Storage Oscilloscope (H405a) 297

ALTERNATIVE PRODUCTS:

- Pipe Surge and Water Hammer (H405) 111

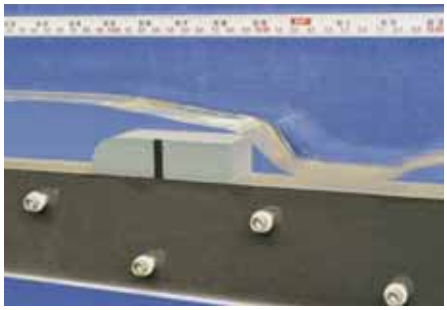
RIGHT PART, RIGHT PLACE, RIGHT TIME

We have a computerised stock control system to manage the 40,000 different components, ensuring the very best quality, delivery times and customer support in the industry.

FC50-2.5

2.5-METRE FLOW CHANNEL

Demonstrates flow around weirs and other objects in an open channel. Supplied with all the models and instrumentation required for a complete package in flow channel investigations.



FLOW OVER BROAD CRESTED WEIR

- Inclinable acrylic channel providing maximum flow visualisation
- Inlet includes baffle section to provide steady flow conditions
- Works with TecQuipment's Digital Hydraulic Bench (H1F) for easy installation
- Includes:
  - Broad-crested weir
  - Sluice gate (undershot weir)
  - Venturi flume
  - Sharp-crested weir
  - Cylindrical gate
  - Crump weir
  - Instrument level gauge
  - Pitot tube

The apparatus consists of a floor-standing 2.5-metre, 53 mm wide flow channel, together with various gates, weirs and blocks, enabling the phenomenon of flow channels to be easily demonstrated and studied. The FC50 is TecQuipment's most compact flume, providing simple installation and flexible storage in the laboratory.

LEARNING OUTCOMES:

- Study of sluice and drum gates including investigation into hydraulic jump, specific energy and the determination of discharge coefficient.
- Study of submerged narrow-crested and crump weirs revealing the relationship between head over a weir and discharge.
- Study of a broad-crested weir (by combining the square and radius jump blocks) and the effects of changing the profile of the weir.
- Study of uniform flow in an inclined channel with investigations into the Chézy factor and coefficient.
- Study of a Venturi flume to indicate the discharge and surface profile, thus the derivation of the discharge coefficient.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ALTERNATIVE PRODUCTS:

- Sediment Transport Channels (FC80) 114
- Flow Channels (FC300) 116

FC80 (2.5 AND 5)

FLOW AND SEDIMENT TRANSPORT CHANNELS

Open channel flumes that provide students with the ability to study the varying effects of sediment transport, bedform dynamics and fluid flow in an open channel.

2.5-METRE SEDIMENT TRANSPORT CHANNEL

- Includes four models with the flume for comprehensive experimentation options
- Digital flow meter for quick and accurate measurements
- Transparent sides for clear visibility, ideal for group demonstrations
- Stainless steel beam and toughened glass channel walls, provides long-lasting use with sedimentation
- Built-in, recirculating water supply for convenient laboratory use
- Includes two bags of graded sand for sediment experiments, e.g. bed form development or scour

SUBCRITICAL AND CRITICAL FLOW PAST PIER

The FC80 Flow and Sediment Transport Channel working sections are 80 mm in width and 247 mm deep. They are available in 2.5 metre and 5 metre lengths. Each flume has a built-in recirculating water supply connected to a digital flow meter for accurate measurements during experimentation.

The models included with each flume are:

- Broad-crested weir
- Sharp-crested weir
- Venturi flume
- Sluice gate

BROAD-CRESTED WEIR

LEARNING OUTCOMES:

- Investigations in fixed and smooth bedform
- Mechanics of sediment transport
- Local (bridge) scour experiments, to understand scour holes and effects on the integrity of a structure
- Sluice gate for investigations into hydraulic jump, specific energy and the determination of discharge coefficient
- Submerged sharp-crested weir reveals the relationship between head over a weir and discharge
- A broad-crested weir and the effects of changing the profile of the weir.
- Uniform flow in an inclined channel with investigations into the Chezy factor and coefficient
- A Venturi flume to indicate the discharge and surface profile, thus the derivation of the discharge coefficient

5-METRE SEDIMENT TRANSPORT CHANNEL

BEDFORM DEVELOPMENT

FLOW UNDER A SLUICE GATE

OPTIONAL FLOW SPLITTER (FC80V)

OPTIONAL DRUM GATE (FC80A)

DAM SPLILWAY (FC80E)

OPTIONAL SIPHON SPILLWAY (FC80L)

OPTIONAL PARSHALL FLUME (FC80H) - REQUIRES VENTURI SIDES (INCLUDED)

OPTIONAL BRIDGE PIERS (FC80J)

OPTIONAL RADIAL SECTOR GATE (FC80B)

RECOMMENDED ANCILLARIES:

OPTIONAL MODELS:

- Drum Gate (FC80a)
- Radial Sector Gate (FC80b)
- Crump Weir (FC80d)
- Dam Spillway (FC80e)
- Streamlined Hump (FC80g)
- Siphon Spillway (FC80l)
- Parshall Flume (FC80h)
- Culvert Model (FC80p)
- Roughened Bed (FC80k)
- Wave Generator and Beach (FC80n)
- Flow Splitter (FC80v)
- Bridge Piers - Cylinder, Round, Square, Sharp Nose (FC80j)

ALTERNATIVE PRODUCTS:

- 2.5-Metre Flow Channel (FC50-2.5) 113
- Flow Channels (FC300) 116

VDAS® FC300

FLOW CHANNELS

Large open channel flumes that provide the opportunity for advanced research and student study on a wide range of fluid flow topics. Select a length (2.5 to 15 m) to suit your needs and the space available.

- Digital data acquisition for quick and accurate measurements
- Transparent sides for clear visibility, ideal for group demonstrations
- Stainless steel channel base plate and toughened glass channel walls, provides long-lasting use
- Built-in, re-circulating water supply for convenient laboratory use
- Bed plate pressure tappings at 0.25 metre intervals, providing detailed analysis potential

LEARNING OUTCOMES:

- Sluice gate for investigations into hydraulic jump, specific energy and the determination of discharge coefficient
- Submerged sharp-crested weir reveals the relationship between head over a weir and discharge
- A broad-crested weir and the effects of changing the profile of the weir (optional ancillary)
- Uniform flow in an inclined channel with investigations into the Chezy factor and coefficient
- A Venturi flume to indicate the discharge and surface profile, thus the derivation of the discharge coefficient
- Further experimentation with additional optional models
- With the optional Sediment Loop (FC300sl) sediment transport, scouring, ripple and dune formation and similar studies can be performed

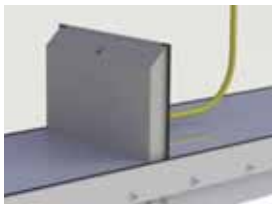
The FC300 series flume working sections are 300mm in width and 450 mm deep. They come in 2.5 m sections and are available in 2.5 metre, 5 metre, 7.5 metre, 10 metre, 12.5 metre and 15 metre lengths.

Included with the flow channel:

- Sluice gate
- Level gauges
- Pitot tube
- Sharp crested weir
- Powered end gate

HOOK DEPTH GAUGE

PITOT TUBE



SHARP CRESTED WEIR

FC300 CONTROL BOX AND INSTRUMENT FRAME (SHOWN WITH VDAS® - INCLUDED)

RECOMMENDED ANCILLARIES:

- Sediment Loop (FC300sl)

MODELS:

- Radial Gate (FC300b)
- Sluice Gate (Undershot Weir) (FC300c)
- Crump Weir (FC300d)
- Dam Spillway (FC300e)
- Ogee Weir with Tappings (FC300e2)
- Energy Dissipation (FC300e3)
- Venturi Flume (FC300f)
- Parshall Flume (FC300h)
- Bridge Piers: Cylinder, Round Nose, Square, Sharp Nose (FC300j)
- Roughened Bed (FC300k)
- Roughened Bed - Sand (FC300k2)
- Roughened Bed - Turf (FC300k3)
- Siphon Spillway (FC300l)
- Self Regulating Siphon (FC300l2)
- Lift and Drag (FC300ld)
- Vibrating Piles (FC300m)
- Wave Generator and Beach (FC300n)
- Culvert Model (FC300p)
- Rectangular and V-Notch Weirs (FC300q)
- Broad Crested Weir (FC300r)
- Trapezoidal Flume (FC300z)

INSTRUMENTATION:

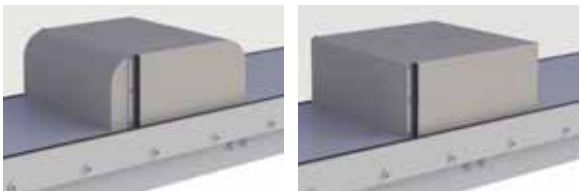
- Instrument Carrier (FC300ic)
- Propeller Flowmeter (FC300x)
- Multi-Tube Manometer (FC300w)
- 32-Way Pressure Display (FCA1)
- Digital Instrument Carrier (FC300ic2)

ALTERNATIVE PRODUCTS:

- 2.5-Metre Flow Channel (FC50-2.5) 113
- Sediment Transport Channels (FC80) 114

FLOAT SWITCH IN CHANNEL

TRAPIZOIDAL FLUME (FC300Z)



PAIR OF BROAD CRESTED WEIRS (FC300R): STREAMLINED (LEFT), SHARP CORNERED (RIGHT)

DAM SPILLWAY (FC300E) SHOWN WITH INTERCHANGABLE APRONS

SUTRO WEIR(PART OF FC300Q)

SIPHON SPILLWAY (FC300L)

BRIDGE PIERS (FC300J)

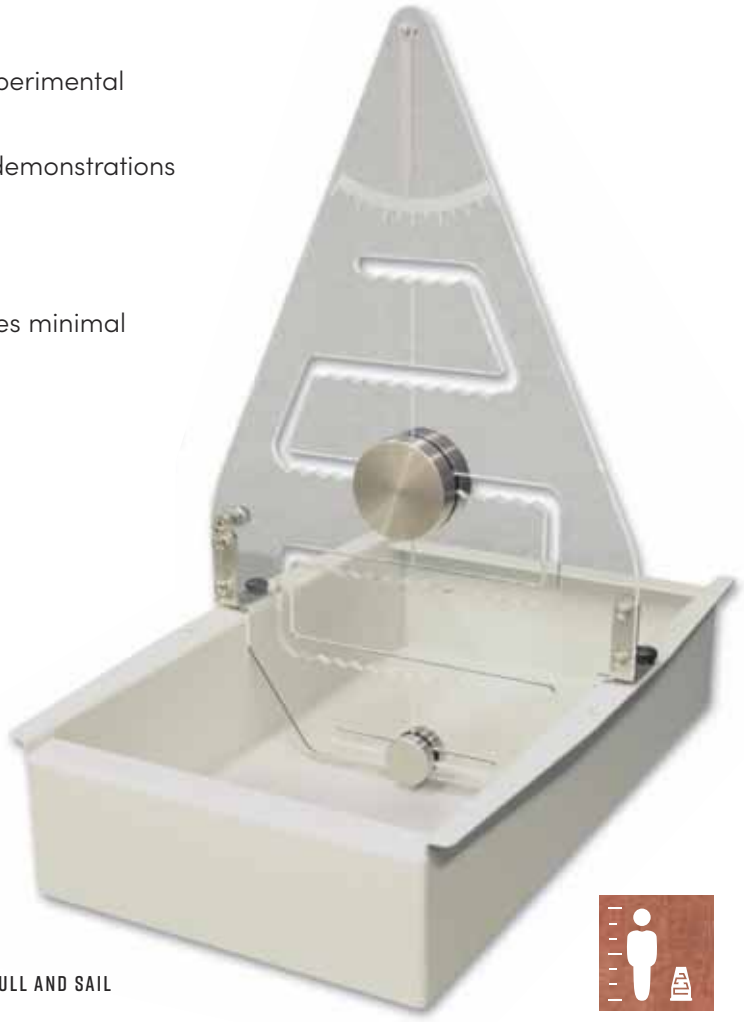
VIEW DOWN CHANNEL

H2 MKII

METACENTRIC HEIGHT AND STABILITY

Demonstrates how to find the metacentric height of a floating body. Allows full investigations into theoretical predictions.

- Full and accurate experimental analysis
- Ideal for classroom demonstrations
- Bench-mounted
- No services required
- Compact and requires minimal storage space



H2 MKII HULL AND SAIL

LEARNING OUTCOMES:

Determination of the metacentric height, and thus the metacentre, of a floating pontoon. This is by graphic analysis of the angles of tilt of the pontoon with various centres of gravity.

OPTIONAL VEE (HARD) CHINE AND HALF ROUND (ROUND BILGE) HULLS (H2A MKII)

Determination and analysis of the stability of floating bodies, such as ships, rafts and pontoons, is important for many branches of engineering. This experiment allows students to determine the stability of a pontoon with its centre of gravity at various heights. They can then compare this to predictions calculated from theory.

RECOMMENDED ANCILLARIES:

- Vee (Hard) Chine and Half Round (Round Bilge) Hulls (H2a MkII)

ALTERNATIVE PRODUCTS:

- Hydrostatics and Properties of Fluids (H314) 120

H11

CENTRE OF PRESSURE

For finding the centre of pressure of a totally or partially submerged plane surface.

- Compact and self-contained – just needs clean water
- Determines theoretical centre of pressure and compares actual and theoretical hydrostatic thrust
- Simple but accurate balance to measure moment due to hydrostatic thrust
- Tests a vertical and inclined plane surface

LEARNING OUTCOMES:

- Studying the relationship between hydrostatic force and head of water for a fully and partially submerged vertical and inclined plane
- Comparison of actual and theoretical hydrostatic force on a fully or partially submerged plane for any given head of water
- Theoretical calculation of the position of centre of pressure on a fully or partially submerged plane

This product allows students to measure the moment due to the fluid (hydrostatic) thrust on a fully or partially submerged plane. The plane works in either a vertical or inclined (angled) position. Students then compare their measurements with theoretical analysis.

ALTERNATIVE PRODUCTS:

- Hydrostatics and Properties of Fluids (H314) 120

COME AND VISIT US

Why not visit us at the TecQuipment global headquarters in the UK, where you can get hands-on with a vast array of products, enjoy a factory tour and spend some time with our team of specialists.

Please contact us to arrange a visit.

H314

HYDROSTATICS AND PROPERTIES OF FLUIDS

Self-contained, mobile unit for many experiments in fluid mechanics, from Archimedes' principle to stability of a floating body.

- Wide range of experiments
- Determination of fluid properties including density, specific gravity, surface tension and viscosity
- Demonstration of hydrostatic principles including Pascal's law, Archimedes' principle and determination of pressure at a point in a fluid
- Experiments cover study of buoyancy, flotation and stability of floating bodies, forces on a plane surface, centre of pressure, operation and calibration of a Bourdon pressure gauge and liquid column manometers

SURFACE TENSION BALANCE (H314A)

The apparatus consists of a self-contained bench complete with all necessary equipment for a wide range of demonstrations and experiments in hydrostatics and properties of fluids. Much of the equipment is rigidly mounted on the bench, the remainder being free-standing items suitable for use on the bench top.

RECOMMENDED ANCILLARIES:

- Surface Tension Balance (H314a)
- Hare's Tube (H314b)

ALTERNATIVE PRODUCTS:

- Metacentric Height and Stability (H2 Mk II) 118
- Calibration of a Bourdon Pressure Gauge (H3a) 92
- Centre of Pressure (H11) 119
- Pressure Measurement Bench (H30) 97

LEARNING OUTCOMES:

- Determination of fluid density and specific gravity
- Principles and use of a hydrometer
- Capillarity in tubes and between plates
- Measurement of viscosity by falling sphere method
- Demonstration of Pascal's law
- Measurement of fluid levels by Vernier hook gauge
- Fluid flow head relationship
- Verification of Archimedes' principle and demonstration of principles of flotation
- Stability of a floating body and determination of metacentric height
- Measurement of force and centre of pressure on a plane surface
- Operation and calibration of a Bourdon pressure gauge
- U-tube manometers with fluids of different density

H410

VISCOSITY AND PARTICLE DRAG

Demonstrates the drag coefficient of different sized particles (spheres) and the viscosity of liquids.

- Chemically inert, high-quality clear-glass tube for use with water and other suitable fluids
- Safe, low-voltage backlighting so students can see the falling test spheres through dark fluids (low translucence)
- Includes test spheres of different sizes and densities to help match a range of test fluids
- Includes stopwatch and timing marks for accurate results

LEARNING OUTCOMES:

- Determination of the viscosity of different fluids
- Determination of the drag coefficient of various spheres

The self-standing Viscosity and Particle Drag apparatus is a simple falling-sphere viscometer. A back plate holds a glass tube filled with the test fluid.

ALTERNATIVE PRODUCTS:

- Osborne-Reynolds Apparatus (H215) 104

PRODUCT DEVELOPMENT

The information contained in this publication has been carefully prepared and is correct at the time of printing. TecQuipment is, however, committed to a programme of continuous improvement; hence we reserve the right to alter the design and product specification without prior notice to ensure it continues to meet your needs.

For the latest information on all our products please visit our website at: TECQUIPMENT.COM

H311

LIQUID SEDIMENTATION APPARATUS

Demonstrates how different particles settle in liquid.

- Finds settling characteristics and particle sizes of suspended solids
- Five identical sedimentation columns for comparison of different sediments
- Translucent rear panel with back lighting for better visibility
- Includes stopwatch, measuring beakers and specific gravity bottle

LEARNING OUTCOMES:

- Comparison of settling characteristics of different sediments
- Determination of the effect of concentration on settling characteristics (hindered settlement)
- Determination of velocity distribution curves
- Comparison of flocculent and particle suspensions
- Determination of particle size distribution (grading curve) by liquid sedimentation

The bench-mounted apparatus consists of five long, transparent sedimentation columns mounted on a rigid frame.

ALTERNATIVE PRODUCTS:

- Sediment Transport Channel (FC80) 114

SEE OTHER SEDIMENT TRANSPORT AND FLOW CHANNELS

(PAGES 113-117)

These open channel flumes provide students with the ability to study the varying effects for sediment transport, bedform dynamics and fluid flow in an open channel.

H312

PERMEABILITY, FLOW NETS AND DARCY'S LAW

Demonstrates flow through permeable media with common structures, such as dams or walls.

- Dye-injector system to help demonstrate flow lines
- Clear plate glass resists abrasion and allows students to see flow patterns
- Includes pressure tappings and piezometer tubes to measure head distribution
- Plates supplied to simulate models of walls, sheet piling and dams
- Self-contained, floor-standing unit – only needs water supply and drain

The apparatus is a transparent-sided tank, mounted on a steel-framed bench with worktop. The tank is clear so students can see the flow patterns. The sides are plate glass to resist abrasion from the permeable medium. The rear of the tank contains pressure tappings with filters that stop any unwanted particles. The tappings connect to a bank of piezometer tubes at the side of the apparatus, which allows measurement of the head distribution along the tank.

RECOMMENDED ANCILLARIES:

- Permeable Medium (H312a) – Washed sand, graded 0.5 mm to 1.5 mm

LEARNING OUTCOMES:

- Determination of seepage beneath a structure
- Construction of flow nets and determination of coefficient of permeability
- Flow under a sheet pile and determination of critical seepage force at which 'piping' occurs
- Seepage flow under an impermeable dam
- Flow through an earth dam with and without a toe drain
- Drawdown in horizontal flow (simulation of groundwater flow into a river or well)
- Determination of uplift pressures on structures such as building foundations
- General studies of seepage and drainage
- Flow through a porous medium (Darcy's law)

H313

HYDROLOGY AND RAINFALL APPARATUS

For studying hydrology principles, including rainfall and movement of water over land and rivers.

- Permeable catchment area fed with 'rain' from overhead spray nozzles and/or by groundwater flow from ends of tank
- Spray nozzles to supply half or all of catchment area
- Can measure 'drawdown' due to single or two interacting wells
- Self-contained – requires only an electrical supply

The apparatus is a sturdy metal frame which holds a large rectangular stainless-steel tank (catchment area) and a reservoir tank. Students can fill the catchment area with a granular medium (not included) to form a permeable catchment area.

LEARNING OUTCOMES:

- Investigation of rainfall/run-off relationships for dry, saturated and impermeable catchments of various slopes (surface run-off only)
- Effect of interflow on outflow hydrograph surface run-off (plus groundwater flow)
- Simulation of multiple and moving storms
- Measurement of cone of depression for a single well, and comparison with theory interaction of cones of depression for two adjacent wells
- De-watering of excavation sites by use of wells
- Flow from a well in a confined aquifer
- Demonstration of watersheds for a simulated island with rainfall and well flows
- Sediment transport and meanders in simulated rivers
- Studies of scour around simulated bridge piers

RECOMMENDED ANCILLARIES:

- Permeable Medium (H313a) – Washed sand, graded 0.5 mm to 1.5 mm

H18

FRANCIS TURBINE

Demonstrates how a Francis turbine works and tests its performance.

- Mounts onto TecQuipment's Digital Hydraulic Bench (H1F) for flow measurement and easy installation
- Includes band brake to measure turbine torque
- Fully adjustable guide vanes with position indicator
- Includes pressure gauge to measure inlet pressure

LEARNING OUTCOMES:

- Efficiency of a Francis turbine
- Performance of a Francis turbine at different flow rates
- The effect of different guide vane settings on turbine performance

The Francis Turbine is a laboratory-scale reaction turbine for use with TecQuipment's Digital Hydraulic Bench (H1F, available separately).

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ESSENTIAL ANCILLARIES:

- Optical Tachometer (OT1) 297

RECOMMENDED ANCILLARIES:

- Stroboscope (ST1) 297

ALTERNATIVE PRODUCTS:

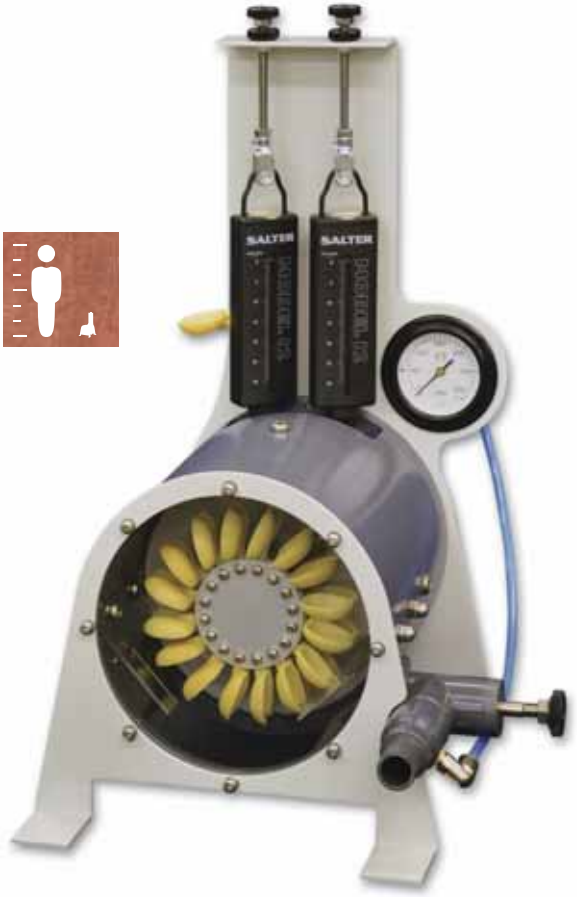
- Francis Turbine (MFP101d) 136
- Pelton Turbine (H19) 126

H19

PELTON TURBINE

A compact unit for demonstrations and performance tests on a Pelton turbine.

- Works with TecQuipment's Digital Hydraulic Bench for easy installation
- Includes dynamometer to load the turbine and help find the power absorbed (needs an optional tachometer to find speed)
- Includes inlet pressure gauge
- Screw-controlled spear valve for precise inlet flow control



LEARNING OUTCOMES:

- Performance charts of power, speed, torque and efficiency
- The effect of spear valve position

Demonstrates how an impulse (Pelton) turbine works and tests its performance. The Pelton wheel is an important and efficient fluid power machine, used in many applications.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

ESSENTIAL ANCILLARIES:

- Optical Tachometer (OT1) 297

RECOMMENDED ANCILLARIES:

- Stroboscope (ST1) 297

ALTERNATIVE PRODUCTS:

- Impact of a Jet (H8) 106
- Francis Turbine (H18) 125
- Pelton Wheel (Turbine) (MFP101b) 135

NEWSLETTER

Subscribe to TecQuipment's regular newsletters on the website for new products and more:

TECQUIPMENT.COM

H31

HYDRAULIC RAM PUMP

Demonstrates the use of water hammer to create a pumping action.

- Works with TecQuipment's Digital Hydraulic Bench for easy installation
- Includes air vessel to reduce hydraulic shock
- Ideal for demonstrations to small groups of students
- Includes header tank and all necessary pipework

SHOWN WITH THE DIGITAL HYDRAULIC BENCH (H1F) - AVAILABLE SEPARATELY

LEARNING OUTCOMES:

- Demonstration of the water hammer effect to produce a pumping action

The Hydraulic Ram Pump uses the water hammer effect. The momentum of a long column of moving water in a pipe causes the water hammer.

ESSENTIAL BASE UNIT:

- Digital Hydraulic Bench (H1F) 91

TALK TO OUR EXPERTS

Our dedicated Sales team can help you choose the equipment best suited for your needs, answer your questions and progress your order.

VDAS® H47

CENTRIFUGAL PUMP TEST SET

For a comprehensive range of investigations into the performance and characteristics of a centrifugal pump.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

TEST SET WITH ANALOGUE PRESSURE MEASUREMENT, DIGITAL PRESSURE MEASUREMENT AND VERSATILE DATA ACQUISITION UNIT

- Pump has a transparent 'window' to allow students to see clearly its impeller, the water flow and cavitation
- Demonstrates how to use a Venturi meter and differential pressure measurement to find flow rate
- Optional stroboscope allows students to see clearly the effects of cavitation around the pump impeller
- Optional easy-to-read analogue instrumentation

LEARNING OUTCOMES:

Comprehensive demonstrations and investigations into a centrifugal pump including:

- Centrifugal pump performance and characteristics, typically head versus flow and efficiency versus flow
- Non-dimensional performance characteristics
- Flow measurement using a Venturi tube
- Demonstration of cavitation

A compact, mobile and fully self-contained centrifugal pump test set that allows students to find the characteristics of a centrifugal pump. It also enables them to see (and hear) cavitation and understand the use of a Venturi meter and differential pressure measurement to find flow rate.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293
- Stroboscope (ST1) 297
- Analogue Pressure Display (AP1)

ALTERNATIVE PRODUCTS:

- Two-Stage (Series and Parallel) Pumps (H83) 130
- Centrifugal Pump Module (MFP101) 133

CAVITATION DEMONSTRATION

WATCH EQUIPMENT IN ACTION

Visit our YouTube channel to see demonstrations and promotional videos:
YOUTUBE.COM/C/TECQUIPMENT

VDAS® H83

TWO-STAGE (SERIES AND PARALLEL) PUMPS

For a comprehensive range of investigations into the operation and characteristics of a single centrifugal pump, and two centrifugal pumps in both series and parallel.

TEST SET SHOWN WITH ALL INSTRUMENTATION OPTIONS AND VERSATILE DATA ACQUISITION SYSTEM

- Pumps have a transparent 'window' to clearly see the impellers, water flow and cavitation
- Pumps can be tested individually, in series and in parallel, with independent speed control
- Demonstrates how to use a Venturi meter and differential pressure measurement to find flow rate
- Optional stroboscope allows students to see clearly the effects of cavitation around a pump impeller
- Works with TecQuipment's Versatile Data Acquisition System (VDAS®) and software

LEARNING OUTCOMES:

Comprehensive demonstrations and investigations into a centrifugal pump including:

- Centrifugal pump performance and characteristics, typically head versus flow and efficiency versus flow
- Non-dimensional performance characteristics
- Flow measurement using a Venturi tube
- Demonstration of cavitation
- Operation of centrifugal pumps in series
- Operation of centrifugal pumps in parallel

A compact, mobile and fully self-contained centrifugal pump test set, that allows students to find the characteristics of centrifugal pumps working alone or in series or parallel. It also allows students to see (and hear) cavitation and understand the use of a Venturi meter and differential pressure measurement to find flow rate.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

RECOMMENDED ANCILLARIES:

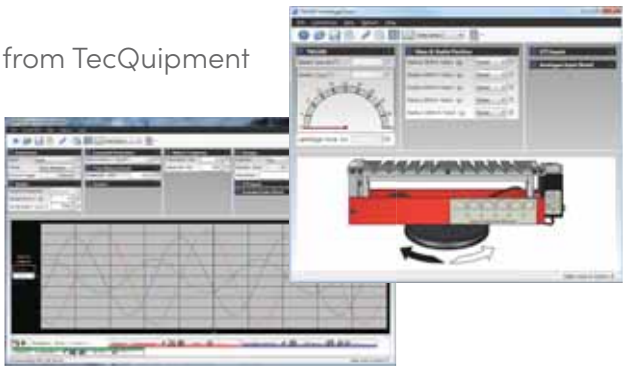
- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293
- Stroboscope (ST1) 297
- Analogue Pressure Display (AP2)

ALTERNATIVE PRODUCTS:

- Centrifugal Pump Test Set (H47) 128
- Centrifugal Pump Module (MFP101) 133

CAPTURE THE POWER OF VDAS®

...the Versatile Data Acquisition System from TecQuipment



Our Versatile Data Acquisition System (VDAS®) is a highly effective way of collecting and using data from experiments using TecQuipment's educational teaching equipment.

LOOK AT THE BENEFITS...

VERSATILE – can be used across a wide range of TecQuipment products
DATA – transforms raw data instantly which easily exports or creates sophisticated graphs and tables
ACQUISITION – USB connectivity, multiple-source real-time data capture
SYSTEM – an expandable modular approach providing easy-to-use digital plug-and-play technology

LABVIEW

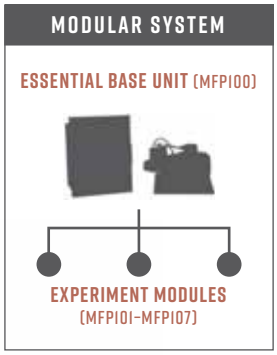
All TecQuipment products compatible with VDAS® have the capability to interface with a LabVIEW environment.

Visit our website at TECQUIPMENT.COM for more information.

MFP100

UNIVERSAL DYNAMOMETER

Provides motive power with speed, torque and power measurements for TecQuipment's Modular Fluid Power range.



FEATURES:		BENEFITS:
Provides motive power to 7 different experiment modules	→	Modular design saves space and reduces costs
Multiple electrical outlets for instruments	→	No need for extra power sockets and increases safety
Quick and easy transfer from one experiment module to another	→	Maximises experiment time
Direct drive	→	No belts or pulleys to adjust

For use with all of TecQuipment's Modular Fluid Power range, the Universal Dynamometer (MFP100) gives motive power and instrumentation for the machines fitted to each module.

AVAILABLE EXPERIMENT MODULES:

- Centrifugal Pump Module (MFP101) 133
- Axial Flow Pump Module (MFP102) 137
- Positive Displacement Pump Module (MFP103) 138
- Reciprocating Compressor Module (MFP104) 141
- Centrifugal Compressor Module (MFP105) 142
- Centrifugal Fan Module (MFP106) 143
- Axial Fan Module (MFP107) 145

VDAS® MFP101

CENTRIFUGAL PUMP MODULE

Allows students to study and perform tests on a centrifugal pump and optional turbines, to understand how they work and calculate performance.

SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100), TURBINE DYNAMOMETER AND A TURBINE

LEARNING OUTCOMES:

- Centrifugal pump performance and characteristics, typically head against flow and efficiency against flow
- Variation of pump performance with inlet pressure
- Variation of pump performance with speed
- Non-dimensional performance characteristics
- Flow measurement using a Venturi tube

- Centrifugal pump mounted in mobile frame with full instrumentation
- Part of TecQuipment's Modular Fluid Power range which connects with the Universal Dynamometer (MFP100) as a common motive power source for a cost-effective solution
- Inlet and delivery valves for wide range of operating conditions
- Turbine dynamometer and turbines (available separately) – propeller, Francis and Pelton

CONTINUED ON NEXT PAGE

CENTRIFUGAL PUMP MODULE (MFP101) CONTINUED FROM PREVIOUS PAGE

The Centrifugal Pump Module is ideal for student experiments, demonstrations and projects.

Centrifugal pumps are common machines used to move water and other fluids in many applications. These can be domestic water systems, agriculture, sanitation and many industrial applications.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 132

AVAILABLE EXPERIMENT MODULES:

- Pelton Wheel (Turbine) (MFP101b) 135
- Propeller Turbine (MFP101c) 136
- Francis Turbine (MFP101d) 136

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293
- Stroboscope (ST1) 297

ALTERNATIVE PRODUCTS:

- Centrifugal Pump Test Set (H47) 128
- Two-Stage (Series and Parallel) Pumps (H83) 130

VDAS® MFP101A

TURBINE DYNAMOMETER

Dynamometer for the turbines of the Centrifugal Pump Module (MFP101).

- Dynamometer that fits on the Centrifugal Pump Module to test the optional turbines
- Electrically powered from outlets on the Universal Dynamometer motor drive
- Measures and displays torque, speed and shaft power
- Can connect to TecQuipment's Versatile Data Acquisition System (VDAS®)

The Turbine Dynamometer is required for tests on the optional turbines. It fits on the Centrifugal Pump Module (MFP101), near the outlet end of the centrifugal pump. Fit any of the three optional turbines to the Turbine Dynamometer. Each turbine has a brake drum that fits inside the dynamometer.

ANCILLARY FOR:

- Pelton Wheel (MFP101b) 135
- Propeller Turbine (MFP101c) 136
- Francis Turbine (MFP101d) 136

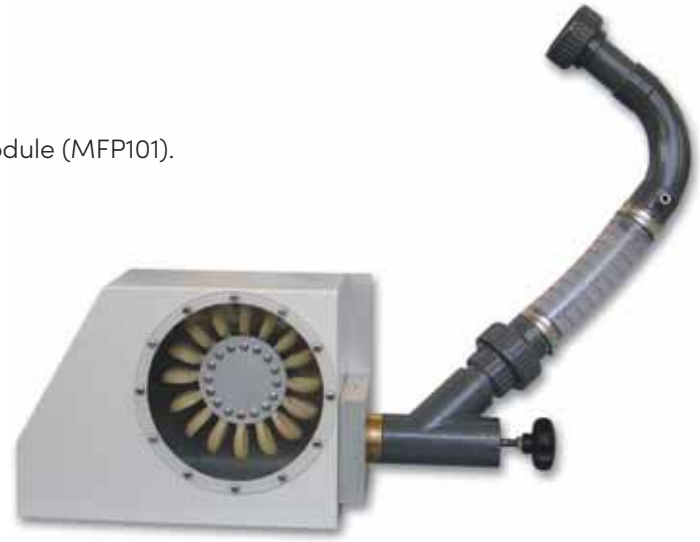
NOTE: Only one Turbine Dynamometer is needed to test all three turbines.

MFP101B

PELTON WHEEL (TURBINE)

Turbine for use with the Centrifugal Pump Module (MFP101).

- Optional turbine that fits on the Turbine Dynamometer (MFP101a) of the Centrifugal Pump Module (MFP101)
- Impulse turbine
- Variable spear jet



LEARNING OUTCOMES:

- Variation of turbine performance with inlet pressure and flow rate
- Variation of turbine performance with speed
- Non-dimensional performance characteristics

The Pelton Wheel is an impulse turbine with tangential flow (the water hits its wheel at a tangent). Good for applications with high pressure (head) and low flow.

ESSENTIAL BASE UNIT:

- Centrifugal Pump Module (MFP101) 133
  (with Universal Dynamometer MFP100) 132

ESSENTIAL ANCILLARIES:

- Turbine Dynamometer (MFP101a) 134

ALTERNATIVE PRODUCTS:

- Impact of a Jet (H8) 106
- Pelton Turbine (H19) 126

MFP101C

PROPELLER TURBINE

Turbine for use with the Centrifugal Pump Module (MFP101).

- Optional turbine that fits on the Turbine Dynamometer (MFP101a) of the Centrifugal Pump Module (MFP101)
- Inward flow reaction turbine
- Four-blade propeller
- Fully adjustable guide vanes

The Propeller Turbine is an inward flow reaction turbine, similar to a Kaplan design, but with fixed blades. It is a very common turbine and works best with high flow rates. Its moving part (runner) is a propeller, similar to those that push ships and submarines through water.

LEARNING OUTCOMES:

- Variation of turbine performance with inlet pressure and flow rate
- Variation of turbine performance with speed
- Non-dimensional performance characteristics

ESSENTIAL BASE UNIT:

- Centrifugal Pump Module (MFP101) 133
  (with Universal Dynamometer MFP100) 132

ESSENTIAL ANCILLARIES:

- Turbine Dynamometer (MFP101a) 134

MFP101D

FRANCIS TURBINE

Turbine for use with the Centrifugal Pump Module (MFP101).

- Optional turbine that fits on the Turbine Dynamometer (MFP101a) of the Centrifugal Pump Module (MFP101)
- Reaction turbine
- Ten-blade runner
- Fully adjustable guide vanes

LEARNING OUTCOMES:

- Variation of turbine performance with inlet pressure and flow rate
- Variation of turbine performance with speed
- Non-dimensional performance characteristics

The Francis turbine is a reaction turbine. It is the most common turbine in the world, due to its ability to work for a wide range of applications. Its moving part (runner) is a radial impeller.

ESSENTIAL BASE UNIT:

- Centrifugal Pump Module (MFP101) 133
  (with Universal Dynamometer MFP100) 132

ESSENTIAL ANCILLARIES:

- Turbine Dynamometer (MFP101a) 134

ALTERNATIVE PRODUCTS:

- Francis Turbine (H18) 125

VDAS® MFP102

AXIAL FLOW PUMP MODULE

Allows students to study and perform tests on an axial flow pump, to understand how it works and calculate its performance.

SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100)

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Axial flow pump, mounted in a mobile frame with full instrumentation, including a digital pressure display
- Self-contained – has its own water reservoir and needs no external water supply
- Part of TecQuipment's Modular Fluid Power range which connects with the Universal Dynamometer (MFP100) as a common motive-power source for a cost-effective solution
- Connection plate with schematic diagram shows the water flow circuit and how parts of the module connect to each other

LEARNING OUTCOMES:

- Variation of pump performance with speed
- Variation of pump performance with different outlet pressures and flow rate
- Non-dimensional performance curves
- Determination of the specific speed of the pump

The Axial Flow Pump Module is ideal for student experiments, demonstrations and projects.

Axial flow pumps are common machines, used to pump water and other liquids. They can be as small as a few centimetres in domestic use, or up to a metre in large irrigation systems. They give high flow rates at a reasonable pressure. The pump fitted to this module has two sections – one fixed and one moving, each with a set of blades.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 132

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

VDAS® MFP103

POSITIVE DISPLACEMENT PUMP MODULE

Allows students to study and perform tests on a range of positive displacement pumps, to understand how they work and calculate their performance.

SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100) AND A PUMP

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Mobile pump-support module with full instrumentation
- Part of TecQuipment's Modular Fluid Power range which connects with the Universal Dynamometer (MFP100) as a common motive-power source for a cost-effective solution
- Allows students to study and test a range of popular positive-displacement pumps (available separately)
- Connection plate with schematic diagram clearly shows oil-flow circuit and how parts of the module connect to each other

When used with one of the optional pumps, the Positive Displacement Pump Module is ideal for student experiments, demonstrations and projects.

AVAILABLE EXPERIMENT MODULES:

- Piston Pump (MFP103a) 139
- Gear Pump (MFP103b) 139
- Vane Pump (MFP103c) 140
- Swash Plate Pump (MFP103d) 140

NOTE: At least one of the optional pumps must be chosen to use with the Positive Displacement Pump Module. Tests or experiments cannot be performed without an optional pump.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 132

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

MFP103A
PISTON PUMP

Piston pump for use with the Positive Displacement Pump Support Module (MFP103).

- Popular design, ideal for student experiments, demonstrations and projects
- Quick-release, self-sealing connections for simple and safe fitting
- Demonstrates the characteristics of a twin-piston pump

LEARNING OUTCOMES:

- Performance and characteristics of a piston pump
- Volumetric and overall efficiencies
- Use of an oval gear flowmeter

When two or more optional pumps are ordered:

- Comparison of positive displacement pumps (economy, flow rate and output pressure pulses)

The piston pump is a positive displacement pump. It has twin vertically-opposed pistons that deliver a given volume of fluid (oil) for each full rotation of the pump shaft.

ESSENTIAL BASE UNIT:

- Positive Displacement Pump Module (MFP103) 138
  (with Universal Dynamometer MFP100) 132

MFP103B
GEAR PUMP

Gear pump for use with the Positive Displacement Pump Support Module (MFP103).

- Popular design pump ideal for student experiments, demonstrations and projects
- Quick-release, self-sealing connections for simple and safe fitting
- Demonstrates the characteristics of a gear pump

LEARNING OUTCOMES:

- Performance and characteristics of a gear pump
- Volumetric and overall efficiencies
- Use of an oval gear flowmeter

When two or more optional pumps are ordered:

- Comparison of positive displacement pumps (economy, flow rate and output pressure pulses)

The gear pump is a positive displacement pump. It has double gears that deliver a given volume of fluid (oil) for each full rotation of the pump shaft.

ESSENTIAL BASE UNIT:

- Positive Displacement Pump Module (MFP103) 138
  (with Universal Dynamometer MFP100) 132

MFP103C

VANE PUMP

Vane pump for use with the Positive Displacement Pump Support Module (MFP103).

- Popular design, ideal for student experiments, demonstrations and projects
- Quick-release, self-sealing connections for simple and safe fitting
- Demonstrates the characteristics of a vane pump

LEARNING OUTCOMES:

- Performance and characteristics of a vane pump
- Volumetric and overall efficiencies
- Use of an oval gear flowmeter

When two or more optional pumps are ordered:

- Comparison of positive displacement pumps (economy, flow rate and output pressure pulses)

The vane pump is a positive displacement pump. It has a fixed displacement balanced vane that delivers a given volume of fluid (oil) for each full rotation of the pump shaft.

ESSENTIAL BASE UNIT:

- Positive Displacement Pump Module (MFP103) 138
  (with Universal Dynamometer MFP100) 132

MFP103D

SWASH PLATE PUMP

Swash plate pump for use with the Positive Displacement Pump Support Module (MFP103).

- Popular design, ideal for student experiments, demonstrations and projects
- Quick-release, self-sealing connections for simple and safe fitting
- Demonstrates the characteristics of a swash plate pump

LEARNING OUTCOMES:

- Performance and characteristics of a swash plate pump
- Volumetric and overall efficiencies
- Use of an oval gear flowmeter

When two or more optional pumps are ordered:

- Comparison of positive displacement pumps (economy, flow rate and output pressure pulses)

The Swash Plate Pump is a positive displacement pump. It has a fixed displacement axial piston assembly that delivers a given volume of fluid (oil) for each full rotation of the pump shaft.

ESSENTIAL BASE UNIT:

- Positive Displacement Pump Module (MFP103) 138
  (with Universal Dynamometer MFP100) 132

VDAS® MFP104

RECIPROCATING COMPRESSOR MODULE

Allows students to study and perform tests on a reciprocating compressor, to understand how it works and calculate its performance.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Reciprocating compressor and air receiver mounted in a mobile frame with full instrumentation
- Allows students to study and test a popular fluid power machine
- Temperature and pressure measurements at key points in the system
- Connection plate with schematic diagram clearly shows how parts of the module connect together

LEARNING OUTCOMES:

- Energy balance for a compressor
- Variation of compressor performance with pressure
- Variation of compressor performance with speed
- Mechanical, volumetric and isothermal efficiencies
- Thermodynamics of a compressor

The Reciprocating Compressor Module is ideal for student experiments, demonstrations and projects.

Reciprocating compressors are common machines that provide compressed air for machines and tools. These can be air tools (saws, sanders and screwdrivers), paint spray equipment, pneumatic actuators and control systems.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 132

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

ALTERNATIVE PRODUCTS:

- Two-Stage Compressor Test Set (GT103) 262

VDAS® MFP105

CENTRIFUGAL COMPRESSOR MODULE

Allows students to study and perform tests on a centrifugal compressor, to understand how it works and calculate its performance.

- Centrifugal compressor, mounted in a mobile frame with full instrumentation
- Part of TecQuipment's Modular Fluid Power range that connects with the Universal Dynamometer (MFP100) as a common motive power source for a cost-effective solution
- Pressure and temperature measurements at key points in the system
- Connection plate with schematic diagram clearly shows the arrangement of the module

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Performance of a compressor
- Variation of compressor performance with speed
- Investigation of non-dimensional characteristics
- Comparison of performance with that of an ideal adiabatic system

The Centrifugal Compressor Module is ideal for student experiments, demonstrations and projects.

Centrifugal compressors are common machines, used for forced ventilation in applications that need a good volume of air at a reasonable pressure – for example: forced ventilation and cooling systems.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 132

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

VDAS® MFP106

CENTRIFUGAL FAN MODULE

Allows students to study and perform tests on a centrifugal fan, to understand how it works and calculate its performance.

- Centrifugal fan, mounted in a mobile frame with full instrumentation
- Part of TecQuipment's Modular Fluid Power range that connects with the Universal Dynamometer (MFP100) as a common motive power source for a cost-effective solution
- Three interchangeable impellers provided as standard
- Optional Pipe Flow and Nozzle Kit (MFP106a) for more experiments

SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100)

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

The Centrifugal Fan Module is ideal for student experiments, demonstrations and projects.

Centrifugal fans are common machines, used for ventilation or any application that needs a good volume of air at a reasonable pressure.

LEARNING OUTCOMES:

- Performance of a centrifugal fan
- Variation of fan performance with speed
- Variation of fan performance with type of impeller
- Non-dimensional performance curves
- Determination of the specific speed of the fan

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 132

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293
- Pipe Flow and Nozzle Kit (MFP106a) 144

MFP106A

PIPE FLOW AND NOZZLE KIT

Optional pipe flow and nozzle kit for use with the Centrifugal Fan Module (MFP106).

- Includes a multiway pressure display with additional instrument frame
- Includes different pipe fittings to compare losses in bends and elbows
- Axial probe and additional nozzle to find pressures along a nozzle
- Pitot traverse to find pressure profile and calculate theoretical flow
- Orifice plate to calculate theoretical flow and compare with the Pitot and standard nozzle measurement

LEARNING OUTCOMES:

- Axial pressure profile along a nozzle
- Velocity profile across a pipe
- Losses in straight pipes
- Losses in bends and elbows (fittings)
- Flow through an orifice

An optional Pipe Flow and Nozzle Kit for the Centrifugal Fan Module (MFP106). This kit includes two long lengths of smooth-walled pipe with multiple pressure tappings and a Pitot traverse. The pipes connect to the inlet of the MFP106 (the standard inlet nozzle is moved), so it becomes a suction fan for tests on the pipes. The pipe tappings connect to a multiway pressure display (supplied with the kit).

ANCILLARY FOR:

- Centrifugal Fan Module (MFP106) 143

BE SOCIAL

Be part of the conversation, follow, like and comment.

VDAS® MFP107

AXIAL FAN MODULE

Allows students to study and perform tests on an axial fan, to understand how it works and calculate its performance.

SHOWN FITTED WITH THE UNIVERSAL DYNAMOMETER (MFP100)

- Part of TecQuipment's Modular Fluid Power range which connects with the Universal Dynamometer (MFP100) as a common motive-power source for a cost-effective solution
- Multiple pressure measurement points along the fan duct allow students to examine a full range of performance characteristics
- Connection plate with schematic diagram clearly shows air flow circuit and how parts of the module connect to each other
- Traversing, calibrated Pitot tube allows investigations of velocity distribution

LEARNING OUTCOMES:

- Characteristics of an axial fan, including head against flow efficiency
- Relationship between power and speed (power law)
- Velocity distribution in a round duct
- Calibration of an inlet nozzle
- Duct resistance and matching to fan to find operating point

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

For use with and driven by the Universal Dynamometer (MFP100, available separately), the Axial Fan Module is part of TecQuipment's Modular Fluid Power range. The Axial Fan Module is ideal for student experiments, demonstrations and projects.

Axial fans move air in a wide range of applications from ventilation in domestic and commercial buildings to mines and agriculture. For these reasons it is important for engineers to be able to study and understand the characteristics of axial fans.

ESSENTIAL BASE UNIT:

- Universal Dynamometer (MFP100) 132

RECOMMENDED ANCILLARIES:

- Pitot-Static Traverse – 450 mm (MFP107a) 146
- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

VDAS® MFP107A

PITOT-STATIC TRAVERSE (450 MM)

A traversing Pitot-static tube with electronic position measurement for use with TecQuipment's Axial Fan Module (MFP107)

The Pitot-Static Traverse allows students to find the velocity distribution across the duct of the Axial Fan Module (MFP107). This optional ancillary comprises a Pitot-static tube which fits on the duct of the Axial Fan Module and has a digital indicator to show the tube position across the duct.

ANCILLARY FOR:

- Axial Fan Module (MFP107) 145

STOCK PRODUCTS READY TO DELIVER

A stock of TecQuipment's most popular products are available in our warehouse ready for speedy delivery. Contact us today to find out more.

HIGH QUALITY - SHORT LEAD TIMES

To ensure high quality and short lead times, products are designed and manufactured in the in-house facility near Nottingham in the UK.

MATERIALS TESTING AND PROPERTIES

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> The university community has been deriving optimal educational benefits from the use of TecQuipment teaching aids. Latest technology of high quality with robustness, durability, environment-friendly and diverse experiment facilities, the TecQuipment products play a significant role in ensuring 'ease of transfer of technology'.
>
> **PROFESSOR M ALIMULLAH MIYAN**
> INTERNATIONAL UNIVERSITY OF BUSINESS AGRICULTURE AND TECHNOLOGY, BANGLADESH

MATERIALS TESTING AND PROPERTIES

EXPERIENCE

TecQuipment has decades of experience making products that test material specimens, refining and developing them over time to match the needs of modern engineering courses. These high-quality robust products are made for the teaching laboratory, giving the long term performance and reliability needed for accurate and dependable results.

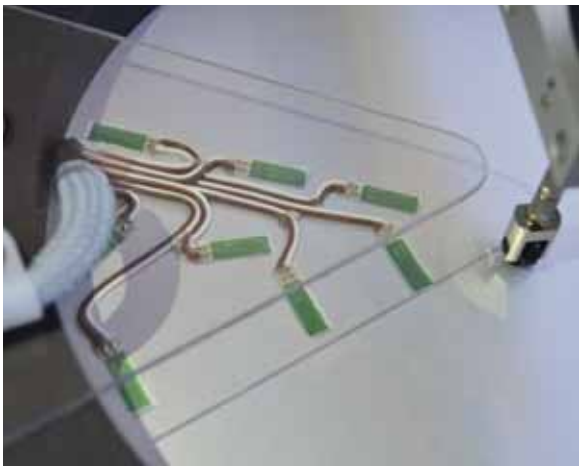
BROAD AND PROGRESSIVE RANGE

The range includes products to demonstrate key materials principles, such as Hooke's law and Young's modulus.

It progresses to complex analysis of stress and strain and testing specimens to destruction.

KEY FEATURES AND BENEFITS:

- **REFINED PRODUCTS:** Meets the needs of a modern materials course..
- **BROAD AND PROGRESSIVE RANGE OF EXPERIMENTS:** Teaches the fundamental principles, progressing to complex stress and strain analysis.
- **AUTOMATIC DATA ACQUISITION:** Multiple and fast-changing measurements make data acquisition a valuable tool.



CHECK OUT OUR OTHER RANGES

Our **STRUCTURES** (page 183) and **ENGINEERING SCIENCE** (page 5) ranges also include products that demonstrate how the choice of materials affects the performance of structural elements.

AUTOMATIC DATA ACQUISITION VDAS®

Many of the products in this range work with TecQuipment's unique Versatile Data Acquisition System (VDAS®).

SEE PAGE 293

VDAS®	PRODUCT	PAGE
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SM110

HOOKE'S LAW AND SPRING RATE

Bench-top apparatus tests extension springs to find their properties. Proves Hooke's law and the basic rules of spring design.

- Fundamental and accurate test instrument to test single springs and springs in series and parallel
- Tests springs and finds their properties – good for mechanical workshops and classroom use
- Includes a set of different springs to compare spring rates and effect of different spring sizes
- Supplied with user guide which includes theory, experiments and results

LEARNING OUTCOMES:

- Spring rate and Hooke's law
- To prove the basic rules of spring design
- Simple spring scale
- Springs in series
- Springs in parallel

The Spring Testing Apparatus uses a fundamental variable mass and scale measurement to test springs. It demonstrates how to find the properties of a spring and proves some basic laws of physics (Hooke's law, Newton's law and spring design rules). It is also a useful tool for a workshop, to check the properties of a spring before it is used, or after it has been used.

ALTERNATIVE PRODUCTS:

- Coil Spring (SM1000f) 164
- Spring Tester Kit (ES19) 13

COMMITMENT TO SUPERIOR QUALITY

All TecQuipment products are designed, manufactured and tested to the highest of quality standards.

TE16

STIFFNESS – BENDING AND TORSION

Bench-mounted apparatus enabling a variety of investigations into material stiffness.

- Allows investigations into stiffness in bending of beams of different materials and cross-section
- Easy-to-use precision parts and instruments for accurate, repeatable and reliable results
- The standard TE16 kit includes test beams of different materials and cross-section
- Optional additional kits (TE16a and TE16b) available for experiments with different beam fixings (cantilever and encastré) and torsional stiffness experiments

LEARNING OUTCOMES:

STANDARD TE16 KIT:

- Investigation of the stiffness in bending of different materials of the same cross-section (Young's modulus/stiffness)
- Investigation of the stiffness of a single material with different cross-section geometries (second moment of area, or I value)

WHEN USED WITH THE OPTIONAL TE16A:

- Experiments to find the deflected shape of a beam and bending of a beam clamped at one end (a cantilever)
- Comparison of a simply supported beam, a cantilever and an encastré beam

WHEN USED WITH THE OPTIONAL TE16B:

- Experiments to find the relationship between angular deflection and the dimensional and material properties of rods and tubes (torsional stiffness)

A compact, bench-mounted frame that holds different parts for investigations into stiffness of materials. The standard TE16 includes parts for tests in bending of beams of different materials and cross-section. Optional additional kits allow investigations into different beam fixings and torsional stiffness.

RECOMMENDED ANCILLARIES:

- Additional Experimentation Kit (TE16a)
- Additional Torsion Testing Kit (TE16b)

ALTERNATIVE PRODUCTS:

- Beam and Leaf Spring (SM1000g) 164
- Beam Apparatus (SM1004) 173
- Deflection of Beams and Cantilevers (STR4) 198
- Continuous and Indeterminate Beams (STR13) 200
- Deflection of Beams and Cantilevers Kit (ES4) 11

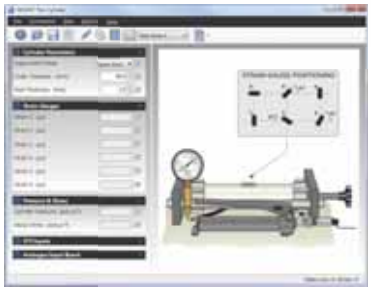
WHEN USED WITH THE ADDITIONAL TORSION TESTING KIT (TE16B):

- Torsion of Circular Sections Kit (ES5) 10
- Torsion Testing Machine – 30 Nm (SM1001) 157
- Torsion of Circular Sections (STR6) 207

VDAS® SM1007

THIN CYLINDER

Bench-mounted machine to allow students to perform stress and strain tests on a thin-walled cylinder.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

TecQuipment's Thin Cylinder apparatus allows students to perform experiments that examine stress and strain in a thin-walled cylinder. It clearly demonstrates the principles, theories and analytical techniques providing effective, practical support to studies.

- Includes experiments to find Young's modulus and Poisson's ratio
- Closed-end and open-end conditions to allow circumferential or biaxial stress tests
- Includes built-in microprocessor-controlled display of strain measurements
- Self-contained, hand-operated hydraulic pressurising system for accurate pressure control

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Thick Cylinder (SM1011) 153

LEARNING OUTCOMES:

Investigations into stresses and strains in a thin cylinder, to give students an understanding of:

- Longitudinal stress, hoop (or circumferential) stress, radial stress and biaxial stress
- The behaviour of the cylinder under both open and closed-end conditions
- The use of strain gauges
- The stress strain relationship and value of Young's modulus for the cylinder material
- Indirect strain and stress
- The value of Poisson's ratio for the cylinder material
- The use of Mohr's circle to calculate the shear strain at any position in the cylinder
- The use of the 'superposition method' to find the principal strains
- The effect of the biaxial stress system
- Sources of errors in experiments

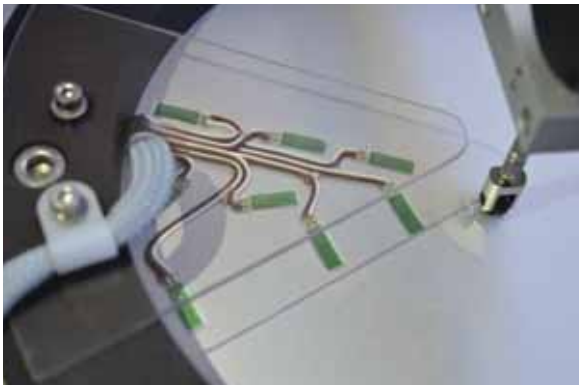
VDAS® SM1008

DIAPHRAGM

Bench-mounted machine to allow students to perform stress, strain and deflection tests on a diaphragm.

- Measurement of effect of pressure on surface profile of a diaphragm
- Measurement of circumferential and radial strains of a diaphragm under pressure
- Includes built-in microprocessor-controlled display of strain measurements
- Self-contained, hand-operated hydraulic pressurising system for accurate pressure control

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE



LEARNING OUTCOMES:

Experiments possible with this apparatus include the effect of pressure on:

- Surface profile – the results are presented as a non-dimensional curve
- Radial and circumferential strains
- Radial and circumferential strain gradients across the diaphragm

Experimental measurements are compared with theory. The student is encouraged to use their results to determine the accuracy of the location of the strain gauges.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

VDAS® SM1011

THICK CYLINDER

Bench-mounted machine to allow students to perform stress and strain tests on a thick-walled cylinder.

- For comprehensive analysis of the stresses and strains in a thick-walled cylinder, under internal pressure
- Experiment results compared with Lamé predictions
- Includes built-in microprocessor-controlled display of strain measurements
- Self-contained, hand-operated hydraulic pressurising system for accurate pressure control

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Radial and hoop strains throughout the cylinder wall
- Radial and hoop stress distribution in the wall
- Longitudinal stress and strain at the outer surface
- Circumferential stress and strains at the inner and outer surfaces
- Comparison with Lamé predictions
- Principal stresses and maximum shear stress
- Appraisal of accuracy of location of strain gauges

TecQuipment's Thick Cylinder apparatus allows students to examine radial and hoop stresses and strains in the wall of a thick cylinder. They can then compare experiment results with the theoretical Lamé predictions. It clearly demonstrates the principles, theories and analytical techniques, and provides effective, practical support to studies.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Thin Cylinder (SM1007) 151

VDAS® SM1009

STRAIN GAUGE TRAINER

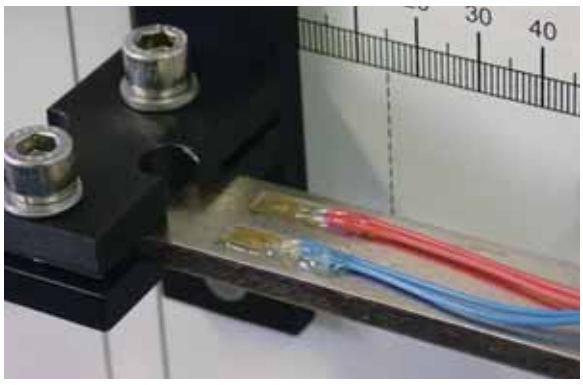
Illustrates how resistance strain gauges work, and methods of measuring strains in different structures.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Clear layout with printed graphics to help students understand how strain gauges work
- Includes electronic strain display to show all readings, and automatically calculates strain
- Fully open bridge connection with dummy resistors to allow quarter, half and full-bridge connection to demonstrate how strain bridge connections work
- Uses strain gauges on three different, popular structures for realistic experiments

LEARNING OUTCOMES:

- Introduction to the equipment and the different bridge connections (quarter, half and full-bridge)
- Strains and stresses in a bending system
- Strains and stresses in a torsion system
- Strains and stresses in a tension system, Poisson's ratio and Young's modulus
- Tensile strains and stresses in different materials (needs optional tensile specimens) and comparison of Poisson's ratio and Young's modulus
- Comparison of different strain measurement systems and how they could measure force



The compact Strain Gauge Trainer fits on a bench or desktop. It contains everything needed to demonstrate how resistance strain gauges work on three different structures. It is ideal for groups of two or more students to do experiments and for classroom demonstrations.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293
- Optional Tension Specimens (SM1009a) – Aluminium, brass and copper

E19

STRAIN GAUGE KIT

Selection of resistance strain gauges and necessary accessories and consumable materials – for use with TecQuipment's SM1010 Digital Strain Display.

- All expendable items required for cementing gauges included
- Reduced risk of spillage of chemicals
- Refills available (E19a)
- Step-by-step instructions supplied
- Supplied in a PVC carrying case

STRAIN GAUGE INSTRUMENTATION

TecQuipment offers the following instrumentation for monitoring and display of strain:

- Digital Strain Display (SM1010) – **SEE BELOW**

RECOMMENDED ANCILLARIES:

- Digital Strain Display (SM1010) 156
- Refill Kit for E19 (E19a)

VDAS® SM1010

DIGITAL STRAIN DISPLAY

A 16-channel instrument that connects to industry-standard strain gauges to give direct readings of strain.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Direct connections for half and full strain bridge connections, with internal 'make-up' resistors.
- Supplied with cable, self-locking connectors and a crimp tool to reduce connection problems
- Fully programmable to match most types of strain gauges and connections
- Ideal for use with TecQuipment's Strain Gauge Kit (E19)

The Digital Strain Display accepts up to 16 channels from strain gauges connected in quarter, half or full bridge. The display is fully programmable to match the strain gauges and their bridge connections. The display includes precision internal 'make-up' resistors to work with halfbridge connections if needed.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ANCILLARY FOR:

- Strain Gauge Kit (E19) 156

VDAS® SM1001

TORSION TESTING MACHINE - 30 NM

Bench-mounted machine to allow students to do torsion tests on different materials.

- Suitable for destructive tests on specimens
- Forward and reverse loading
- Wide range of test specimens
- Optional Torsiometer (SM1001a) available for tests which need increased accuracy

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Determination of modulus of rigidity (shear modulus) and yield strength (when used with the optional torsiometer)
- Determination of upper and lower yield stresses for normalised steel specimens
- Reversed torsion tests to demonstrate the Bauschinger effect and the effects of residual body and textural stresses on torsional strength
- Comparison of the different elastic and plastic properties of materials (optional specimens required)

The Torsion Testing Machine is a compact machine, ideal for classroom demonstrations and for safe use by small groups of students. Its frame is a rigid, precision-engineered alloy box-section, supported at each end by adjustable feet.

RECOMMENDED ANCILLARIES:

- Torsion Test Specimens (TR) 170
- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293
- Torsiometer (SM1001a) – Mechanical torsiometer for use with 6 mm diameter specimens in both the elastic and plastic regions

ALTERNATIVE PRODUCTS:

- Additional Torsion Testing Kit (TE16b) 150
- Torsion of Circular Sections (STR6) 207
- Torsion of Circular Sections Kit (ES5) 10

VDAS® SM1090

ROTATING FATIGUE MACHINE

Demonstrates the failure of materials when subjected to an alternating stress.

- Demonstrates clearly both high and low cycle fatigue
- Adjustable 'dead weight' and load cell system – to apply and measure a consistent and accurate load on the test specimens
- Automatic switch stops the experiment when the specimen breaks – lets the equipment run unattended
- Includes tools and three sets of specimens of different metals

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

The user guide includes suggested experiments that show:

- Low and high cycle fatigue
- How to create and use Wohler (S-N) curves for various materials
- Comparison of fatigue properties of various materials

This machine demonstrates the fatigue failure of materials when subject to alternating stresses. Based on Wohler's design, it uses a motor to rotate a circular cantilever specimen with a load at its free end.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293
- Additional specimens: RF1010 (steel), RF1020 (aluminium) and RF1030 (brass) 170

VDAS® SM1006

CREEP MACHINE

Bench-mounted machine which demonstrates the phenomenon of creep under different conditions and in different materials.

- Demonstrates the three phases of creep
- Demonstrates effect of temperature on creep
- Supplied with weights and test specimens
- Inexpensive specimens readily available in lead and plastics

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

This simple machine uses specimens of lead and different plastics which creep significantly at room temperature and under low loads.

LEARNING OUTCOMES:

An extensive range of experiments may be carried out with this apparatus, including:

- The normal breaking load of a specimen over a fixed time
- Relationship between breaking load and time for lead specimens
- Time extension curves to show the three phases of creep (primary, secondary and tertiary)
- The effect of temperature on the creep rate of specimens
- Creep recovery

RECOMMENDED ANCILLARIES:

- Creep Test Specimens (CP) 170
- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

VDAS® SM1002

BENCH-TOP TENSILE TESTING MACHINE

A laboratory-scale, hand-driven bench-top tensile testing machine, 20 kN capacity.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

OPTIONAL EXTENSOMETER (SM1002A) FITTED TO TL SPECIMEN

FEATURES:		BENEFITS:
Simple hand-operated load application	→	For safe and easy operation that minimises risks to students
Supplied with chucks for standard 20 mm² specimens	→	Compatible with older Hounsfield specimens and chucks – cost saving
Optional Extensometer (SM1000d)	→	For tests of Young's modulus
Optional Compression Cage and Brinell Test Set (SM1002b and SM1002c)	→	Combines hardness testing with tensile testing for flexibility and cost saving

LEARNING OUTCOMES :

- Tensile tests up to 20 kN on specimens made of different metals, to find material characteristics such as upper and lower yield strengths, tensile strength and overall extension.
- Tests of Young's modulus (E) for the specimen material (needs SM1002a and TL specimens).

A small-scale machine that fits on a bench-top and allows simple tensile tests of metal specimens up to a maximum load of 20 kN. This machine is a good partner to TecQuipment's Torsion Testing Machine (SM1001).

AVAILABLE EXPERIMENT MODULES:

- Brinell Hardness Test Set (SM1002c) 161

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293
- Extra TL and TS specimens 171
- Extensometer (SM1002a)

ALTERNATIVE PRODUCTS:

- Universal Testing Machine (SM1000) 162
- Materials Laboratory with Data Capture (MF40) 165
- Tensile Tester Kit (ES6) 12

SM1002C

BRINELL HARDNESS TEST SET

Fits in the Compression Cage (SM1002b) of the Bench Top Tensile Testing Machine (SM1002) for Brinell hardness tests.

- Fits in TecQuipment's Bench Top Tensile Testing Machine (SM1002) for Brinell hardness tests of different materials
- Includes specimens of different basic engineering materials
- Includes magnifier with graticule to accurately measure the indentation
- Works with TecQuipment's hardness test specimens (HTP)

LEARNING OUTCOMES:

- Brinell hardness tests of different basic engineering materials

THE OPTIONAL COMPRESSION CAGE (SM1002B) FITS INTO THE TENSILE TEST AREA, ADAPTING THE MACHINE FOR EXPERIMENTS THAT NEED A COMPRESSIVE LOAD.

An extra experiment module for the test machine, parts of this test set fit into the optional Compression Cage (SM1002b) for simple Brinell hardness tests. The set includes a magnifier with graticule (measurement scale) and test specimens made of basic engineering materials.

ESSENTIAL BASE UNIT:

- Bench-Top Tensile Testing Machine (SM1002) 160

ESSENTIAL ANCILLARIES:

- Compression Cage (SM1002b)

RECOMMENDED ANCILLARIES:

- Extra hardness specimens (HTP) 171

ALTERNATIVE PRODUCTS:

- Materials Laboratory with Data Capture (MF40) 165
- Brinell Indenter (SM1000e) 163

FIRST-CLASS EQUIPMENT TRAINING

We offer comprehensive equipment training programmes, either at our offices or at your premises, from our specialist engineers.

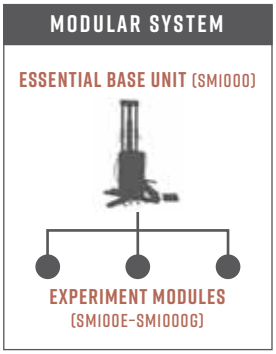
These sessions include:

- Operation
- Safety
- Maintenance
- Introductory experimentation

VDAS® SM1000

UNIVERSAL TESTING MACHINE

A compact machine for compressive and tensile tests on different materials and structures.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

FEATURES:		BENEFITS:
Supports and provides tensile or compressive force to three different experiment modules	→	Modular design saves space and reduces costs
Optional Brinell, coil spring, beam and leaf spring modules	→	Additional tests in material hardness and deflections of beam and springs
Includes a set of tensile specimens	→	Allows tensile tests 'out of the box'
Optional Extensometer (SM1000d)	→	For accurate tests of Young's modulus on tensile specimens
Works with VDAS	→	Quick and reliable tests with data capture

LEARNING OUTCOMES:

- Tensile tests on different materials
- Compression tests on different materials

The Universal Testing Machine is ideal for classroom demonstrations and for safe use by small groups of students. It fits onto any suitable strong desk or bench top, but TecQuipment offers the optional Support Table and Cupboard (SM1000a).

AVAILABLE EXPERIMENT MODULES:

- Brinell Indenter (SM1000e) 163
- Coil Spring (SM1000f) 164
- Beam and Leaf Spring (SM1000g) 164

RECOMMENDED ANCILLARIES:

- Bench-mounted version of the Versatile Data Acquisition System (VDAS-B) 293
- Support Table and Cupboard (SM1000a) – A steel-frame table with a pre-drilled work-top to accept the Universal Testing Machine. Includes a cupboard underneath.
- Extensometer (SM1000d) – A precision sliding gauge with a digital indicator
- Tensile test (TH) specimens 170

ALTERNATIVE PRODUCTS:

- Materials Laboratory with Data Capture (MF40) 165
- Bench-Top Tensile Testing Machine (SM1002) 160
- Tensile Tester Kit (ES6) 12

SM1000E
BRINELL INDENTER

Fits in the Universal Testing Machine (SM1000) for Brinell hardness tests.

- Fits in the compressive test area of TecQuipment's Universal Testing Machine (SM1000) for Brinell hardness tests of different materials
- Includes magnifier with graticule to accurately measure the indentation
- Includes specimens of different basic engineering materials
- Works with TecQuipment's hardness test specimens (HTP)

LEARNING OUTCOMES:

- Brinell hardness tests of different basic engineering materials

The Brinell Indenter (SM1000e) fits in the area above the loading platform of TecQuipment's Universal Testing Machine (SM1000).

ESSENTIAL BASE UNIT:

- Universal Testing Machine (SM1000) 162

RECOMMENDED ANCILLARIES:

- Extra hardness specimens (HTP) 171

ALTERNATIVE PRODUCTS:

- Materials Laboratory with Data Capture (MF40) 165
- Brinell Hardness Test Set (SM1002c) 161

SM1000F

COIL SPRING

Fits in the Universal Testing Machine (SM1000) for compression spring tests on a coiled spring.

- Fits in the compressive test area of TecQuipment's Universal Testing Machine for tests on a coiled compression spring
- Includes fittings to hold the spring securely
- Demonstrates Hooke's law and how to find 'spring rate' by experiment
- Heavy-duty coil spring for a more practical experience

LEARNING OUTCOMES:

- Compression tests on a coiled spring

The Coil Spring (SM1000f) fits in the area above the loading platform of TecQuipment's Universal Testing Machine (SM1000).

ESSENTIAL BASE UNIT:

- Universal Testing Machine (SM1000) 162

ALTERNATIVE PRODUCTS:

- Hooke's Law and Spring Rate (SM110) 149
- Spring Tester Kit (ES19) 13

SM1000G

BEAM AND LEAF SPRING

Fits in the Universal Testing Machine (SM1000) for tests on bending beams and a leaf spring.

- Includes two different test beams – flat steel and channel section aluminium
- Knife-edge supports for the beams, and rollers for the leaf spring for accurate results
- Includes tools needed to fit the parts to the testing machine
- Heavy-duty leaf spring for a more practical experience

LEARNING OUTCOMES:

- Beam bending tests on beams of different shape, material and length
- Spring rate tests on a leaf spring

The Beam and Leaf Spring (SM1000g) parts fit into the compressive test area of TecQuipment's Universal Testing Machine (SM1000).

ESSENTIAL BASE UNIT:

- Universal Testing Machine (SM1000) 162

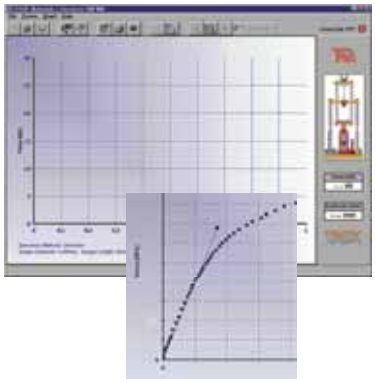
ALTERNATIVE PRODUCTS:

- Beam Apparatus (SM1004) 173
- Deflection of Beams and Cantilevers (STR4) 198
- Deflection of Beams and Cantilevers Kit (ES4) 11
- Continuous and Indeterminate Beams (STR13) 200
- Stiffness – Bending and Torsion (TE16) 150
- Plastic Bending of Beams (STR15) 196

MF40

MATERIALS LABORATORY WITH DATA CAPTURE

A hydraulic machine with electronic instruments and software, it tests the hardness and tensile properties of materials.



- For Brinell hardness tests and tensile tests of materials
- Includes an extensometer for accurate tensile test results
- Supplied with a set of test specimens – additional test specimens available separately
- Includes software to automatically record results and produce charts (a suitable computer is required)

LEARNING OUTCOMES:

- Tensile testing to destruction and Brinell hardness testing of various specimens
- Modulus of elasticity
- Yield stress
- Ultimate tensile stress
- Percentage elongation
- Brinell hardness test and hardness number derivation

A hydraulic tensile and Brinell hardness testing machine. The machine tests any suitably shaped specimens of various materials. The material must not exceed the maximum strength or hardness limits specified. TecQuipment can also supply additional low-cost test specimens.

RECOMMENDED ANCILLARIES:

- Additional tensile test specimens of different materials: 171
  - ML1MS – Mild Steel
  - ML2CS – Carbon Steel
  - ML3SS – Stainless Steel
  - ML4AL – Aluminium
  - ML5BR – Brass
- Hardness test specimens of different materials: 171
  - HTPAL – Aluminium
  - HTPBR – Brass
  - HTPMS – Mild Steel
  - HTPNY – Nylon

ALTERNATIVE PRODUCTS:

- Tensile Tester Kit (ES6) 12
- Bench-top Tensile Testing Machine (SM1002) 160
- Universal Testing Machine (SM1000) 162

TE15

ENERGY ABSORBED AT FRACTURE

Compact, bench-top apparatus for introducing students to impact testing.

- Many safety features including enclosure of all moving parts and mechanically interlocked guard
- Allows investigations into the resistance of materials to crack propagation
- Includes digital display of energy absorbed at impact, and angular position before and after impact
- Visually effective, interesting and motivating experiments

LEARNING OUTCOMES:

- Introduction to the principles of common impact testing methods, such as Izod and Charpy tests
- Investigations into the resistance of materials to crack propagation

A small-scale, bench-mounted, notched-bar impact tester. The equipment provides an effective, convenient and safe introduction to the principles of common impact testing techniques, enabling investigations into the resistance of materials to crack propagation.

ALWAYS HERE TO HELP

Whether you have a technical enquiry, need spare parts or support material, you can contact our Customer Care team at:

CUSTOMER.CARE@TECQUIPMENT.COM

SM1015

ROCKWELL HARDNESS TESTER

A bench-top industrial-standard tester for accurate measurements of Rockwell hardness.

- Friction-free dead-weights
- Nose-mounted indenter allows 360 degree access
- Extended range of applications by means of free-standing indenter
- Fully automatic testing cycle and automatic conversion to alternative scales eliminates operator influence on the test results
- High level of test result repeatability
- Robust construction with a play-free screw spindle running on ball-bearings
- Visual and audible signals when specified tolerance exceeded and during pre-load setting

LEARNING OUTCOMES:

Hardness testing of classical Rockwell methods according to ISO 6508 and ASTM E18

The machine performs Rockwell hardness tests in accordance with established specifications, including BS EN ISO 6508:1999 and ASTM E18. The machine is supplied with a diamond cone indenter and a 1/16" diameter ball indenter, as standard.

RECOMMENDED ANCILLARIES:

- Hardness Reference Blocks (HTB-R) 171

COME AND VISIT US

Why not visit us at the TecQuipment global headquarters in the UK, where you can get hands-on with a vast array of products, enjoy a factory tour and spend some time with our team of specialists.

Please contact us to arrange a visit.

SM1016

VICKERS HARDNESS TESTER

A bench-top industrial-standard tester for accurate measurements of Vickers hardness.

MEASURING THE HARDNESS OF AN INTERNAL BORE

- Capable of performing tests using forces: 1, 3, 5, 10, 20, 30 kgf
- Unique nose-mounted indenter, allows access to awkward to reach test points
- Test scale designation on display, for simple operation and data gathering
- Fully automatic testing cycle – eliminates operator influence on the test results
- Calculation of average ($\bar{x}$) and range (R)
- Audible and visual indication of "out of tolerance" results, eliminating operator decisions

LEARNING OUTCOMES:

Vickers testing to ISO 6507, ASTM E384 and ASTM E92, UKAS accredited Key Specifications

The machine performs the Vickers hardness test, in accordance with established specifications including BS EN ISO 6507 and ASTM E92.

RECOMMENDED ANCILLARIES:

- Hardness Reference Blocks (HTB-V) 171

SM1017

UNIVERSAL HARDNESS TESTER

A bench-top industrial-standard tester for accurate measurements of Vickers, Brinell and Rockwell hardness.

THE DISPLAY OF THE HARDNESS TESTER

- Dead weight load combinations up to 187.5 kg
- Setting of hardness tolerance and statistics ($\bar{x}$ and R), for a range of experiments
- Integral microscope with measuring shutters and push button for transfer of dimensional data
- Simple operation

LEARNING OUTCOMES:

Hardness testing of a range of different materials, using three different methods:

- Vickers (HV) DIN EN ISO 6507, ASTM E92
- Brinell (HB) DIN EN ISO 6506, ASTM E10
- Rockwell (HR) DIN EN ISO 6508, ASTM E18

The machine performs Brinell, Vickers and Rockwell tests in accordance with established specifications:

- Brinell: ISO 6506, ASTM E10
- Vickers: ISO 6507, ASTM E92
- Rockwell: ISO 6508, ASTM E18

RECOMMENDED ANCILLARIES:

- Hardness Reference Blocks (HTB-B) 171

SPECIMENS AVAILABLE EX-STOCK

CP
CREEP TEST SPECIMENS

Creep test specimens of different materials for use with TecQuipment's Creep Machine (SM106 or SM1006).

CP1010: Lead

CP1020: Polypropylene

CP1025: Nylon 66 (unfilled)

CP1030: Unplasticised PVC

RF
ROTATING FATIGUE SPECIMENS

Fatigue test specimens of different metals for use with TecQuipment's Rotating Fatigue Machine (SM1090).

RF1010: Mild Steel

RF1020: Aluminium

RF1030: Brass

TH
TENSILE TEST SPECIMENS

Tensile test specimens of different grade steel for use with TecQuipment's Universal Testing Machine (SM100 or SM1000).

TH4010: 0.1% Carbon Steel. As drawn. To British Standard Specification 230M07. Has no identity rings.

TH4015: 0.1% Carbon Steel. Normalised at 900°C. To British Standard Specification 230M07. Has one identity ring.

TH4035: 0.4% Carbon Steel. Normalised at 860°C. To British Standard Specification 212A42. Has two identity rings.

TR
TORSION TEST SPECIMENS

Torsion test specimens of different metals for use with TecQuipment's Torsion Testing Machine (SM1 or SM1001).

TR1010: 0.1% Carbon Steel. As drawn. To British Standard Specification 230M07. No grooves.

TR1011: 0.1% Carbon Steel. Normalised at 900°C. To British Standard Specification 230M07. 1 groove.

TR1020: 0.4% Carbon Steel. As drawn. To British Standard Specification 212A42. 2 grooves.

TR1021: 0.4% Carbon Steel. Normalised at 860°C. To British Standard Specification 212A42. 3 grooves.

TR1040: Half-hard Brass. 60% Copper, 40% Zinc. To British Standard Specification CZ121. No grooves.

TR1050: Cast iron. Grade 260. To British Standard BS1452. 4 grooves.

TL AND TS
TENSILE TEST SPECIMENS

Long (TL) and short (TS) tensile test specimens of different metals for use with TecQuipment's Tensile Testing Machine (SM1002). Will also fit Hounsfield or Monsanto tensometer.

TL1010 AND TS1010: 0.1% Carbon Steel. As drawn. To British Standard Specification 220M07 or 230M07.

TL1011 AND TS1011: 0.1% Carbon Steel. Normalised at 900°C. To British Standard Specification 220M07 or 230M07.

TL1020 AND TS1020: 0.4% Carbon Steel. As drawn. To British Standard Specification 080M040.

TL1021 AND TS1021: 0.4% Carbon Steel. Normalised at 860°C. To British Standard Specification 080M040.

TL1030 AND TS1030: Aluminium 2011 – T3.

TL1040 AND TS1040: Half hard Brass. To British Standard Specification CZ121.

HTP
HARDNESS TEST SPECIMENS

Hardness test specimens of different materials for use with the Materials Laboratory with Data Capture (MF40), Bench-Top Tensile Testing Machine (SM1002) and Brinell Indenter (SM1000e).

HTPAL: Aluminium (6026-T9)

HTPBR: Brass (CZ121/CW614N)

HTPMS: 0.1% Carbon steel (230M07)

HTPNY: Nylon 6

ML
TENSILE TEST SPECIMENS

Tensile test specimens of different materials for use with the Materials Laboratory with Data Capture (MF40).

ML1MS: Mild steel – specification EN1A or 230M07

ML2CS: Carbon steel – specification EN8 or 080M40

ML3SS: Stainless steel – specification SAE303

ML4AL: Aluminium – specification 2011-T3

ML5BR: Brass – specification CZ121

HTB
HARDNESS REFERENCE BLOCKS

For use with the Rockwell Hardness Tester (SM1015), Vickers Hardness Tester (SM1016) and Universal Hardness Tester (SM1017).

HTB-R: for the Rockwell Tester
HTB-V: for the Vickers Tester
HTB-B: for the Universal Tester

VDAS® SM1003

UNSYMMETRICAL CANTILEVER APPARATUS

Examines and displays bending of an unsymmetrical cantilever.

- Self-contained – needs no other parts
- Explains 'shear centre' and the use and construction of Mohr's circle
- Supplied with structural and stress analysis textbook with full theory
- Supplied with set of different specimens

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

Investigations into bending of unsymmetrical cantilevers, including:

- Vertical and horizontal displacement measurement for varying angles of applied load
- Demonstration that maximum and minimum vertical deflection occurs when horizontal deflection is zero
- Use of Mohr's circle
- Experimental and theoretical determination of the principal moments of area of test sections
- Location of shear centre of each section

The Unsymmetrical Cantilever Apparatus allows students to load a cantilever and accurately measure its deflection in any coplanar direction.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

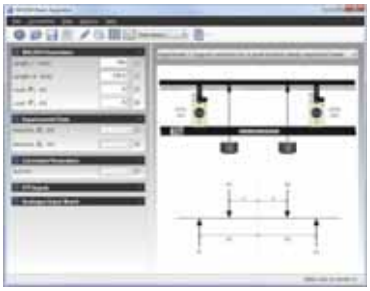
- Unsymmetrical Bending and Shear Centre (STR7) 208

VDAS® SM1004

BEAM APPARATUS

Examines the deflection and forces on different types of beams for a wide range of supports and loads.

- Includes textbook with full theory
- Simply supported and cantilever beam tests with up to four supports with any loading
- Three load cells with digital indicators measure reaction forces or act as rigid sinking supports
- Precision digital indicators for accurate deflection measurements



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Verification of the bending equation
- Determination of flexural rigidity and elastic modulus (Young's modulus)
- Verification of static equilibrium
- Deflection of beams on two simple supports with point loads
- Reciprocal properties for loads and deflection
- Simple and propped cantilevers with any loading
- Continuous beams – statically indeterminate cases for simply supported beams and cantilevers on more than two supports with any loading (including measurement of unknown reactions)
- Simply supported and cantilever beams with sinking supports

With the SM1004a Specimen Beams, these additional experiments can be done:

- The effects of material and section shape on flexural rigidity
- Bending characteristics of a brass/steel compound beam, with and without shearing connection between the two layers
- Equivalent sections – characteristics of a metal-faced wooden beam
- Deflections on a non-uniform (tapered) beam or cantilever

CONTINUED ON NEXT PAGE

BEAM APPARATUS (SM1004) CONTINUED FROM PREVIOUS PAGE

The Beam Apparatus allows an extensive range of experiments to cover virtually all course requirements relating to bending of beams. The basic unit provides facilities for supporting beams on simple, built-in and sinking supports, applying point loads, and measuring support reactions and beam deflections.

RECOMMENDED ANCILLARIES:

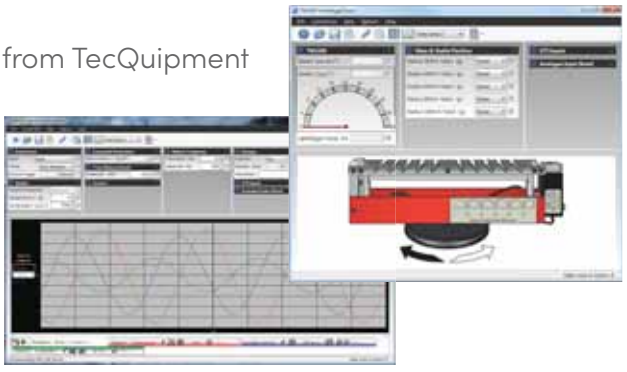
- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293
- Additional Specimen Beams (SM1004a)

ALTERNATIVE PRODUCTS:

- Deflection of Beams and Cantilevers Kit (ES4) 11
- Stiffness – Bending and Torsion (TE16) 150
- Beam and Leaf Spring (SM1000g) 164
- Deflection of Beams and Cantilevers (STR4) 198
- Continuous and Indeterminate Beams (STR13) 200

CAPTURE THE POWER OF VDAS®

...the Versatile Data Acquisition System from TecQuipment



Our Versatile Data Acquisition System (VDAS®) is a highly effective way of collecting and using data from experiments using TecQuipment's educational teaching equipment.

LOOK AT THE BENEFITS...

VERSATILE – can be used across a wide range of TecQuipment products
DATA – transforms raw data instantly which easily exports or creates sophisticated graphs and tables
ACQUISITION – USB connectivity, multiple-source real-time data capture
SYSTEM – an expandable modular approach providing easy-to-use digital plug-and-play technology

LABVIEW

All TecQuipment products compatible with VDAS® have the capability to interface with a LabVIEW environment.

Visit our website at TECQUIPMENT.COM for more information.

VDAS® SM1005

EULER STRUT BUCKLING APPARATUS

Bench-top apparatus tests different types of struts and demonstrates how they deflect under load.

- Can also test struts as simply supported beams – to extend experiments and find flexural rigidity of the struts
- Buckling tests cover pinned and clamped (encastré) ends for various strut lengths and cross sections
- Special end fittings allow tests with eccentric loading
- Range of ten struts supplied as standard
- Extra specimen struts available for more advanced experiments

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

WITH THE STANDARD SET OF TEN SPECIMENS:

- Demonstration of buckled (crippled) shape of struts with different end conditions
- Determination of load/deflection curves and buckling loads for struts of different lengths and cross-sections, with any combination of 'pinned' or clamped end fixings
- Comparing experiment results with those using Euler's buckling theory
- Investigation of the effects of side load and eccentric loading on strut buckling characteristics
- Flexural rigidity and buckling loads for struts of different materials
- The use of Southwell's method to estimate buckling loads and strut eccentricities from experimental results
- Determination of flexural rigidity and comparison with calculated values
- Deflections of a simply supported beam with a point load including the verification of general deflection formulae, and the deflected shape

WITH THE SM1005A OPTIONAL SET OF ADDITIONAL STRUTS:

- Flexural rigidity and buckling loads for struts of a further range of different materials
- Tests on typical engineering sections (circular, angle, channel and irregular section specimens); the significance of the neutral axes; combined bending and twisting due to eccentric loading.
- The effect of flexibility in end fixings
- Tests on a compound strut with imperfect shearing connections between the two components

CONTINUED ON NEXT PAGE

The Loading and Buckling of Struts apparatus allows tests on a full range of struts. It demonstrates load and deflection characteristics and buckling loads for various strut lengths, cross-sections and end conditions. It also allows studies of the effect of eccentric loading.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293
- Set of Additional Struts (SM1005a)

ALTERNATIVE PRODUCTS:

- Euler Buckling of a Column (STR12) 195

WATCH EQUIPMENT IN ACTION

Visit our YouTube channel to see demonstrations and promotional videos:
YOUTUBE.COM/C/TECQUIPMENT

STATICS FUNDAMENTALS

WORK PANEL	179
EXPERIMENTS	180

“

The School of Engineering at the University of Lincoln is the first new Engineering School in the UK for more than 20 years and collaborates closely with industry to produce graduates who are not only academically excellent, but ‘industry ready’.
TecQuipment products form the practical basis of our Static Mechanics and Dynamic Mechanics curriculum and help to demonstrate fundamental aspects of the theory to our undergraduate students.

DANIEL STONES
TECHNICIAN, UNIVERSITY OF LINCOLN

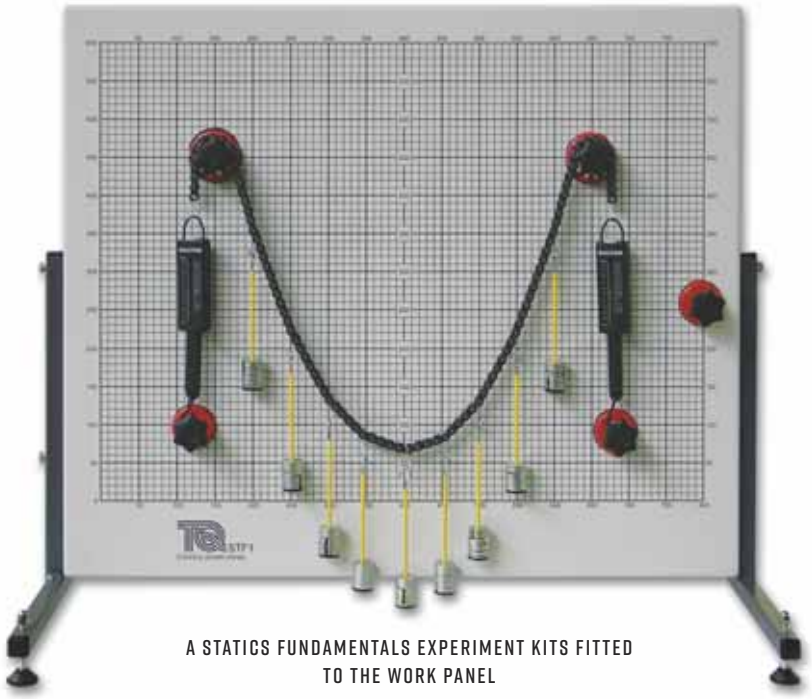
STATICS FUNDAMENTALS

FLEXIBLE, MODULAR AND EXPANDABLE

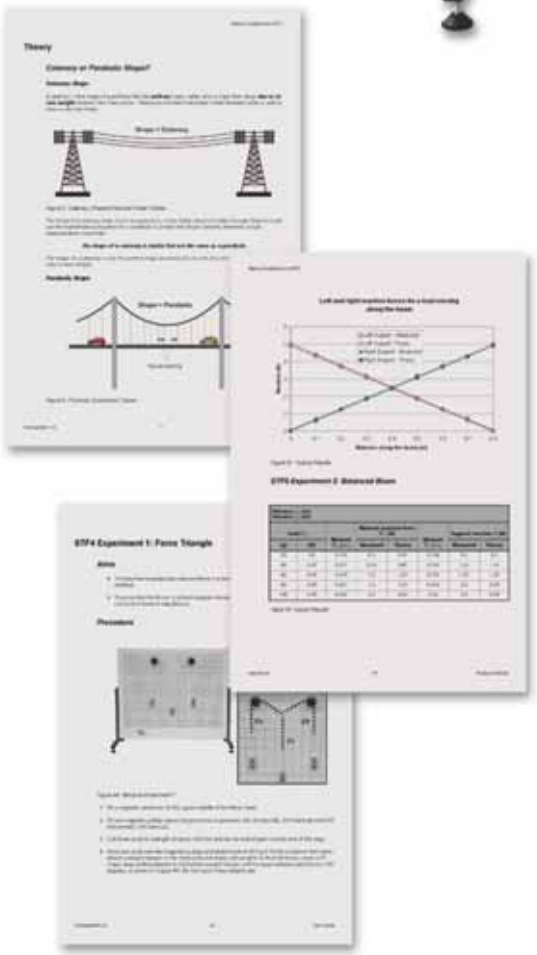
Each experiment kit fits onto a common work panel. This allows the selection of just one work panel shared between all four kits or a work panel for each kit.

VISUAL AND HANDS-ON

The Statics Fundamentals products continue TecQuipment's core value of creating 'hands-on' equipment. Students or teachers assemble and adjust the parts for highly visual and tactile experiments.



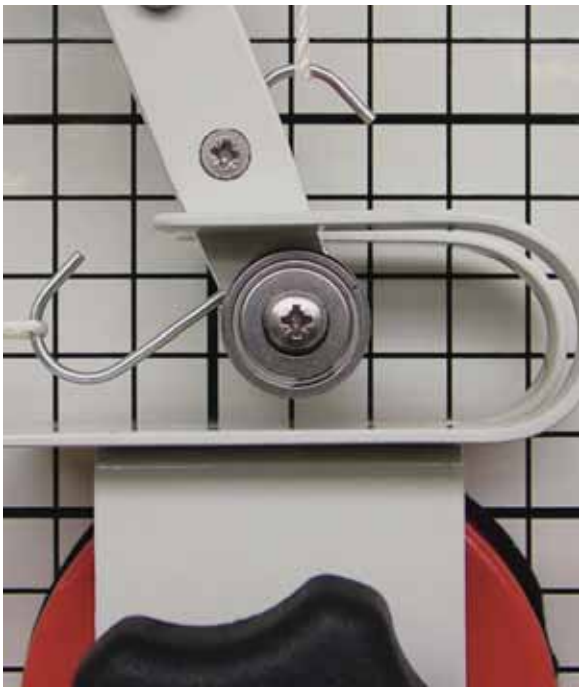
A STATICS FUNDAMENTALS EXPERIMENT KITS FITTED TO THE WORK PANEL



EACH KIT IS SUPPLIED WITH A FULLY ILLUSTRATED USER GUIDE CONTAINING THEORY, EXPERIMENTS AND TYPICAL RESULTS.

KEY FEATURES AND BENEFITS:

- **FLEXIBILITY:** Share one work panel between experiments kits, or one work panel for each kit.
- **HANDS-ON:** Large tactile parts for students to fit and adjust.
- **HIGHLY VISUAL:** For classroom demonstrations or groups of students.

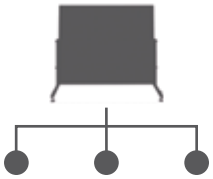


STI
STATICS WORK PANEL

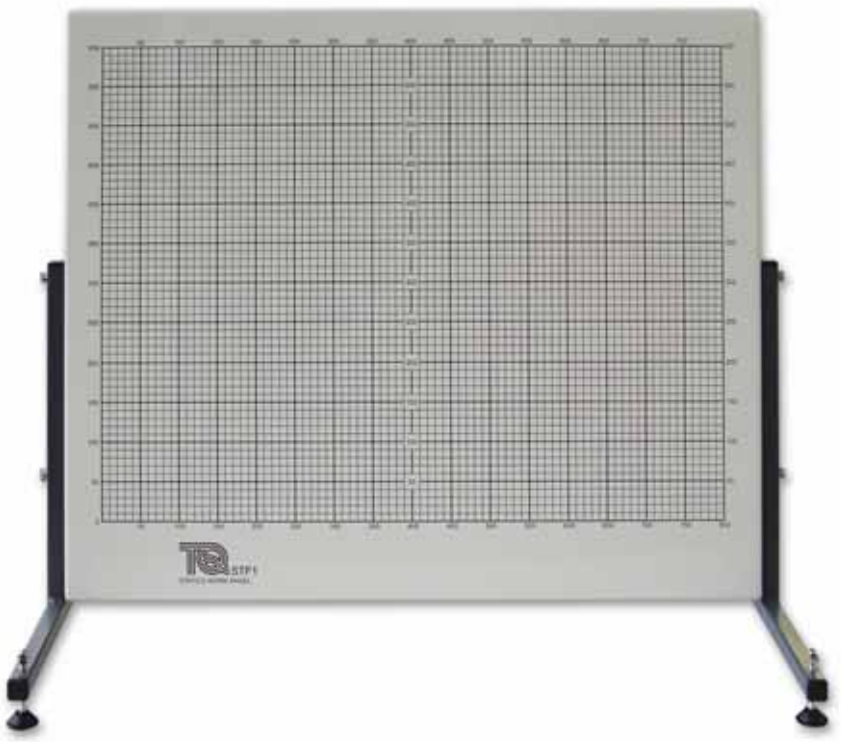
Work panel for use with TecQuipment's Statics Fundamentals (STF) range.

MODULAR SYSTEM

ESSENTIAL BASE UNIT (STF1)



EXPERIMENT MODULES
(STF2-STF5)

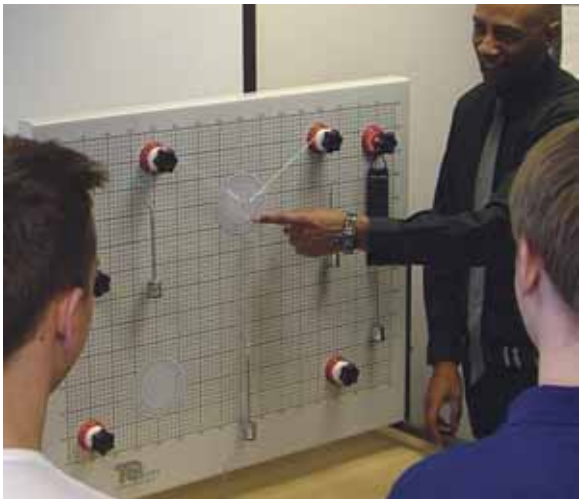


FEATURES:		BENEFITS:
Supports four different experiment kits	→	Modular design saves space and reduces costs
Large working area	→	Ideal for classroom demonstrations
Clear metric grid	→	Repeatable positioning of parts with accurate results
Easy set-up – all experiment kits can be removed and fitted in minutes	→	Maximises experiment time
Highly visual, hands-on design	→	Improves student understanding, even with a large class

For use with TecQuipment's Statics Fundamentals range, the work panel fits on most desk or bench tops. Students or teachers fit the magnetic parts of their Statics Fundamentals kits to the work panel to study or demonstrate one of the fundamental topics of static forces.

AVAILABLE EXPERIMENT KITS:

- Suspension Cable Demonstration (STF2) 180
- Equilibrium of a Rigid Body (STF3) 180
- Equilibrium of Forces (STF4) 181
- Equilibrium of a Beam (STF5) 181



STF2

SUSPENSION CABLE DEMONSTRATION

Demonstrates the tensions and shapes in a suspension cable, comparing them with theory.

LEARNING OUTCOMES:

- Analysis using catenary and parabola theory
- Cable weight and tension
- Comparison of a symmetrical suspension cable and catenary
- Unsymmetrical suspension cable
- A point load on a suspension cable

For use with the Work Panel (STF1), the kit allows several experiments with a suspension cable. Students or teachers fit the magnetic parts of the kit to the work panel to study or demonstrate the shapes and tensions in a suspension cable.

ESSENTIAL BASE UNIT:

- Work Panel (STF1) 179

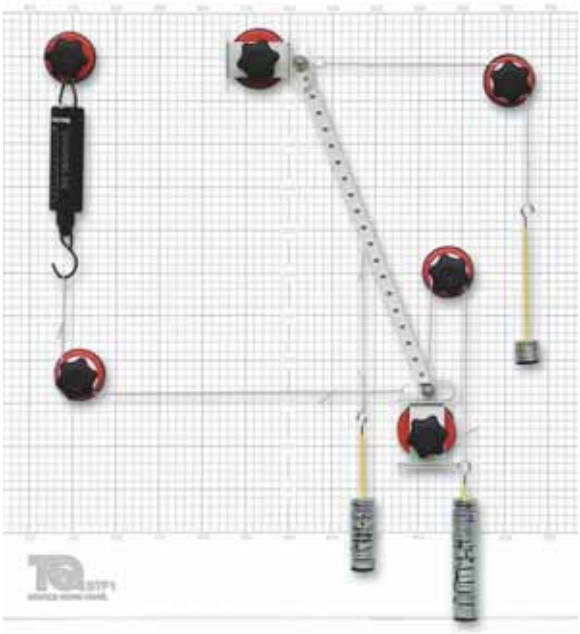
ALTERNATIVE PRODUCTS:

- Simple Suspension Bridge (STR19) 194

STF3

EQUILIBRIUM OF A RIGID BODY

Demonstrates the forces around a ladder-type structure.



LEARNING OUTCOMES:

- Horizontal and vertical reaction forces on a ladder
- Safe angles for a ladder
- A climbing mass on a ladder
- A ladder at different angles

For use with the Work Panel (STF1), the kit allows several experiments with a rigid body – a ladder structure. Students or teachers fit the magnetic parts of the kit to the Work Panel (STF1) to study or demonstrate the forces around an inclined ladder-type structure.

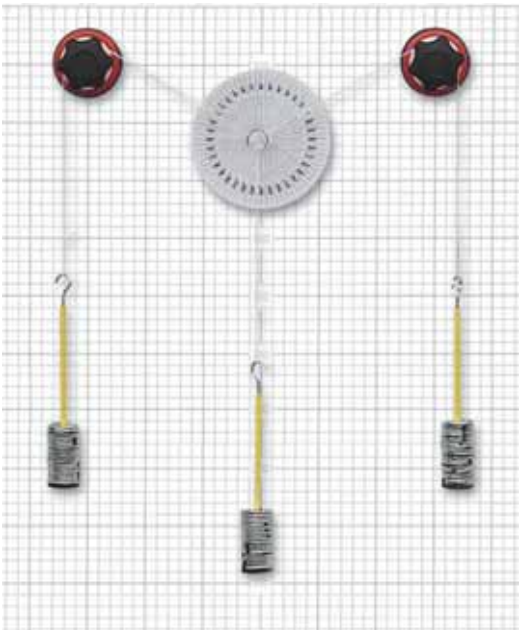
ESSENTIAL BASE UNIT:

- Work Panel (STF1) 179

STF4

EQUILIBRIUM OF FORCES

For experiments with three or more coplanar forces at equilibrium.



LEARNING OUTCOMES:

- Concurrent and non–concurrent coplanar forces
- An introduction to Bow's notation and graphical analysis
- Force triangles, polygons and link polygons

For use with the Work Panel (STF1), the kit allows several experiments with forces pulling on one or more points at different angles. Students or teachers fit the magnetic parts of the kit to the Work Panel (STF1) to study or demonstrate three coplanar concurrent forces (triangle of forces) or more (force polygons).

ESSENTIAL BASE UNIT:

- Work Panel (STF1) 179

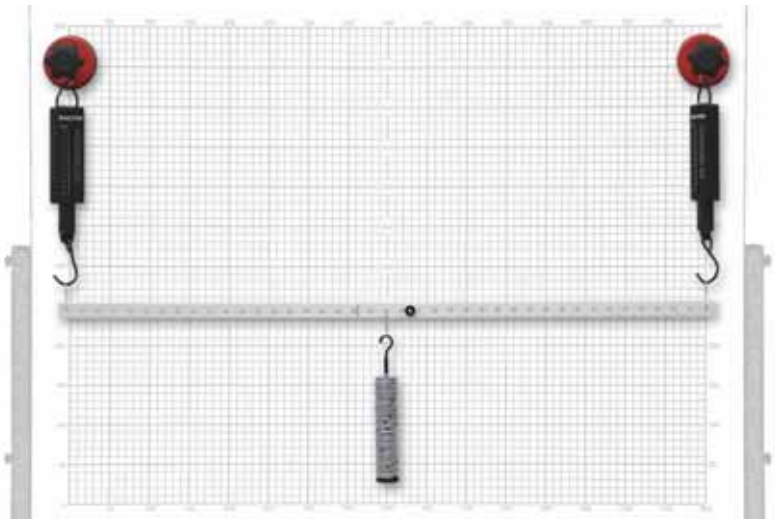
ALTERNATIVE PRODUCTS:

- Forces Kit (ES2) 8

STF5

EQUILIBRIUM OF A BEAM

For experiments with forces, moments and reactions around a beam at equilibrium.



LEARNING OUTCOMES:

- Using moments and the theory of equilibrium to find beam reaction and other unknown forces
- Simply-supported beams
- Balanced beams

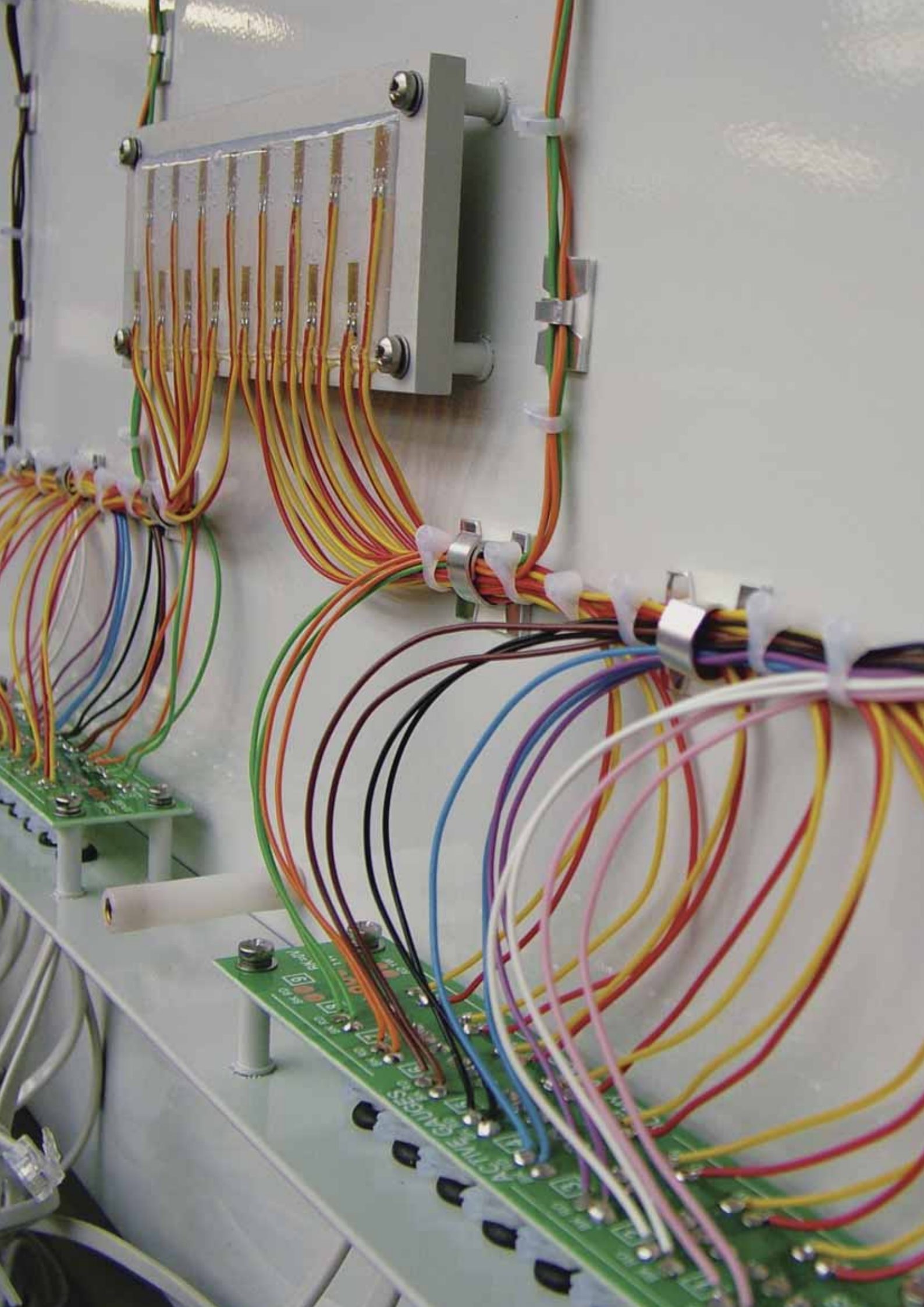
For use with the Work Panel (STF1), the kit allows several experiments with a rigid beam. Students or teachers fit the magnetic parts of the kit to the Work Panel (STF1) to study or demonstrate forces, moments and reaction forces around a rigid beam at equilibrium.

ESSENTIAL BASE UNIT:

- Work Panel (STF1) 179

ALTERNATIVE PRODUCTS:

- Moments Kit (ES3) 9



STRUCTURES

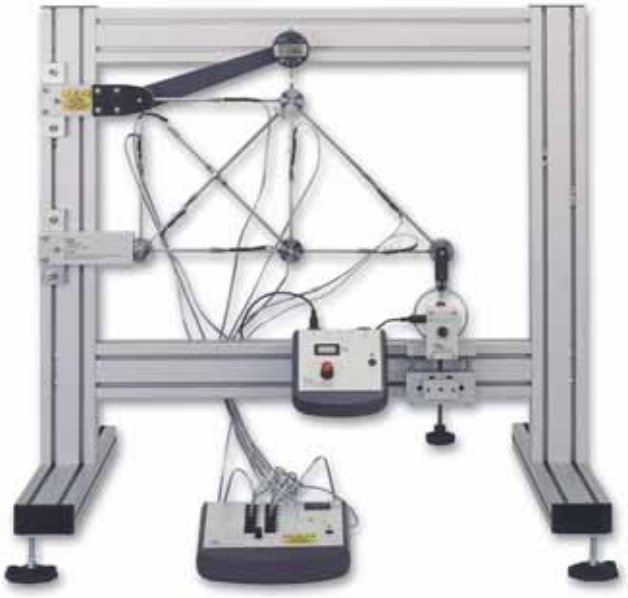
SUPPORT EQUIPMENT AND ANCILLARIES	186
SOFTWARE	188
ARCHES, BRIDGES AND TRUSSES	189
FAILURE	195
DEFLECTIONS AND STRESS	198
MOMENTS	204
TORSION	207

“

Tecquipment’s Structures line was chosen to enhance the learning experience of our engineering students. The products were delivered in a timely manner and were easy to set up. After-sales support has been very accommodating, allowing us to modify the experiment manuals as we saw fit, giving us flexibility in learning objectives. Students have shown great interest and have found operating the units to be easy and simple.

RIAD RAJAB
YORK UNIVERSITY, ONTARIO, CANADA

STRUCTURES



Our modular Structures range offers a cost-effective, flexible teaching system that we believe is the most advanced in its field.

The range teaches basic principles to more advanced theory for students of mechanical, civil and structural engineering. It has 19 desk-mounted hardware experiment modules supported by full automatic data acquisition, and TecQuipment's powerful and popular Structures Software (STRS).

The hardware modules and the Structures Software can be used together or as stand-alone products. However, using both with automatic data acquisition gives a powerful teaching solution.

In addition, the products include a full selection of user guides, student guides, lecturer guides, textbook and other supporting material.

FLEXIBLE AND MODULAR

- Experiment modules and instrumentation fix easily to the test frame.
- Easily removeable and changeable experiments, making good use of laboratory space.
- The modularity of the range allows for expansion as required.

AUTHENTIC SOFTWARE SIMULATION

- The Structures Software offers an affordable and effective method for students to quickly learn structures principles by performing virtual experiments on a computer.
- Allows students the flexibility of working away from the laboratory.
- Expands experiments beyond the limits of the hardware.

AUTOMATIC DATA ACQUISITION

- The use of automatic data acquisition and digital instrumentation means students can get quick and accurate results, optimising laboratory time.
- There are no difficult-to-read instruments or abstract experiment set-ups to distract students.

HIGH FUNCTIONALITY, AFFORDABLY PRICED

- One experiment can demonstrate several principles, for excellent value.
- Extensive experiment capabilities and choice of hardware and software, mean our Structures range provides an unsurpassed teaching solution at an unbeatable price.

THE STRUCTURES TEST FRAME (STR1)

This strong, sturdy and bench-mounted test frame holds the interchangeable experiment modules and instruments of TecQuipment's Structures range.

INCLUDES TEXTBOOK

THE EXPERIMENT MODULES (STR2-STR20)

Interchangeable experiment modules give realistic and verifiable experiment results.

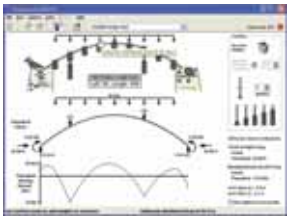
AUTOMATIC DATA ACQUISITION UNIT (STR2000)

Links to load cells and other instruments in the Structures range to send data to a suitable computer.

INCLUDES STRUCTURES SOFTWARE (STRS)

STRUCTURES SOFTWARE (STRS)

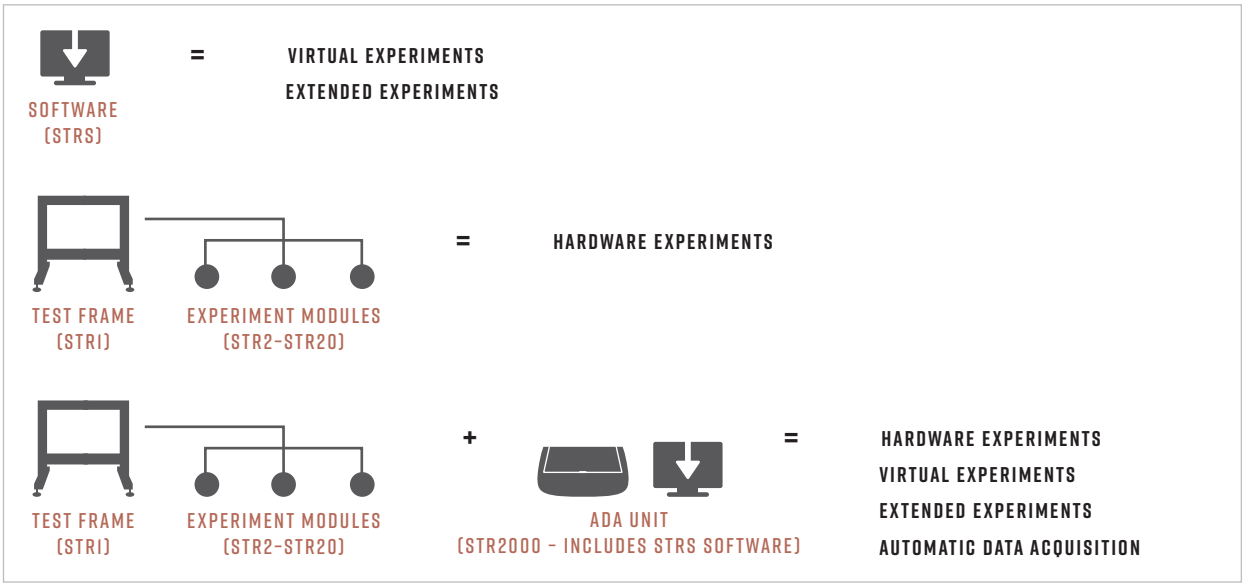
The software accurately simulates all 19 experiment modules on a suitable computer without the need of the Structures hardware.



INCLUDES EXTENSIVE USER GUIDES AND EXAMPLE EXPERIMENTS

ORDERING

The modular nature of our Structures range means parts can be chosen to create the right combination of products that best suits teaching needs.



BUNDLES

Alternatively, the following bundles are available which offer great value for money.

Each bundle is supplied with **all the hardware needed for the use of the included 25 seat Structures Software**:

ARCHES, BRIDGES AND TRUSSES BUNDLE (STRA)

- Pin-jointed Frameworks (STR8) 189
- Three-Pinned Arch (STR9) 190
- Two-Pinned Arch (STR10) 191
- Fixed Arch (STR11) 192
- Redundant Truss (STR17) 193
- Simple Suspension Bridge (STR19) 194

FAILURE BUNDLE (STRC)

- Euler Buckling of a Column (STR12) 195
- Plastic Bending of Beams (STR15) 196
- Plastic Bending of Portals (STR16) 197

DEFLECTIONS AND STRESS BUNDLE (STRB)

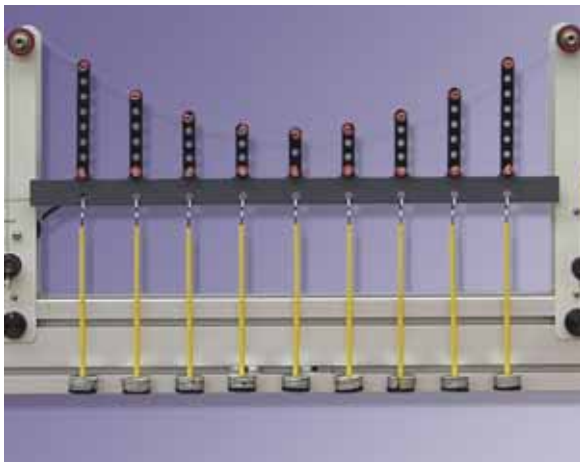
- Deflection of Beams and Cantilevers (STR4) 198
- Bending Stress in a Beam (STR5) 199
- Continuous and Indeterminate Beams (STR13) 200
- Curved Bars and Davits (STR14) 202
- Frame Deflections and Reactions (STR18) 203

MOMENTS BUNDLE (STRD)

- Bending Moments in a Beam (STR2) 204
- Shear Force in a Beam (STR3) 205
- Bending Moments in a Portal Frame (STR20) 206

TORSION BUNDLE (STRE)

- Torsion of Circular Sections (STR6) 207
- Unsymmetrical Bending and Shear Centre (STR7) 208



STRI

STRUCTURES TEST FRAME

A strong frame that holds the experiments of TecQuipment's Structures range.

- Holds the interchangeable experiment modules and instruments of TecQuipment's Structures range
- Strong, bench-mounted frame
- Easy-to-use fixings and slots so students can quickly set up, remove or change experiments
- Also ideal for holding experiments during storage
- Includes textbook with full theory and explanations of different structures

A lightweight yet strong bench-mounted frame that holds interchangeable experiment modules and instrumentation from the TecQuipment Structures range.

AVAILABLE EXPERIMENT MODULES:

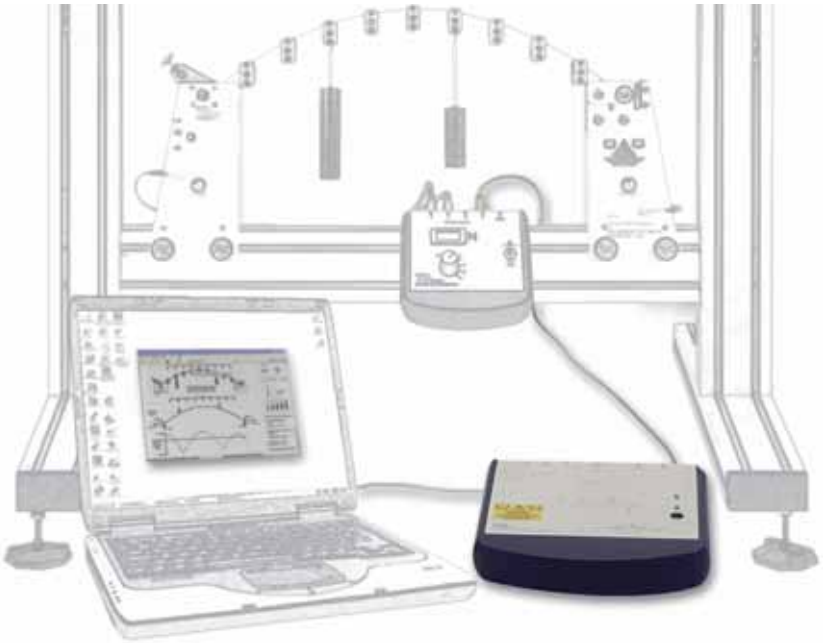
- One or more Structures experiment modules (STR2–STR20) 189–208

TEST FRAME (STRI) FITTED WITH THE EXPERIMENT MODULE BENDING STRESS IN A BEAM (STR5) AND DIGITAL FORCE DISPLAY (STRIA)

STR2000
AUTOMATIC DATA ACQUISITION UNIT

Connects any of the Structures range experiments to a computer – includes TecQuipment's Structures Software for automatic data acquisition and virtual experiments.

- Interface unit links to load cells and other instruments in the Structures range to send data to a suitable computer
- Allows students to compare results from actual experiments with results from simulation software
- Fully automatic and simple connection to most modern computers – no need to add any extra circuit boards



THE STR2000 COMPUTER INTERFACE UNIT SHOWN TRANSMITTING DATA FROM ONE OF THE STRUCTURES HARDWARE EXPERIMENT MODULES TO THE STRUCTURES SOFTWARE

ESSENTIAL ANCILLARIES:

- Suitable computer (not supplied by TecQuipment)

ANCILLARY FOR:

- One or more experiment modules from the Structures range (STR2–STR20) 189–208

STRIA
DIGITAL FORCE DISPLAY

For use with TecQuipment's Structures range, this display shows the forces from up to four force sensors on the Structures experiments.

- Fits onto the Structures Test Frame (STR1) to give a tidy work area
- Real-time display of each of up to four forces
- Can connect to TecQuipment's Automatic Data Acquisition Unit (STR2000) to automatically measure all four forces at the same time

ANCILLARY FOR:

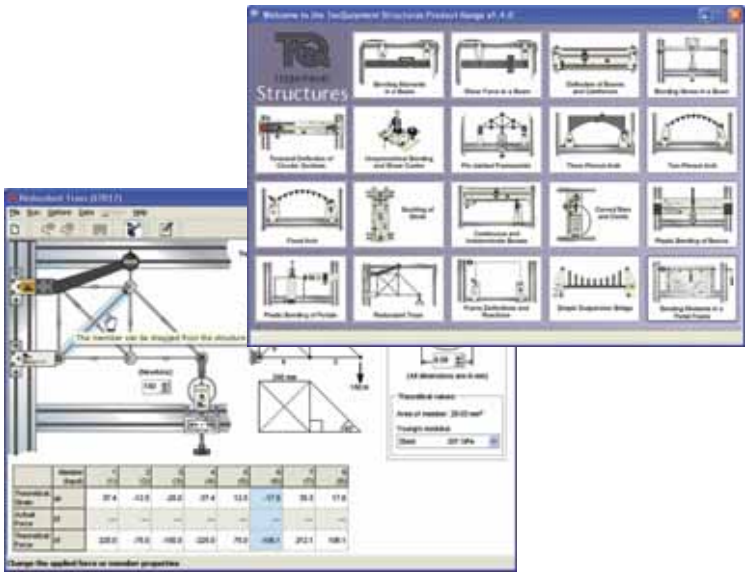
- One or more Structures experiment modules (STR2–STR20) 189–208

STRS

STRUCTURES SOFTWARE

Software that allows computer simulation of structures. Simulates and extends TecQuipment's Structures range.

- Accurately simulates all 19 of TecQuipment's Structures range experiments
- Includes user guides with suggested experiments and typical answers
- Gives virtual experiments that extend beyond the limits of the experiment hardware
- Single-user and networked options available



LEARNING OUTCOMES:

Computer-simulated examination of a wide variety of structures principles, including:

- Bending moments in a beam
- Shear force in a beam
- Deflection of beams and cantilevers
- Bending stress in a beam
- Torsional deflection of circular sections
- Unsymmetrical bending and shear centre
- Pin-jointed frameworks
- Three-pinned arch
- Two-pinned arch
- Fixed-arch
- Euler buckling of a column
- Continuous and indeterminate beams
- Curved bars and davits
- Plastic bending of beams
- Plastic bending of portals
- Redundant truss
- Frame deflections and reactions
- Simple suspension bridge
- Bending moments in a portal frame

SEE FOR YOURSELF!

DOWNLOAD A DEMONSTRATION VERSION FROM THE "RESOURCES" PAGE OF OUR WEBSITE

TecQuipment's Structures Software is ideal for students of civil, mechanical and structural engineering. It allows them to perform computer-simulated experiments which study the principles of structures.

NOTE: The Structures Software (STRS) can be bought by itself, but it is also included free with the Automatic Data Acquisition Unit (STR2000) – **SEE PAGE 187**.

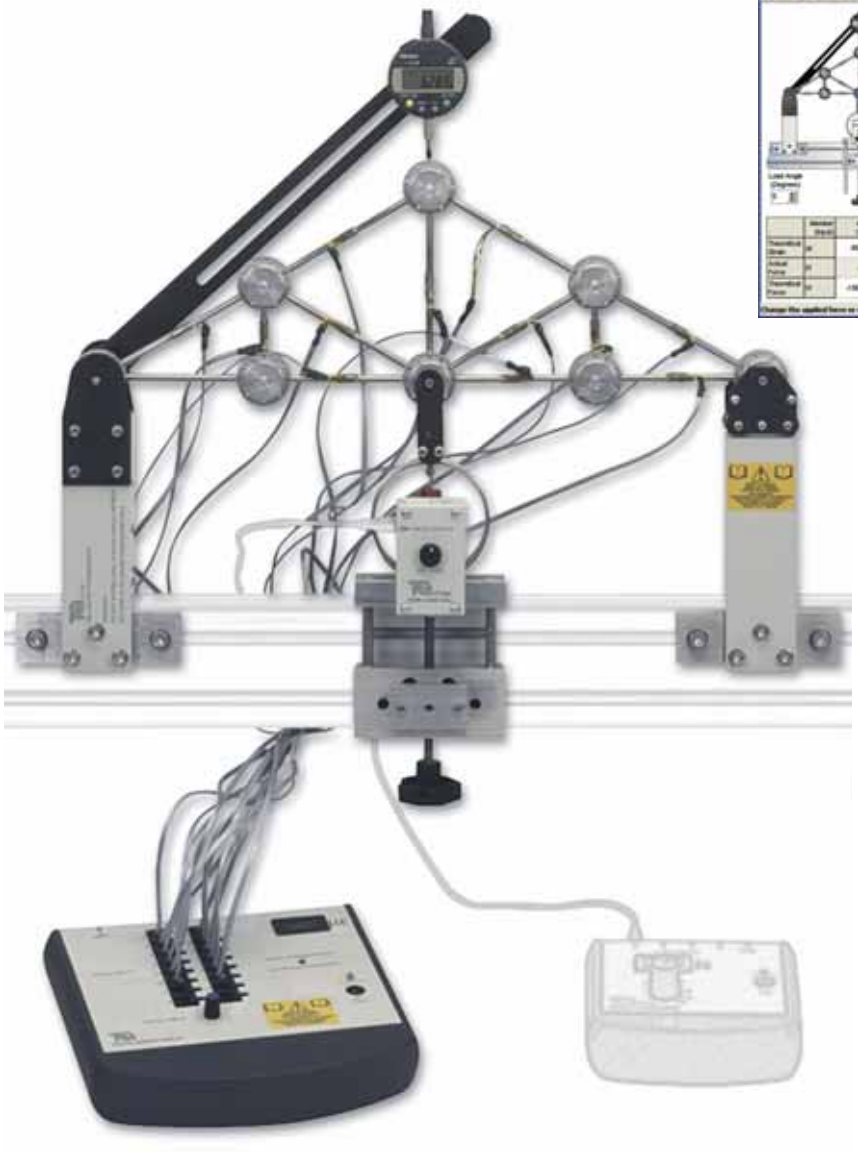
ESSENTIAL ANCILLARIES:

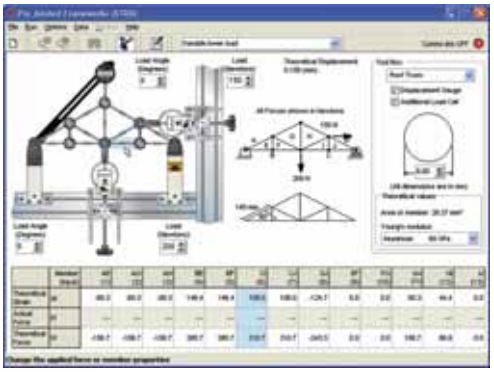
- Suitable computer (not supplied by TecQuipment)

STR8

PIN-JOINTED FRAMEWORKS

For the study of strains, stresses, forces and deflections in various pin-jointed frameworks.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

- Study of Bow's notation, strains, stresses, forces and deflections in various frameworks, including a Warren girder and roof truss
- Comparison of different frameworks

Students use stainless-steel members to build different pin-jointed frameworks. The equipment includes two framework supports: a pivoting support, and a pivoting and rolling support. Each member has a strain gauge attached that connects to a digital strain bridge. Load cells measure the load applied at various angles. A second load cell can be fitted to simulate lateral forces on the truss (STR8a).

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187
- Additional Load Cell (STR8a)

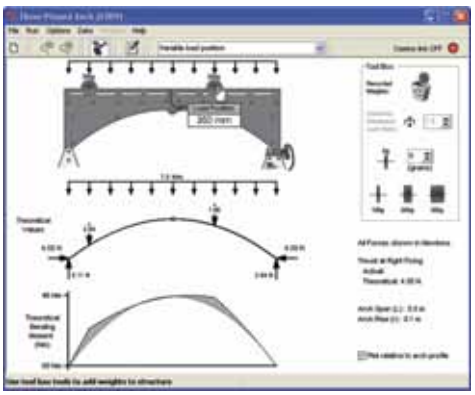
ALTERNATIVE PRODUCTS:

- Redundant Truss (STR17) 193

STR9

THREE-PINNED ARCH

For the study of the characteristics of a three-pinned arch under various load conditions.



SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

Students apply various loads at set positions along the top of a simple 'determinate' three-pinned arched structure. They can also apply a uniformly distributed load. A load cell measures the thrust reaction.

LEARNING OUTCOMES:

Studies of:

- The characteristics of a three-pinned arch
- The relationship between applied loads and horizontal thrust produced from a simple determinate arched structure

Also:

- Appreciation of footing stability and economy.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

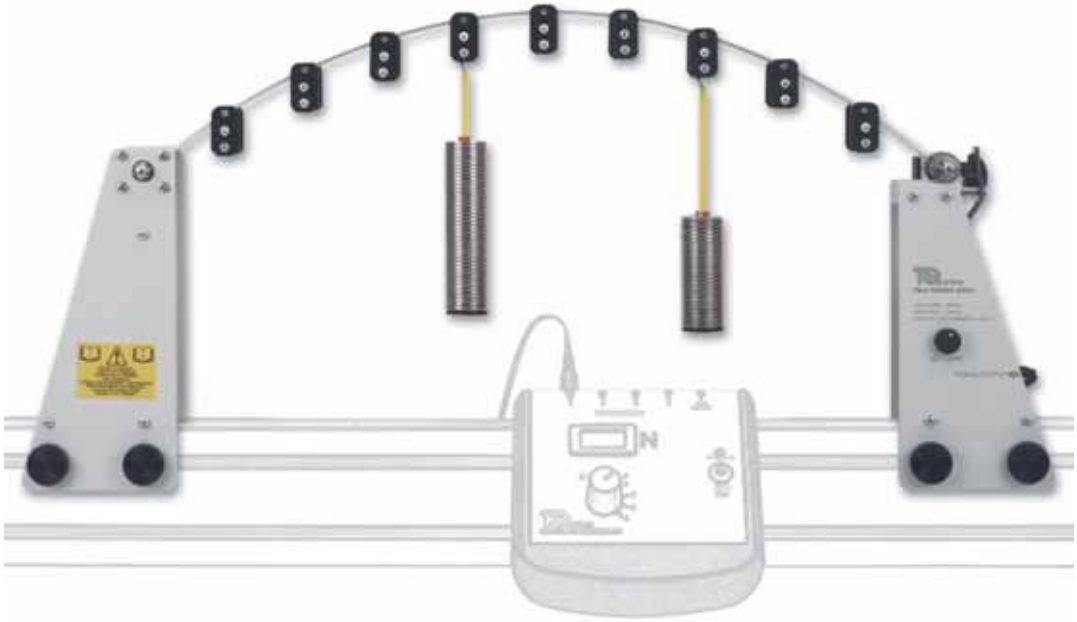
ALTERNATIVE PRODUCTS:

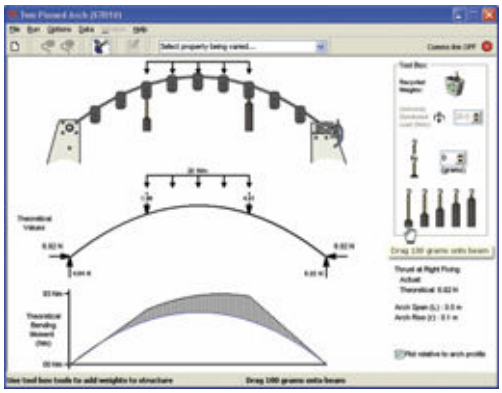
- Two-Pinned Arch (STR10) 191
- Fixed Arch (STR11) 192

STR10

TWO-PINNED ARCH

For studies of the characteristics of a two-pinned arch under various load conditions.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

- Demonstration of the characteristics of a two-pinned arch
- Examination of the relationship between applied loads and horizontal thrust produced from a redundant (in one degree) arched structure
- Comparison of behaviour to simplified theory based on the Secant assumption

Students use masses on weight hangers to apply various loads to the arch at set positions along its span. A load cell measures the thrust reaction.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

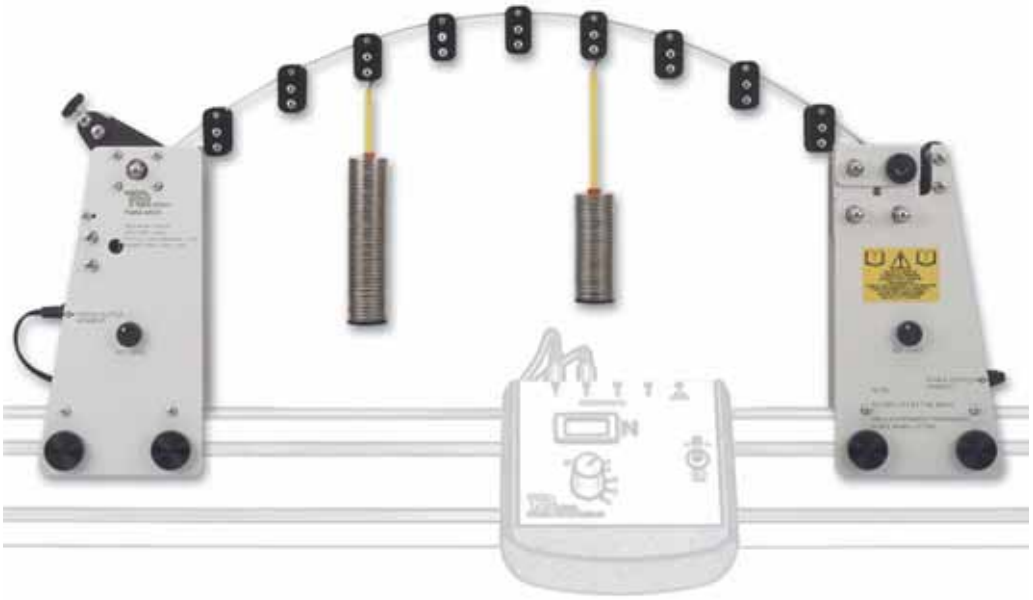
ALTERNATIVE PRODUCTS:

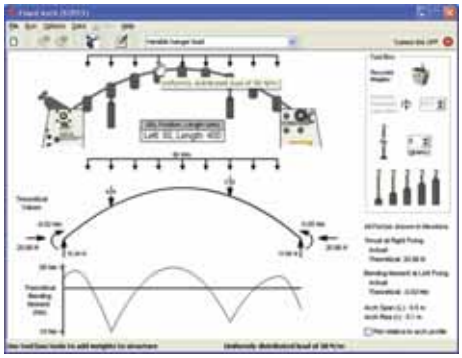
- Three-Pinned Arch (STR9) 190
- Fixed Arch (STR11) 192

STR11

FIXED ARCH

For the study of the characteristics of a fixed arch under various load conditions.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

- Demonstration of the characteristics of a fixed arch
- Examination of the relationship between applied loads, horizontal thrust and fixing moment produced from a fixed (thus redundant in three degrees) arched structure.
- Comparison of behaviour to simplified theory based on the Secant assumption.

To load the arch, students fit masses on weight hangers to set positions along the arch span. Load cells measure the fixed moment reaction and horizontal thrust.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

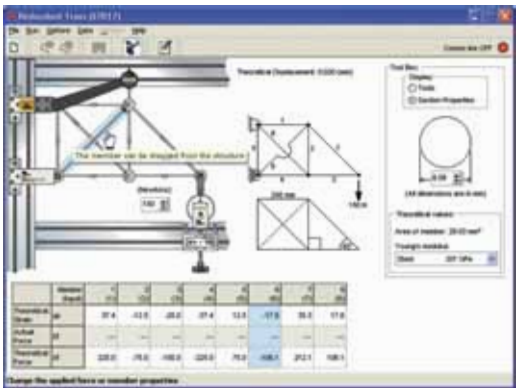
ALTERNATIVE PRODUCTS:

- Three-Pinned Arch (STR9) 190
- Two-Pinned Arch (STR10) 191

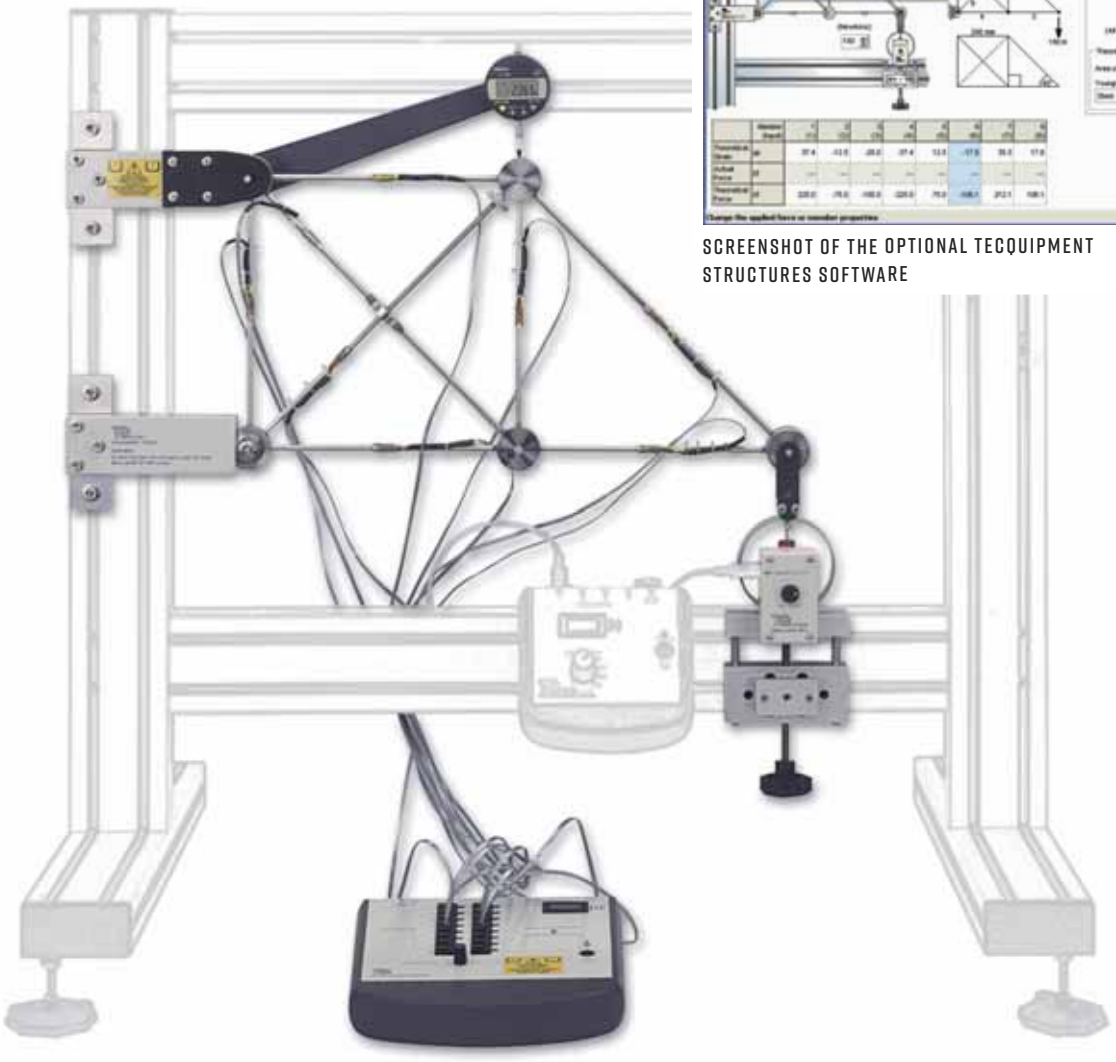
STR17

REDUNDANT TRUSS

For the study of determinate and indeterminate structures.



SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE



LEARNING OUTCOMES:

Study of strains, stresses, forces and deflections in a:

- statically determinate structure; and
- statically indeterminate structure.

Two supports hold the top and base of one side of a structure. The top support allows pivoting, the base support allows pivoting and rolling. Initially, one of the members is missing from the structure, making it determinate. To make the structure indeterminate, students refit the missing member. A load cell measures the applied force.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

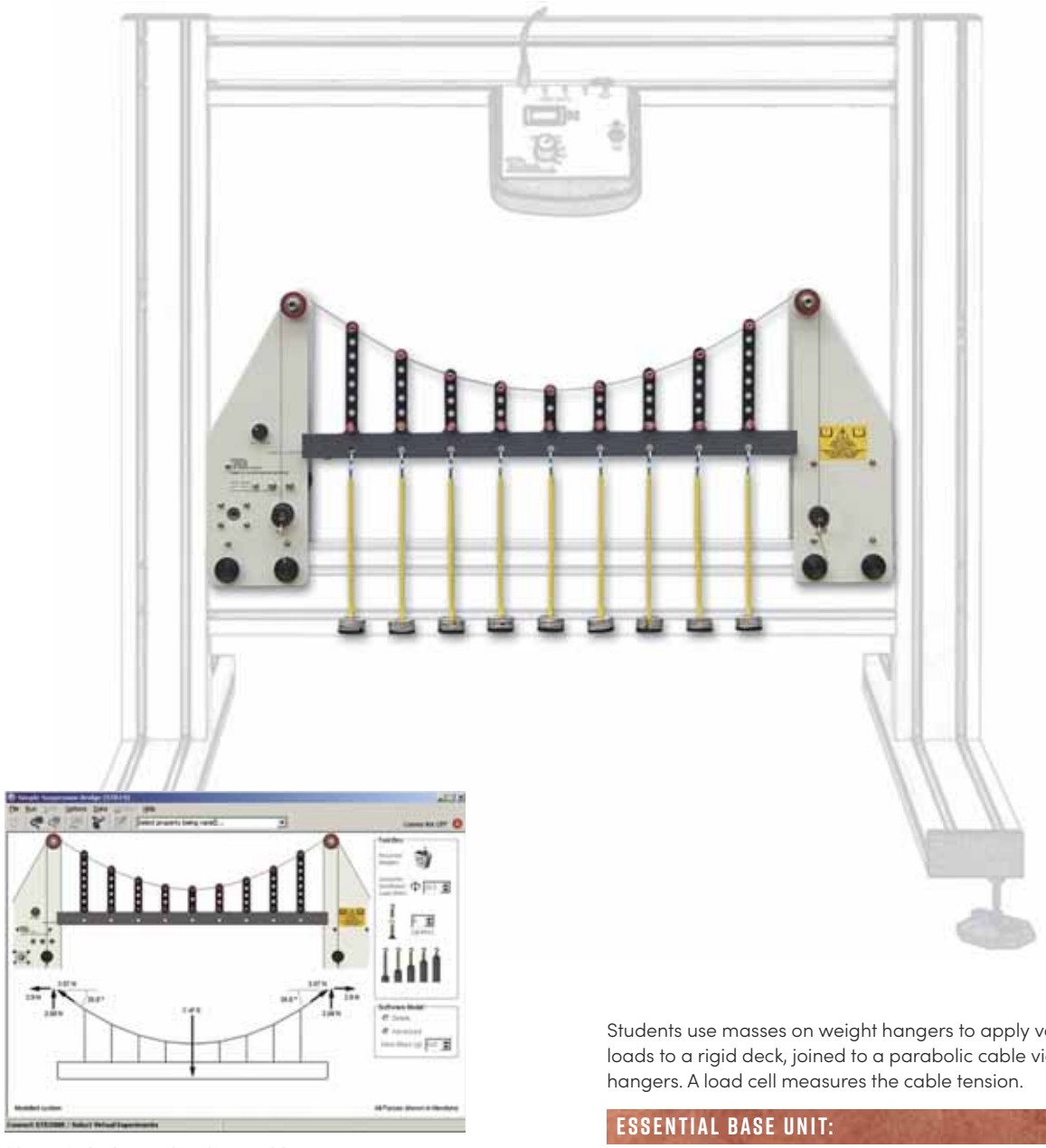
ALTERNATIVE PRODUCTS:

- Pin-Jointed Frameworks (STR8) 189

STR19

SIMPLE SUSPENSION BRIDGE

For the study of characteristics of a simple suspension bridge.



SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

Students use masses on weight hangers to apply various loads to a rigid deck, joined to a parabolic cable via hangers. A load cell measures the cable tension.

LEARNING OUTCOMES:

- Demonstration of the characteristics of a simple suspension bridge
- Examination of the relationship between applied loads and the suspension cable tension
- Observation of the stability of the structure
- Comparison of behaviour to simplified cable theory

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

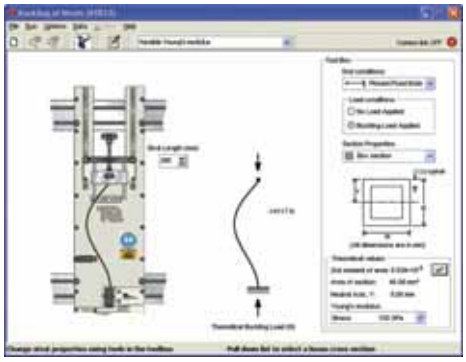
ALTERNATIVE PRODUCTS:

- Suspension Cable Demonstration (STF2) 180

STR12

EULER BUCKLING OF A COLUMN

For the study of buckling of slender columns and relationships between length, end-fixing conditions and buckling load.



SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

- Euler buckling loads
- Relationship between strut length and collapse load
- Relationship between various end-fixing conditions and collapse load
- Nature of deflection and deflected shapes with various end-fixing conditions

Students compress aluminium columns (struts) using a screw mechanism. The equipment uses chucks to hold the struts and allows different end-fixing conditions. A load cell measures the load applied to the strut.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

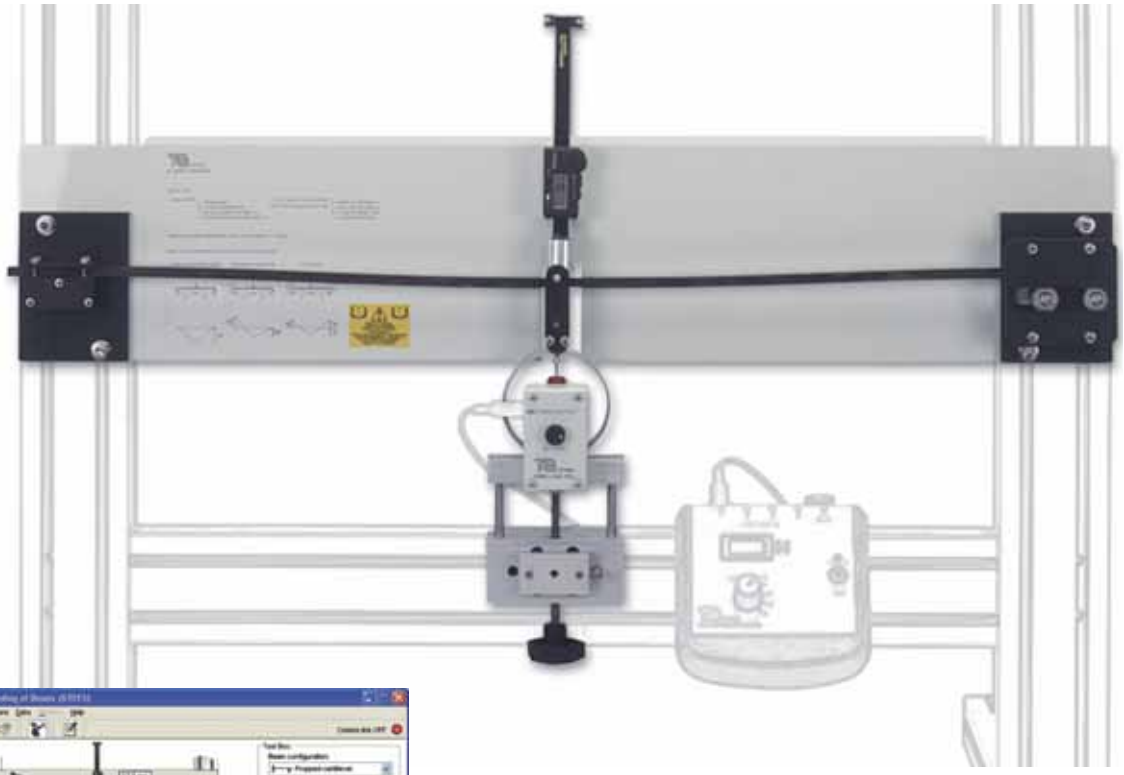
ALTERNATIVE PRODUCTS:

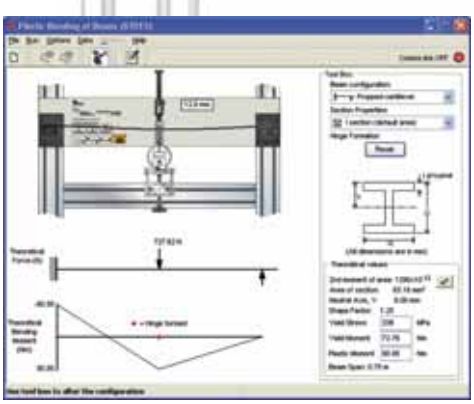
- Euler Strut Buckling Apparatus (SM1005) 175

STR15

PLASTIC BENDING OF BEAMS

Introduces students to plastic theory and limit state design.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

Students fix a specimen beam in chucks at both ends of a backboard. The chucks can either clamp the beam (encastré fixing), or hold it on a knife-edge. The students then load the beam using a screw mechanism and electronic load cell. Deflection of the structure is measured by a digital indicator.

LEARNING OUTCOMES:

- Relationship between load and deflection for beams loaded to the plastic condition
- Introduction to form factor
- Introduction to limit state design
- Relationship between maximum loading and plastic hinge formation for a simply supported beam, a propped cantilever and a fixed beam

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

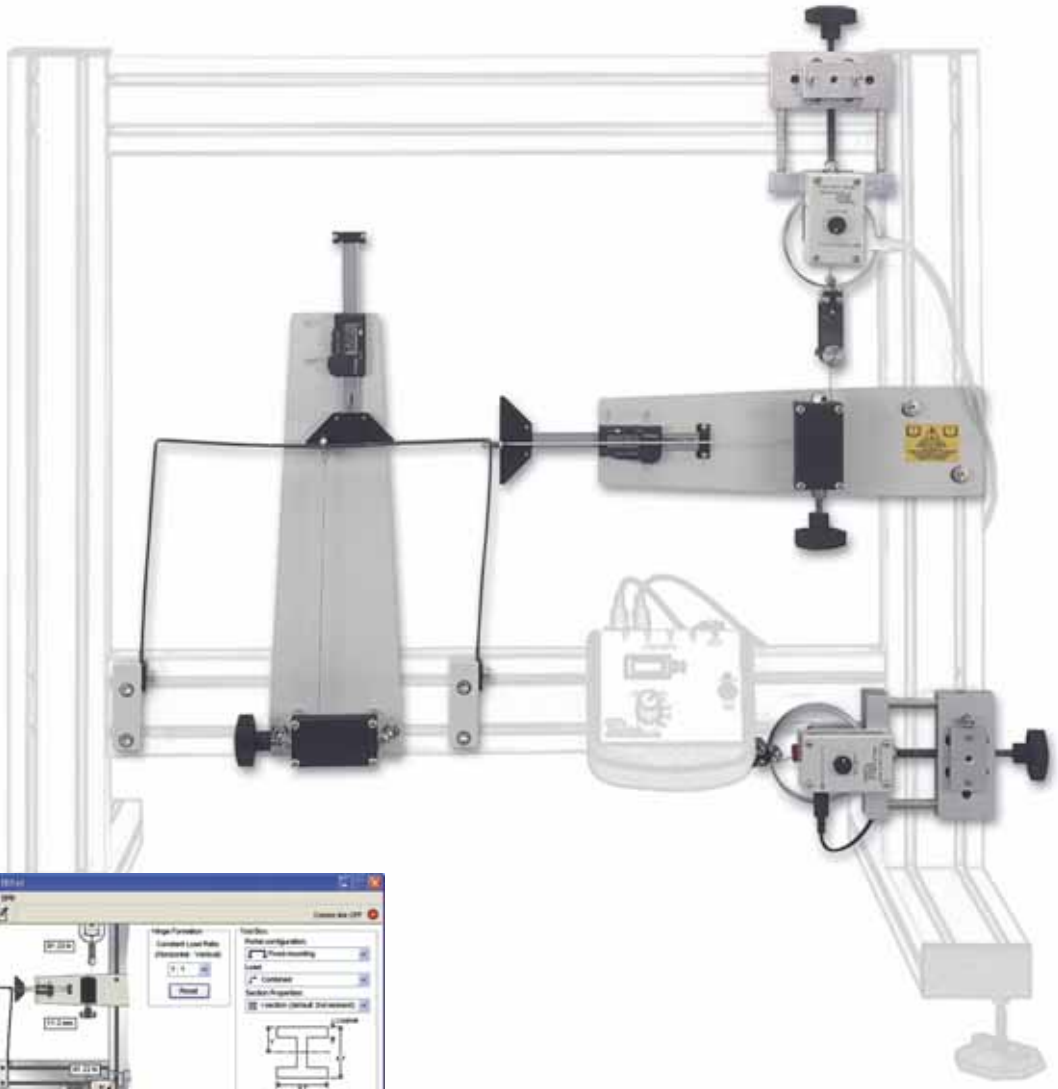
ALTERNATIVE PRODUCTS:

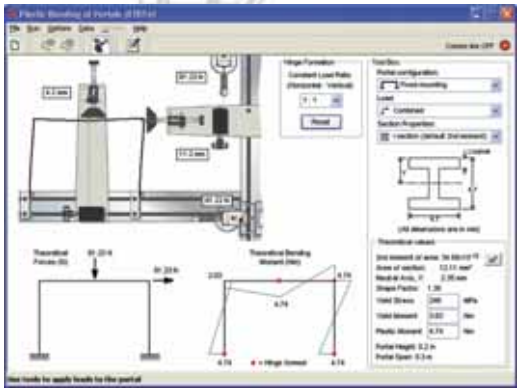
- Beam and Leaf Spring (SM1000g) 164

STR16

PLASTIC BENDING OF PORTALS

For the study of plastic theory and limit state design in portal frames.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

Students fix a specimen portal frame (two uprights with a cross-beam at the top) to the bottom cross-piece of a test frame. The test frame also holds horizontal and vertical screw mechanisms with electronic load cells for loading the portal frame. Deflection is measured by two digital indicators.

LEARNING OUTCOMES:

- Relationship between load and deflection for portal frames loaded to the plastic condition
- Introduction to limit state design
- Relationship between maximum loading and plastic hinge formation in portal frames loaded vertically from the centre, horizontally from one corner, and equally from both positions
- Interaction between horizontal and vertical loading in terms of plastic hinge position and mode of collapse

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

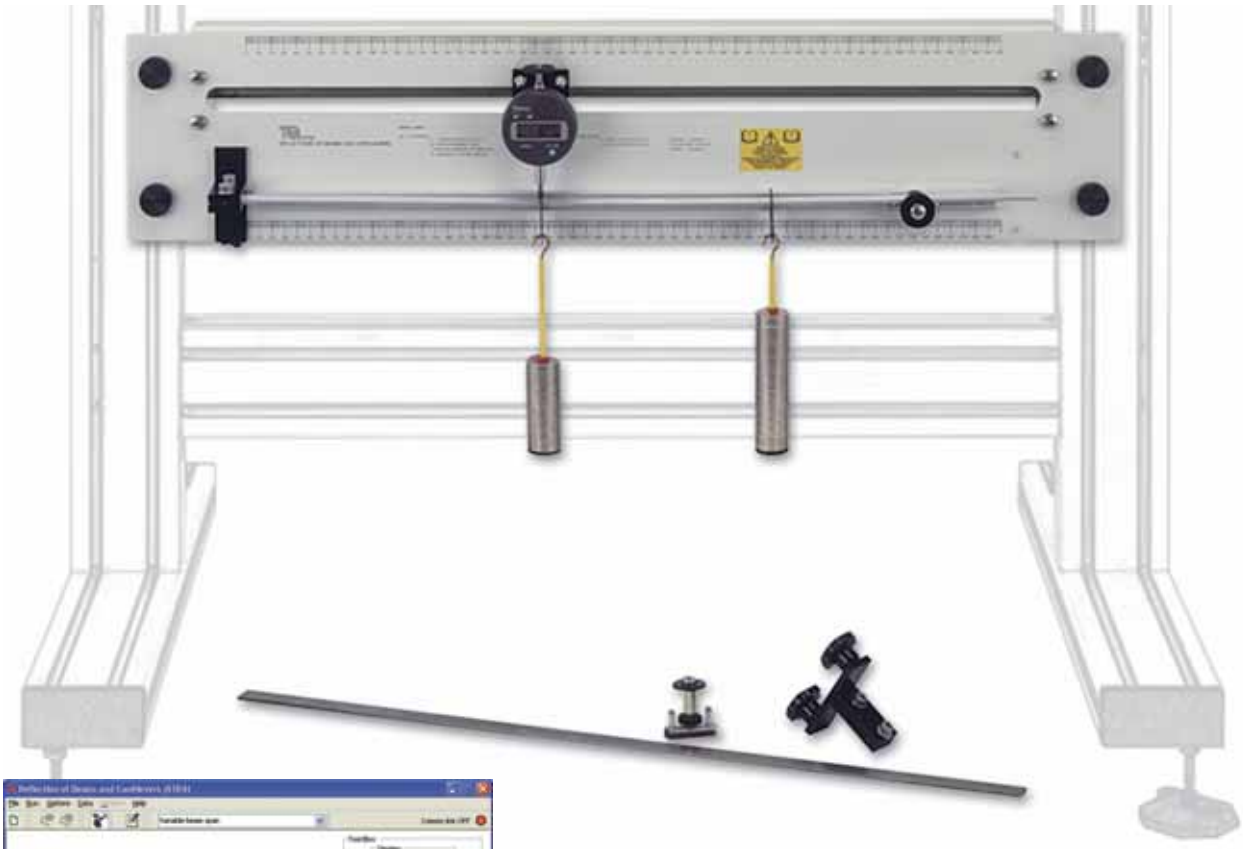
OR

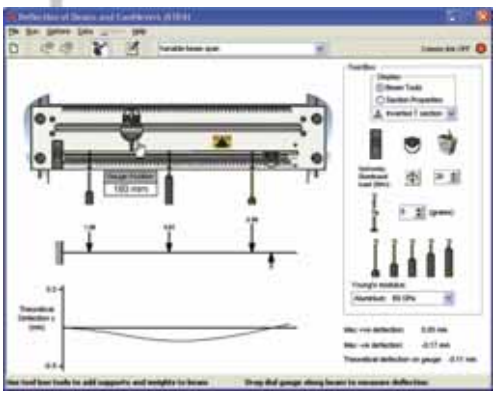
- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

STR4

DEFLECTION OF BEAMS AND CANTILEVERS

For the study of beam deflection under different loads and fixing conditions.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

EXAMINATION OF:

- Beam deflections
- General bending formulae
- Beam end rotations
- Elastic modulus (Young's modulus) for various materials

TYPICAL CONDITIONS ARE:

- Cantilever
- Propped cantilever
- Encastré beam
- Simply supported beam

The experiment hardware consists of a backboard that fixes to the Structures Test Frame (STR1, available separately). Test beams fit onto the backboard using a rigid clamp and knife-edge supports. Students apply loads at any position using hangers holding various masses. Mounted on a trammel, a digital deflection indicator traverses the beam to measure beam deflection.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

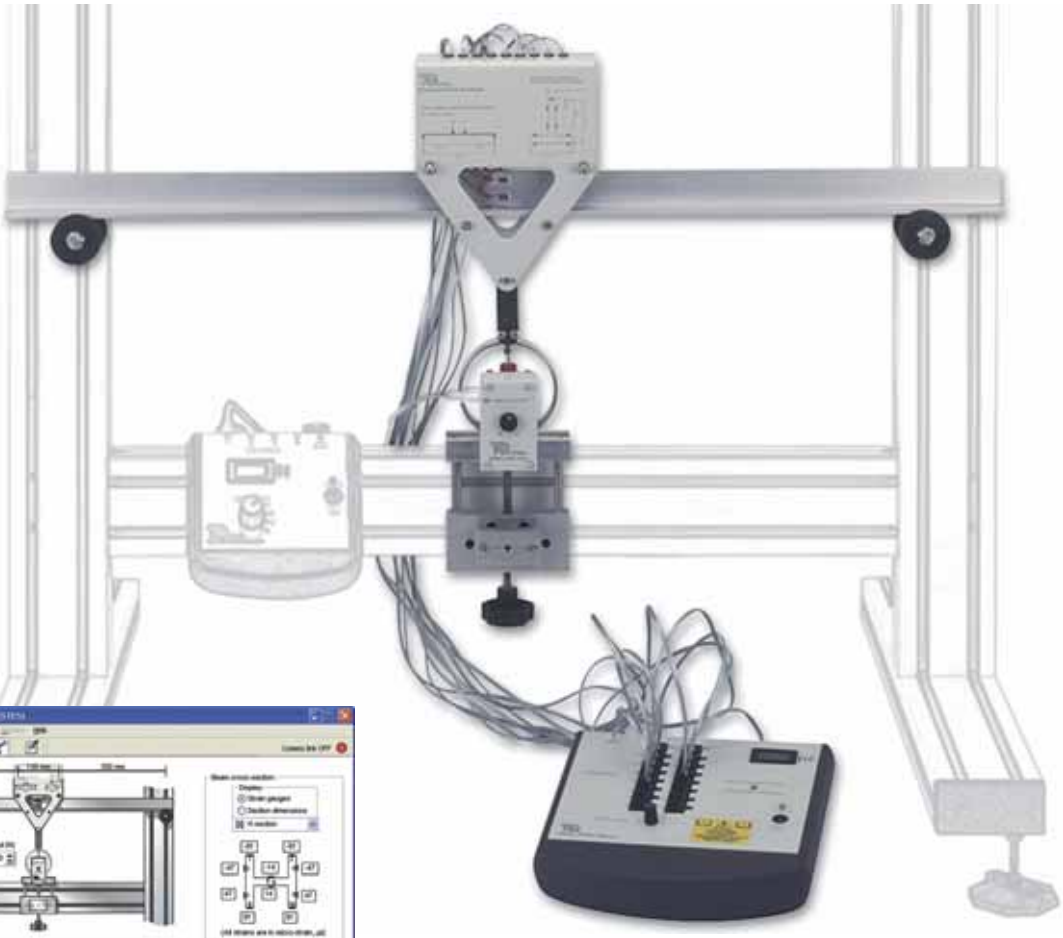
ALTERNATIVE PRODUCTS:

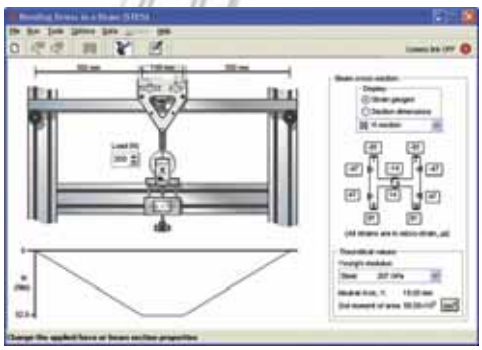
- Deflection of Beams Kit (ES4) 11
- Stiffness – Bending and Torsion (TE16) 150
- Beam and Leaf Spring (SM1000g) 164
- Beam Apparatus (SM1004) 173
- Continuous and Indeterminate Beams (STR13) 200

STR5

BENDING STRESS IN A BEAM

For the study of stress distribution across the section of a beam.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

Study of:

- Second moment of area
- Converting strains to stresses
- Strain gauges
- The neutral axis
- The bending equation

The experiment hardware is a T-beam that fits onto a Structures Test Frame (STR1, available separately). Students adjust a load cell that bends the beam and, when connected to the optional Digital Force Display (STR1a, available separately), it measures the bending force (load). Strain gauges and a digital strain bridge measure the strains in the beam. Dummy strain gauges compensate for temperature variation and balance the strain bridges.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

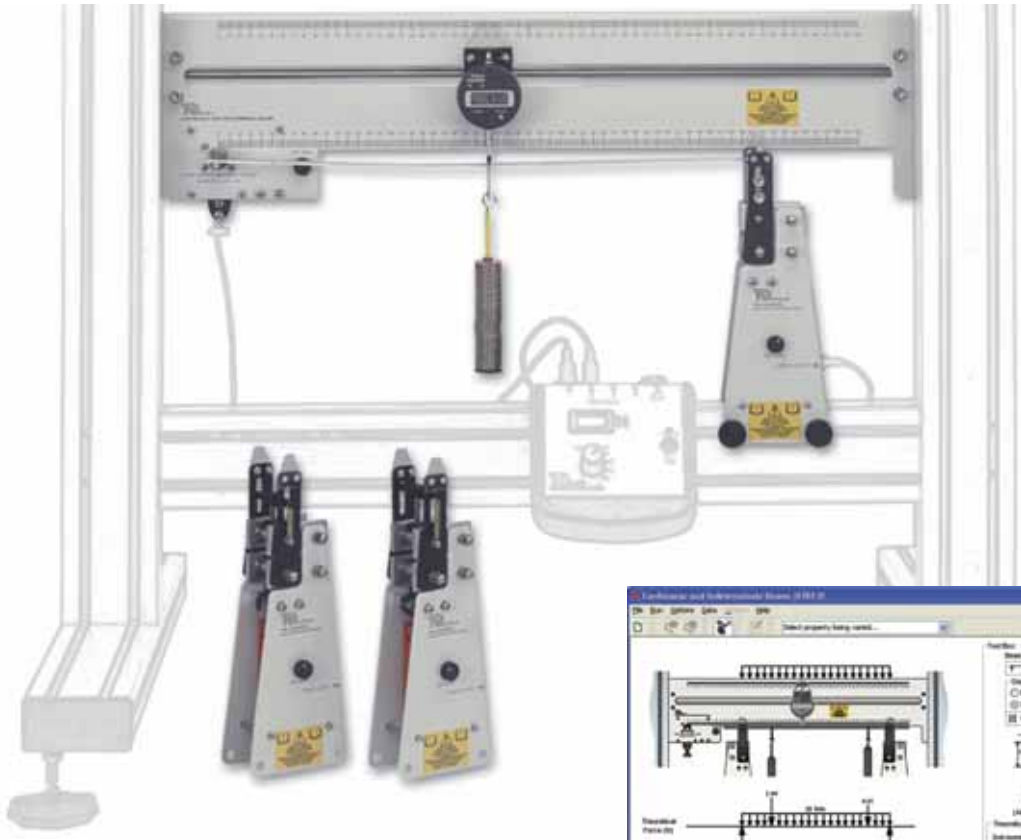
OR

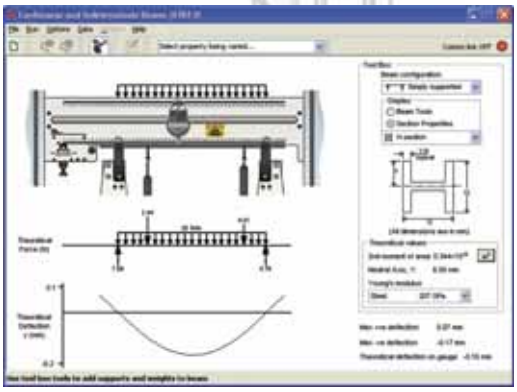
- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

STR13

CONTINUOUS AND INDETERMINATE BEAMS

Versatile equipment for a wide variety of beam experiments, from simple cases to complex problems.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

- Reactions of a simply supported beam
- Reactions of a two-span continuous beam
- Reactions and fixing moments of a fixed beam and a propped cantilever
- Reaction and fixing moment of a propped cantilever with a sinking support
- Relationship between load and deflection for beams and cantilevers

This equipment allows many possible experiment configurations, using a stiff (rigid) beam, or a significantly more flexible beam.

Students rest a beam on up to three 'piers'. The piers are movable, so students can arrange them in many different positions under the beam. Students use masses on weight hangers to load the beam. Each pier has a load cell to measure the reaction force. A flexible beam can also be attached to measure deflection or fixing moment.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

ALTERNATIVE PRODUCTS:

- Deflection of Beams Kit (ES4) 11
- Stiffness – Bending and Torsion (TE16) 150
- Beam and Leaf Spring (SM1000g) 164
- Beam Apparatus (SM1004) 173
- Deflection of Beams and Cantilevers (STR4) 198

HAVE YOU ALSO SEEN OUR MATERIALS TESTING RANGE?

OUR MATERIALS TESTING AND PROPERTIES RANGE ALSO EXTENDS INTO THE AREA OF STRUCTURES AND STRUCTURAL ELEMENTS AND INCLUDES THE FOLLOWING FREE-STANDING PRODUCTS:

UNSYMMETRICAL CANTILEVER APPARATUS (SM1003) – PAGE 172

Examines and displays bending of an unsymmetrical cantilever

BEAM APPARATUS (SM1004) – PAGE 173

Examines the deflection and forces on different types of beams for a wide range of supports and loads

EULER STRUT BUCKLING APPARATS (SM1005)

EULER STRUT BUCKLING APPARATUS (SM1005) – PAGE 175

Tests different types of struts and demonstrates how they deflect under load

VDAS®

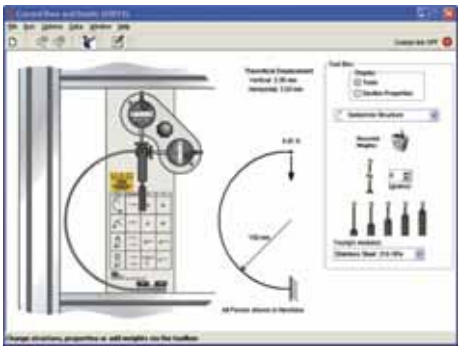
The above equipment is compatible with TecQuipment's Versatile Data Acquisition system (VDAS®). This gives accurate real-time data capture, monitoring and display, calculation and charting of all important readings on a computer – PAGE 293.

SM1003 VDAS® SCREENSHOT

STR14

CURVED BARS AND DAVITS

For students to investigate two common curved structures and two common davit structures.



SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

Investigation of the relationship between load, horizontal deflection and vertical deflection for:

- Curved davit
- Angled davit
- Semicircle structure
- Quarter-circle structure

Included with the experiment module are four different structures. Loads are then applied to the structure using masses on hangers. Deflection of the structure is measured by two digital indicators.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

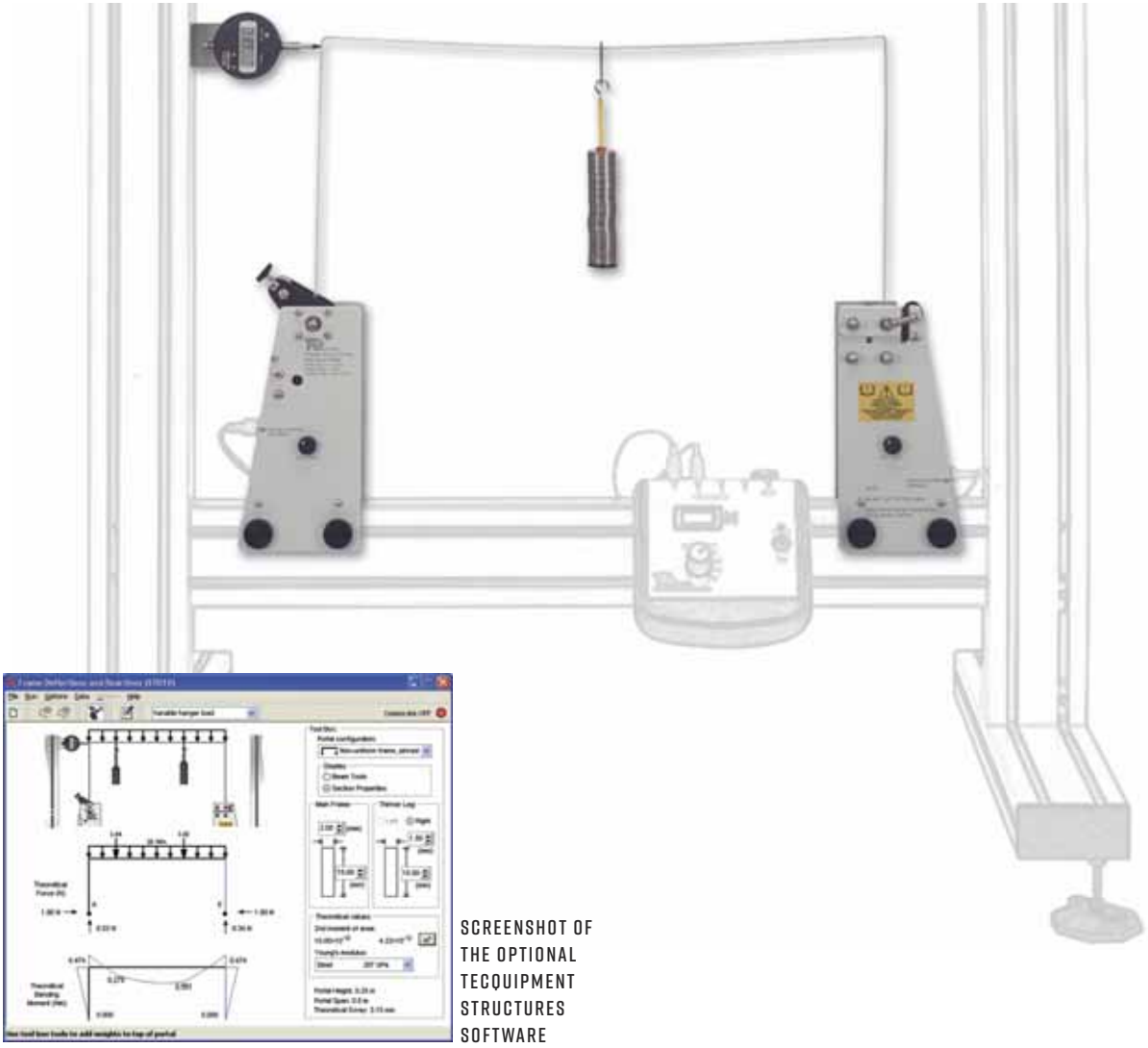
OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

STR18

FRAME DEFLECTIONS AND REACTIONS

For the study of rectangular portals subjected to vertical loads.



SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

Study and comparison of load, horizontal reactions, fixing moments, sway and shear forces in a:

- Rectangular portal with a uniform section
- Rectangular portal with a non-uniform section

The hardware includes two rectangular portal frames with the same dimensions. However, one of the frames has a constant second moment of area, while the other has one leg with a smaller second moment of area. Load is applied using variable masses whilst deflection is measured by a digital indicator.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

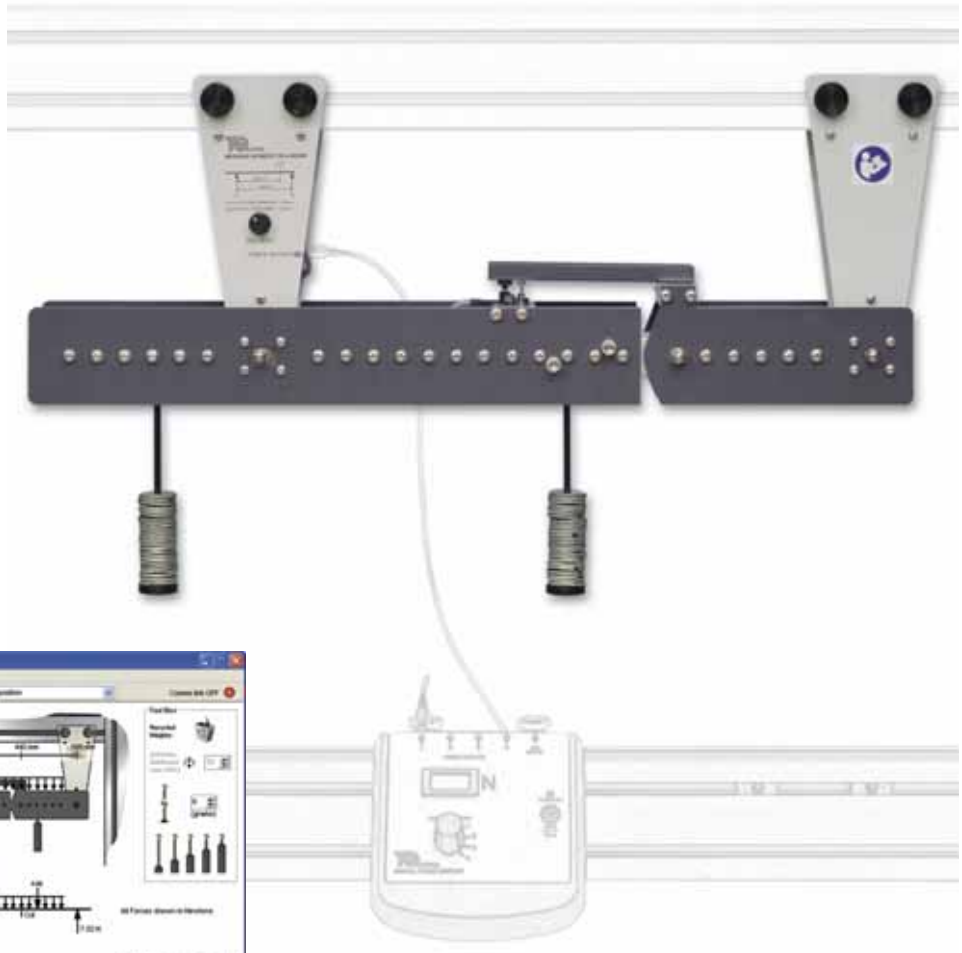
ALTERNATIVE PRODUCTS:

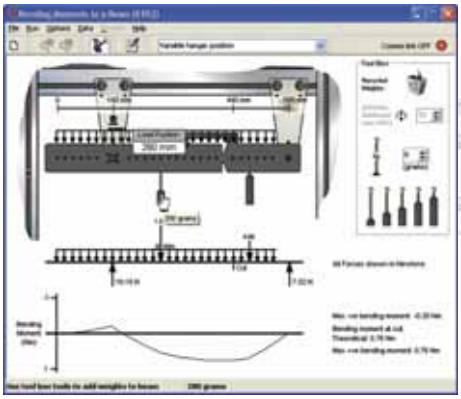
- Bending Moments in a Portal Frame (STR20) 206

STR2

BENDING MOMENTS IN A BEAM

Illustrates and proves the basic theory of bending moments in a beam.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

- Bending moment variation at the point of loading
- Variation of bending moment away from the point of loading
- Examination of various other loading cases, including loads traversing the beam

The experiment hardware is a simply supported beam 'cut' by a pivot. Students apply loads at set positions using hangers holding various masses. To stop the beam collapsing, a moment arm bridges the "cut" onto a load cell thus reacting to (and measuring) the bending moment force.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

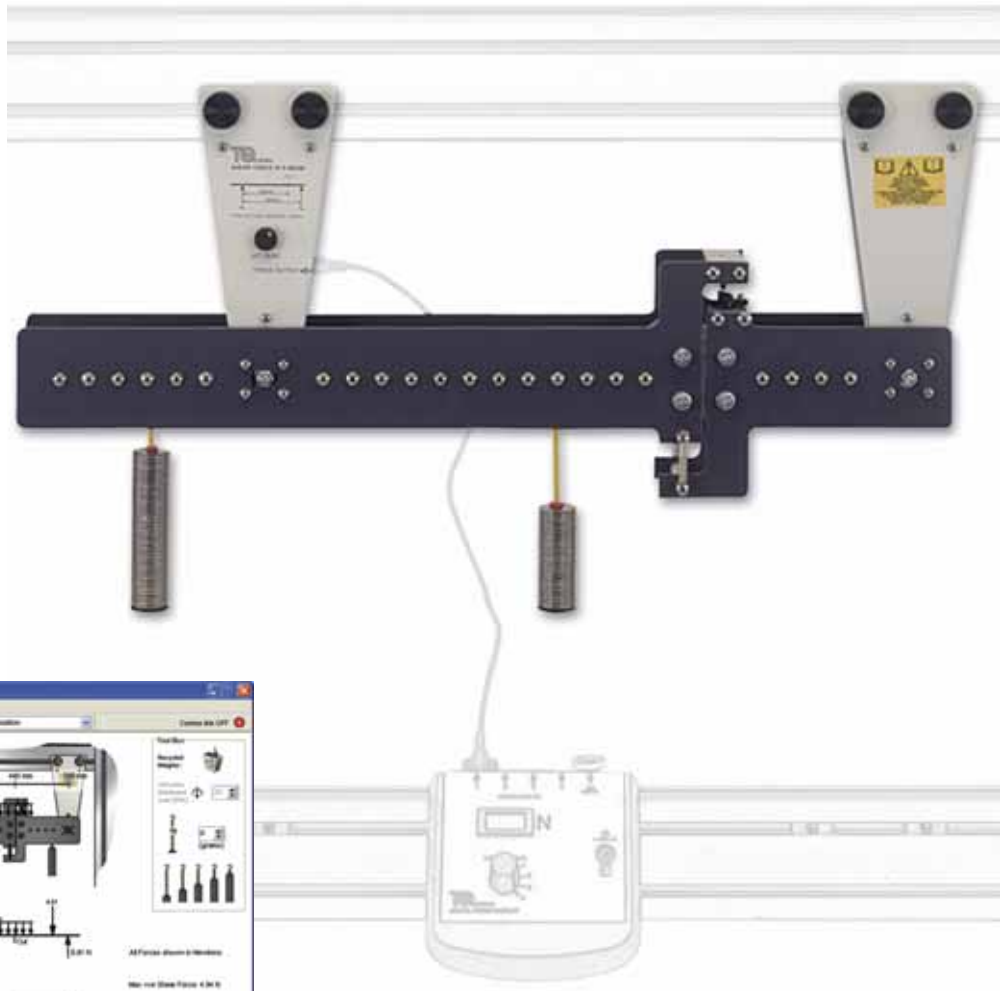
OR

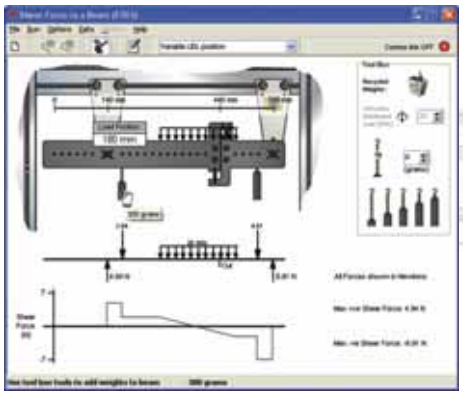
- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

STR3

SHEAR FORCE IN A BEAM

Illustrates and proves the basic theory of shear force in a beam





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

- Shear force variation with an increasing point load
- Variation of shear force for various loading conditions
- Examination of various other loading cases and their effect on shear force, including loads traversing the beam

The experiment hardware is a simply supported beam with a 'cut'. A mechanism bridges the cut, which stops the beam collapsing and allows movement in the shear direction only. Students apply loads at set positions using hangers holding various masses. The load cell measures shear force at the 'cut'.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

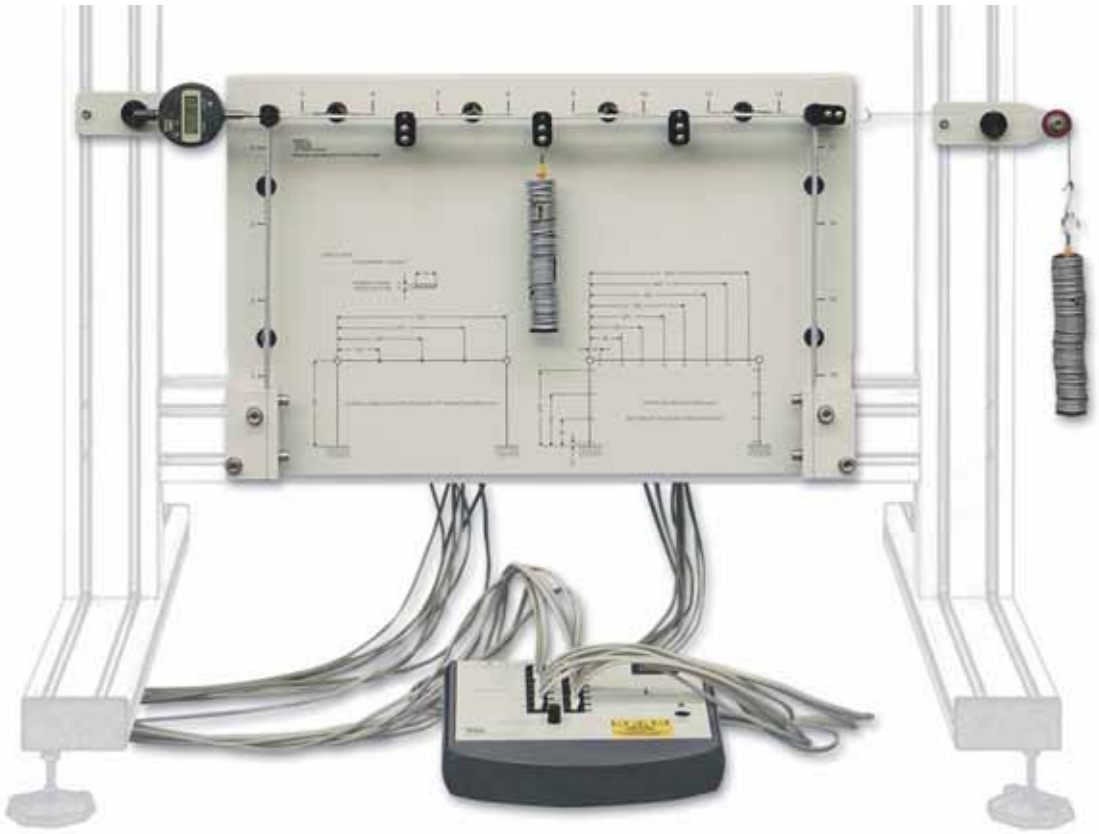
OR

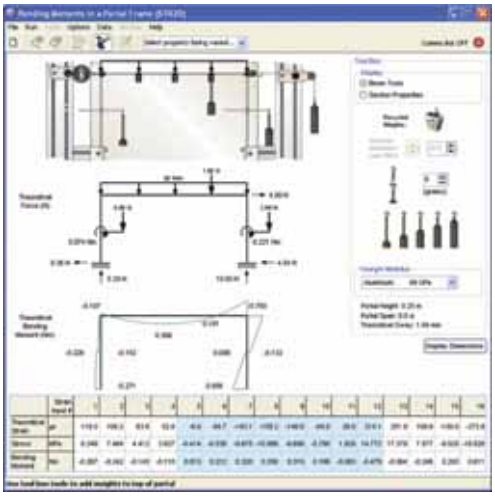
- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

STR20

BENDING MOMENTS IN A PORTAL FRAME

For the study of bending moments and sway in portal frames.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

Students use masses on weight hangers to apply various loads to a portal frame. The portal has three members: a horizontal beam and two vertical members or 'legs' joined at two upper corners. All members are of the same material and have the same flexural rigidity (i.e. value). Deflection is measured by a digital indicator.

LEARNING OUTCOMES:

- Strain gauge linearity
- Using strain measurement to find the bending moment
- Bending moments and sway for vertical and horizontal loads
- Bending moments for internal and external moments on vertical members
- Comparison of ideal and non-ideal structures

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

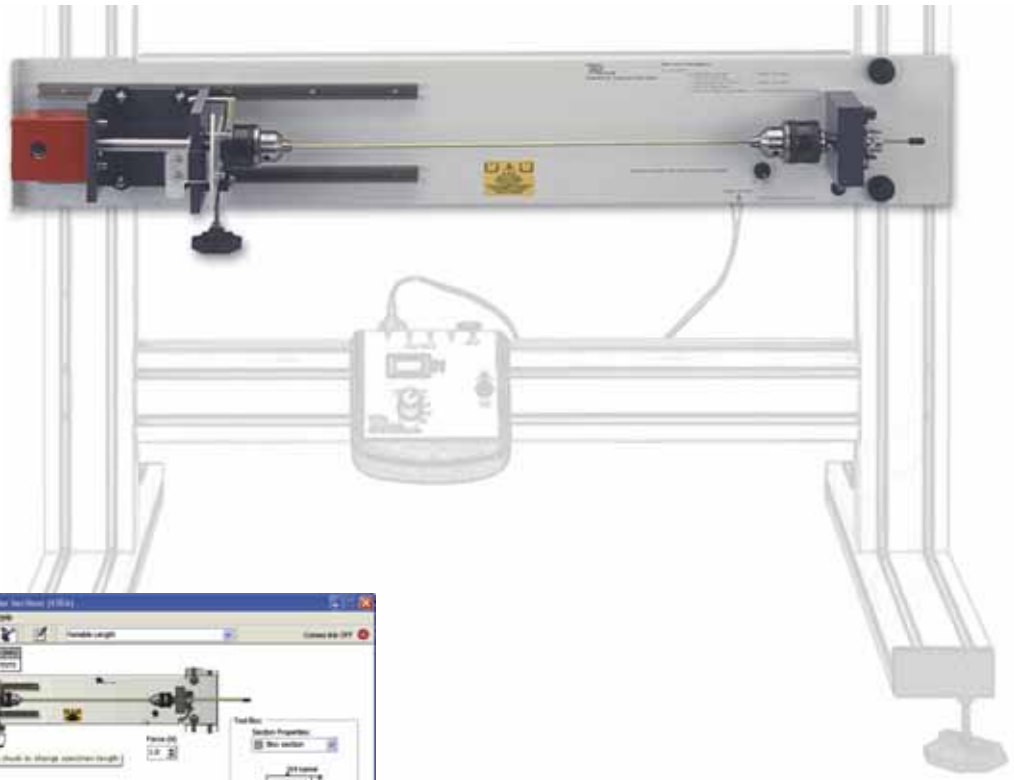
ALTERNATIVE PRODUCTS:

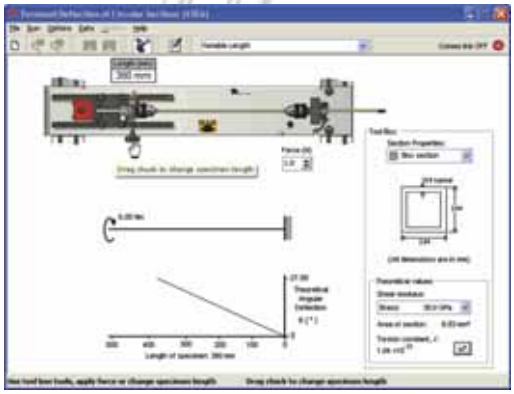
- Frame Deflections and Reactions (STR18) 203

STR6

TORSION OF CIRCULAR SECTIONS

For the study of torque and deflection in different materials with circular section.





SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

Study of:

- The relationship between specimen length, torque and angular deflection
- The behaviour of specimens of different materials and sections
- General torsion theory
- Shear modulus
- Polar moment of inertia

The experiment module examines the behaviour in the elastic region of solid and tubular-section specimens. Two chucks on a backboard hold a test specimen. A mechanism on one chuck applies torque manually to the specimen. A protractor scale on this chuck measures angular movement. A load cell on the other chuck measures torque.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

ESSENTIAL ANCILLARIES:

- Digital Force Display (STR1a) 187

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

ALTERNATIVE PRODUCTS:

- Torsion of Circular Sections Kit (ES5) 10
- Additional Torsion Testing Kit (TE16b) 150
- Torsion Testing Machine – 30 Nm (SM1001) 157

STR7

UNSYMMETRICAL BENDING AND SHEAR CENTRE

For the study of vertical and horizontal deflection of different asymmetric (unsymmetrical) sections.

SCREENSHOT OF THE OPTIONAL TECQUIPMENT STRUCTURES SOFTWARE

LEARNING OUTCOMES:

Study of:

- Horizontal and vertical deflection of different unsymmetrical sections under various loads and at various angles
- Relationship between the vertical and horizontal deflections and the principal moments of area of each section
- Shear centre of various unsymmetrical sections

The experiment module examines the vertical and horizontal deflection of different unsymmetrical sections at various angles and loads. Two multi-way chucks hold a test specimen vertically. One chuck has an indexing system for rotating the beam in set increments. This changes the angle of loading. The other chuck and a weight hanger applies a variable load. Two digital deflection indicators measure deflection in the x and y directions. An interchangeable plate allows students to find the shear centre of the specimen.

ESSENTIAL BASE UNIT:

- Structures Test Frame (STR1) 186

RECOMMENDED ANCILLARIES:

- Structures Software (STRS) for virtual experiments 188

OR

- Automatic Data Acquisition Unit (STR2000) for automatic data acquisition and virtual experiments 187

ALTERNATIVE PRODUCTS:

- Unsymmetrical Cantilever Apparatus (SM1003) 172

DATASHEETS FOR FULL SPECIFICATIONS

Download the latest information and a comprehensive specification of each product from the website.

TECQUIPMENT.COM

THEORY OF MACHINES

FRICTION	211
MOTION	215
VIBRATION	224

> I have the pleasure to express my full satisfaction with the smooth functioning of the TecQuipment laboratory educational equipment supplied to IUBAT Departments of Mechanical and Civil Engineering. I particularly appreciate TecQuipment's local agent for assisting IUBAT with free installation, commissioning, testing along with comprehensive training.

PROFESSOR M ALIMULLAH MIYAN
INTERNATIONAL UNIVERSITY OF BUSINESS AGRICULTURE AND TECHNOLOGY, BANGLADESH

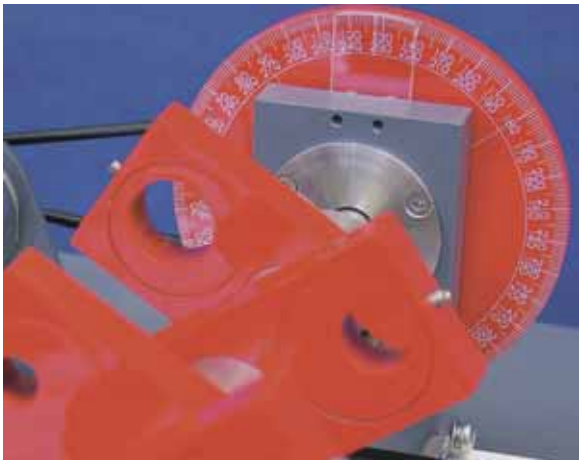
THEORY OF MACHINES

BASIC AND ADVANCED

The Theory of Machines range includes equipment that teaches the basics of machine engineering such as vibration and motion, to more advanced studies of friction in bearings.

SAFE YET HIGHLY VISUAL

For clarity and understanding, most of the equipment includes fast moving parts. TecQuipment's products always include safety by design, using interlocked guards to prevent accidents, while still allowing students to see what is happening.



AUTOMATIC DATA ACQUISITION VDAS®

Check out the products in this range that work with TecQuipment's unique Versatile Data Acquisition System (VDAS®).

SEE PAGE 293

KEY FEATURES AND BENEFITS:

- **BASIC TO ADVANCED TEACHING:** To suit all your laboratory needs.
- **SAFETY BY DESIGN:** Interlocked guards where required prevent accidents.
- **AUTOMATIC DATA ACQUISITION:** Fast moving equipment often requires multiple fast measurements, making data acquisition a powerful tool.

ENGINEERING SCIENCE

The Engineering Science range also includes products that demonstrate some of the fundamental principles of simple machines, such as pulleys and gears.

SEE PAGE 5

VDAS®	PRODUCT	PAGE
✓	Air Bearing Apparatus (TE96)	211
✓	Cam Analysis Machine (TM1021)	215
✓	Geared Systems (TM1018)	217
✓	Gyroscope (TM1004)	221
✓	Centrifugal Force (TM1005)	222
✓	Governors (TM1027)	223
✓	Free Vibrations of a Mass-Spring System (TM164)	228
✓	Free Torsional Vibrations (TM165)	229
✓	Free Vibrations of a Cantilever (TM166)	230
✓	Free Vibrations of a Beam and Spring (TM167)	231
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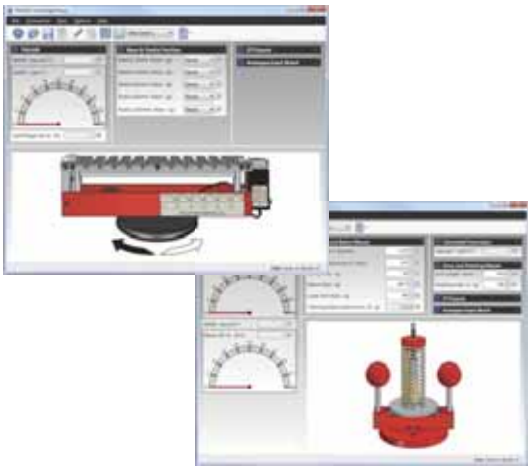
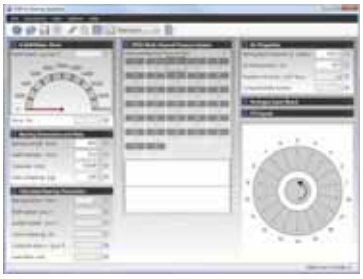


VDAS® TE96

AIR BEARING APPARATUS

A self-contained air bearing apparatus to demonstrate the performance of self-acting, gas-lubricated journal bearings including the phenomenon of half-speed whirl.

- Demonstrates the performance of a self-acting, gas (air) lubricated journal bearing
- Self-contained and bench-mounted – includes all instrumentation needed for tests
- Variable bearing load and speed, for a range of tests
- Includes a multi-channel digital pressure display
- Demonstrates the onset of bearing 'whirl'



TYPICAL SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Demonstrate how a vertical load affects the pressure distribution around an air-lubricated journal bearing
- Demonstrate how bearing speed, and therefore compressibility number, affects the pressure distribution in the bearing, and how this compares with theory
- Demonstrate the onset of 'whirl'

A self-contained product that illustrates how a self-acting, gas-lubricated journal bearing works. It also demonstrates the onset of 'whirl'.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

ALTERNATIVE PRODUCTS:

- Michell Pad Apparatus (TE99) 213
- Journal Bearing Demonstration (TM25) 214

TE98

HERTZIAN CONTACT APPARATUS

Self-contained unit that allows a practical examination of Hertz's theories of contact between materials.

- Compact, self-contained unit – needs no electricity or external services
- Uses flexible material to produce magnified and easily viewed results
- Controllable hydraulic pressure system with gauge for repeatable results
- Variable relative contact angles and pressures for a range of experiments

LEARNING OUTCOMES:

- The effect of varied pressure with constant angle
- The effect of varied angle (different relative curvature) with constant pressure

The Hertzian Contact Apparatus is a self-contained and easy-to-use unit that demonstrates the nature of contact between two surfaces. It compares experiment results with predictions based on Hertz's original theories. This helps engineers to predict contact areas between common machined surfaces and materials (for example, different types of bearings).

STOCK PRODUCTS READY TO DELIVER

A stock of TecQuipment's most popular products are available in our warehouse ready for speedy delivery. Contact us today to find out more.

TE99

MICHELL PAD APPARATUS

Demonstrates the pressure distribution across the film of oil in a Michell tilting pad slider bearing. Helps to prove Reynold's equation for pressure gradient in fluid film.

- Proven design, based on a machine created by Imperial College, London
- Accurately mimics a Michell tilting pad, fluid-lubricated slider bearing
- Fully adjustable pad (tilt) angle
- Includes oil and a viscometer

Demonstrates the pressure distribution across the film of oil in a Michell tilting pad slider bearing, invented by A G M Michell. Helps to prove Reynold's equation for pressure gradient in fluid film.

ALTERNATIVE PRODUCTS:

- Air Bearing Apparatus (TE96) 211
- Journal Bearing Demonstration (TM25) 214

LEARNING OUTCOMES:

Study of:

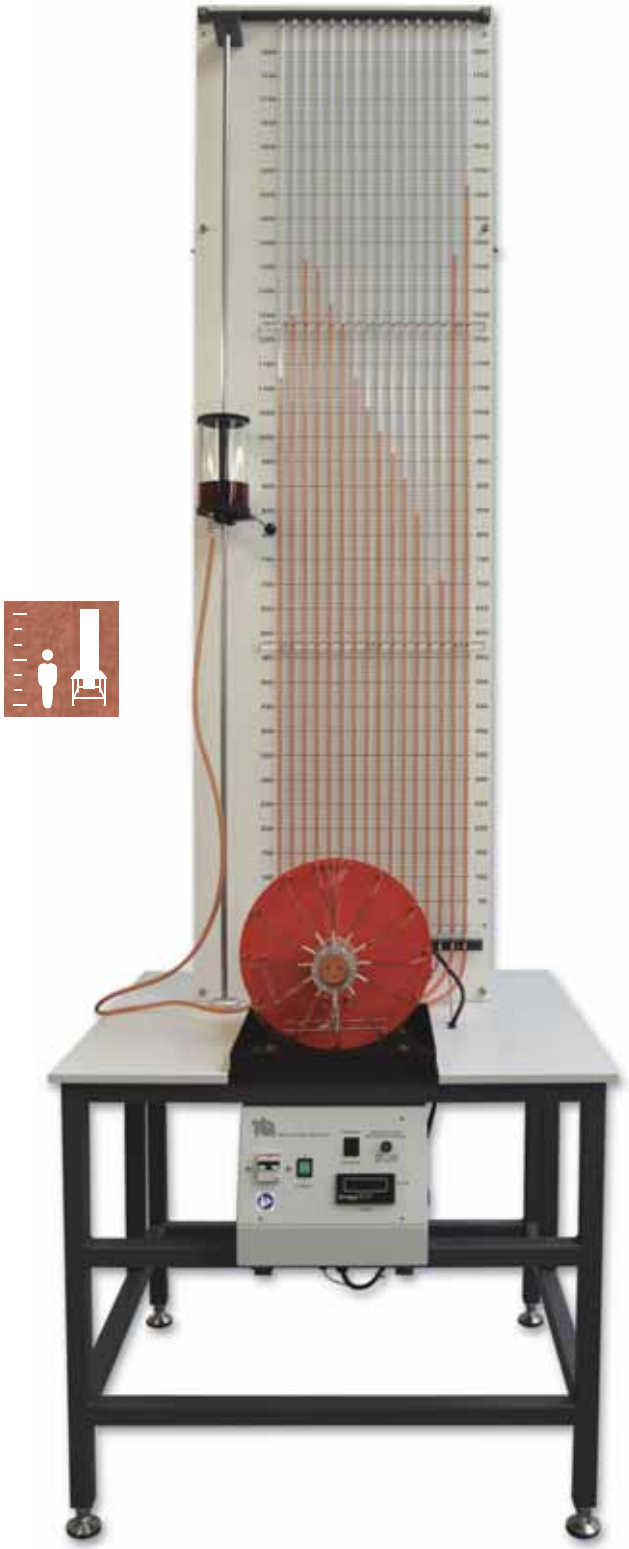
- Pressure distributions in a tilting pad bearing
- Influence of sliding speed and viscosity on the pressure distribution in the bearing and comparison with calculations based on Reynold's equation
- Relationship between pressure and the film thickness at the trailing edge of the pad

TM25

JOURNAL BEARING DEMONSTRATION

Demonstrates the pressures around a journal bearing at different speeds.

- Acrylic bearing allows clear observation of oil film at all times
- Pressure profiles, along and around the bearing, continuously monitored on large manometer panel
- Theoretical pressure profiles (Sommerfeld analysis) may be tested and compared with practical results
- Provides striking demonstration of self-excited vibrations (half-speed whirl)
- Fully adjustable speed, direction and loads



This floor-standing apparatus allows students to study the performance of a journal bearing during different test conditions.

LEARNING OUTCOMES:

SIMPLE DEMONSTRATIONS:

- Observation of oil wedge (film thickness) and hence eccentricity variations for different speeds and loads
- Observation of the pressure profiles at these conditions
- Observation of the critical bearing whirl

EXPERIMENTS:

- Measuring pressure profiles for chosen conditions and plotting the Cartesian and polar pressure curves
- Measuring pressure profiles for chosen conditions and plotting the theoretical Sommerfeld curve
- Measuring shaft speed and journal speed at the critical whirl

All tests may be conducted for either direction of rotation of the shaft.

RECOMMENDED ANCILLARIES:

- Stroboscope (ST1) 297

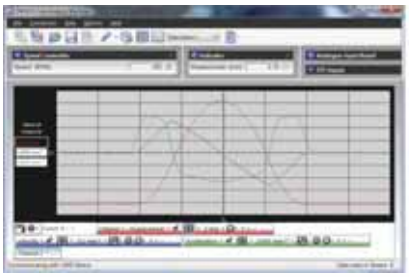
ALTERNATIVE PRODUCTS:

- Air Bearing Apparatus (TE96) 211
- Michell Pad Apparatus (TE99) 213

VDAS® TM1021

CAM ANALYSIS MACHINE

Studies the dynamic behaviour of different cams and followers and their 'bounce' speed.



SCREENSHOT OF THE VDAS® MKII SOFTWARE

- Illustrates cam and follower separation or 'cam bounce' under safe and controlled conditions
- Fully interlocked for safety
- Highly visual and audible – perfect for demonstrations
- Works with TecQuipment's VDAS® to capture data and show live traces (on a computer screen) of the follower movement – even at bounce

LEARNING OUTCOMES:

- Comparing actual results with theory for profiles of follower displacement, acceleration and velocity
- Cam bounce speeds for different cam and follower combinations, and comparison of speeds to those predicted by simplified theory
- How spring rate, preload and follower mass affect cam bounce speed

The TM1021 is a comprehensive machine that allows students to study cams and followers. It demonstrates how they convert rotary to linear motion, and helps students understand their limits of use before the onset of 'bounce'. It also introduces students to key topics of cam terminology such as 'nose', 'flank' and 'dwell'.

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – bench-mounted version (VDAS-B mkII) 293

NOTE: This equipment needs VDAS® mkII and will not work with earlier versions of VDAS®. If unsure, contact TecQuipment or your local agent for advice.

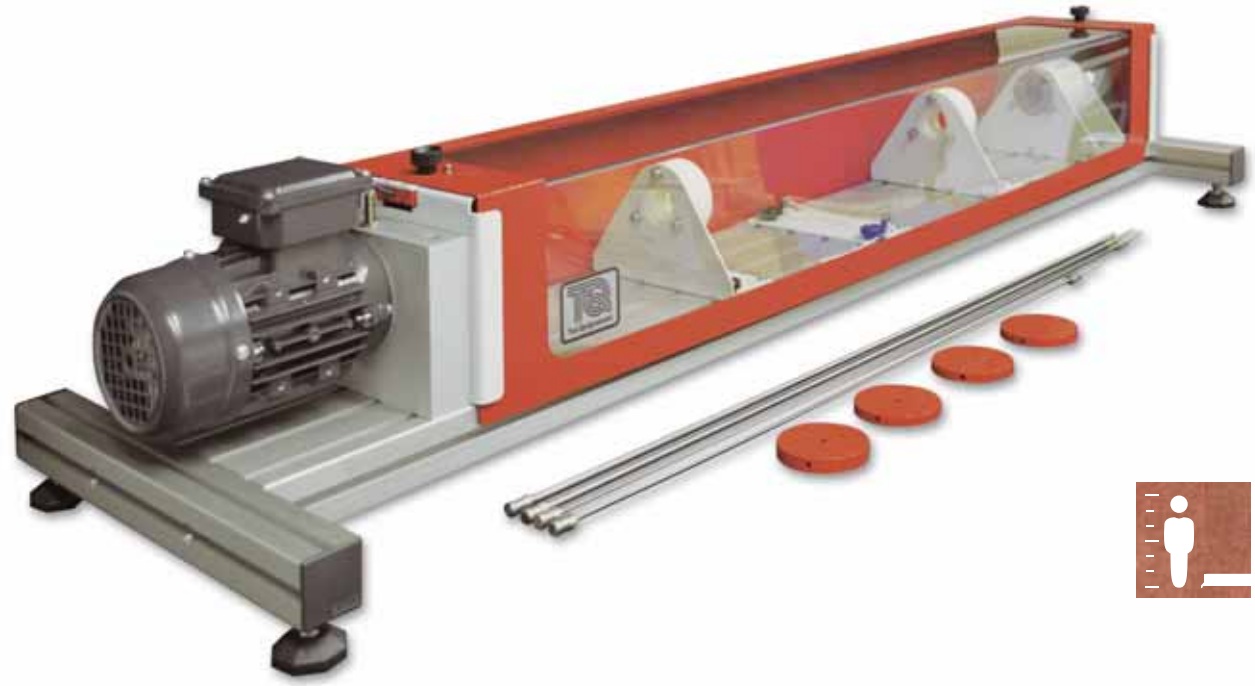
ALTERNATIVE PRODUCTS:

- Cam and Crank and Toggle Kit (ES12) 22

TM1001

WHIRLING OF SHAFTS AND CRITICAL SPEED

Demonstrates 'whirling' in different horizontal shafts with a variety of fixings (end conditions), loaded and unloaded.



- Demonstrates first and second mode whirl speeds and how to predict them
- Extra bearings and weights (included) give a choice of free-free, fixed-free and fixed-fixed end conditions and experiments with loaded shafts and eccentric loading
- Supplied with different shafts to study how length and diameter affects whirling
- Optional stroboscope to 'freeze' the image of the shaft to see its shape clearly

LEARNING OUTCOMES:

- Basic whirling demonstration
- The effect of shaft length and diameter
- The effect of end conditions (fixings)
- Loaded shaft (one and two masses)
- Eccentric loading

TecQuipment's Whirling of Shafts and Critical Speed (TM1001) demonstrates how shafts vibrate transversely and 'whirl' at a certain rotation frequency. This helps engineers understand possible problems with long shafts and allow for them in their designs.

RECOMMENDED ANCILLARIES:

- Stroboscope (ST1) 297

TALK TO OUR EXPERTS

Our dedicated Sales team can help you choose the equipment best suited for your needs, answer your questions and progress your order.

VDAS® TM1018

GEARED SYSTEMS

A set of products for dynamic and static experiments on geared and other drive systems.

FEATURES:		BENEFITS:
Fully equipped bench-mounted base unit for tests on several different drive units	→	Saves space and reduces costs
Includes gear drive unit, with optional belt, chain and helical gear drives	→	Offers comparative tests of different designs
Optional Test Stand (TM1018a)	→	For additional tests in static efficiency and inertia
Easy set-up - all drive units can be removed and fitted in minutes	→	Maximises experiment time
Works with VDAS®	→	Quick and reliable tests with data capture

LEARNING OUTCOMES:

DYNAMIC:

- Simple and compound gear trains
- Mechanical advantage, velocity ratio and dynamic efficiencies of gear trains
- Mechanical advantage, velocity ratio and dynamic efficiencies of optional drive units (chain, belt and helical gears)
- Appreciation of the different characteristics of drive systems
- Chain and belt drive tension, including different methods of application

ACCELERATION AND STATIC:

- Mechanical advantage, velocity ratio and static efficiencies of gear drives
- Mass moment of inertia of a flywheel by experiment and calculation
- Mass moment of inertia of geared drive systems by experiment and calculation

CONTINUED ON NEXT PAGE

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

A bench-mounted base unit forms the main part of this set of products. Supplied with a three-shaft gear drive unit as standard, the base unit dynamically tests the gear drive and the other optional drive units (TM1018b, c, d and e).

OPTIONAL TEST STAND (TM1018A)

The Acceleration and Static Test Stand (TM1018a) gives extra experiments in measuring angular acceleration and static efficiency.

OPTIONAL DRIVE UNITS

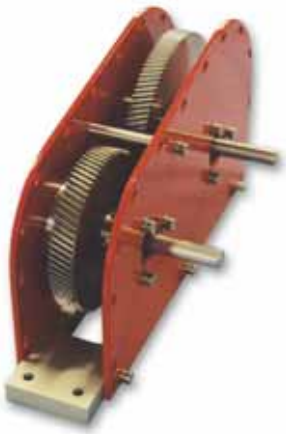
TOOTHED BELT DRIVE (TM1018B)
ROUND BELT DRIVE (TM1018C)
CHAIN DRIVE (TM1018D)
HELICAL GEAR DRIVE (TM1018E)

The optional drive units work with the TM1018 base unit for dynamic tests on performance, allowing comparison with the gear drive. For extended experiments, the optional drives each include three different methods of adjusting their tension to demonstrate how this affects performance.

TOOTHED BELT DRIVE (TM1018B)

ROUND BELT DRIVE (TM1018C)

CHAIN DRIVE (TM1018D)



HELICAL GEAR DRIVE (TM1018E)

RECOMMENDED ANCILLARIES:

- Acceleration and Static Test Stand (TM1018a) 218
- Toothed Belt Drive (TM1018b) 218
- Round Belt Drive (TM1018c) 218
- Chain Drive (TM1018d) 218
- Helical Gear Drive (TM1018e) 218
- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Drive Systems Kit (ES11) 19
- Gear Trains Kit (ES13) 20
- Potential and Kinetic Energy Kit (ES9) (for the optional Test Stand TM1018a) 16

VDAS® TM1022

BALANCE OF RECIPROCATING MASSES

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

- VDAS® connectivity included featuring data acquisition via USB
- Includes a control and instrumentation unit to process the force and moment signals – also has an electronic drive control to adjust and display the engine speed accurately
- Simulates one, two and four-cylinder engines
- Variable crank angle settings and additional piston masses – for a range of tests
- Works with an oscilloscope (OS1) to show dynamic force and moment waveforms for popular engine arrangements and compare them with theory

A bench-mounted model four-cylinder engine that demonstrates 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).

LEARNING OUTCOMES:

- 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 ANCILLARIES:

- Oscilloscope (OS1) – needed to see the dynamic force and moment waveforms and amplitudes 297

ALTERNATIVE PRODUCTS:

- Static and Dynamic Balancing (TM1002) 220

TM1002

STATIC AND DYNAMIC BALANCING

For experiments in balancing a rotating mass system, statically and dynamically.

- Demonstrates balancing a horizontal shaft with two, three or four rotating masses
- Independent analysis of static and dynamic balancing
- Includes four removeable rotating masses (balance blocks) with different inserts for a range of moments
- Protractor, horizontal scale and sliding indicator to help accurately position the rotating masses

LEARNING OUTCOMES:

- Demonstration of simple static and dynamic balancing of two, three and four rotating masses
- Dynamic balancing of rotating mass systems by calculation and vector diagrams (triangle and polygon)

This product allows students to perform experiments in balancing a rotating mass system and check their results against accepted theory.

ALTERNATIVE PRODUCTS:

- Balance of Reciprocating Masses (TM1022) 219

ALWAYS HERE TO HELP

Whether you have a technical enquiry, need spare parts or support material, you can contact our Customer Care team at:

CUSTOMER.CARE@TECQUIPMENT.COM

VDAS® TM1004

GYROSCOPE

For experiments in gyroscopic couple and velocities of rotor and precession.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Interlocked, transparent dome allows students to observe the gyroscope spinning in safety
- Works in both clockwise and anticlockwise directions for a full range of tests
- Unique multifunction controls for coarse and fine adjustment of velocity and direction
- Direct measurement of gyroscopic tilting force, couple and velocities (speeds) shown on digital displays

LEARNING OUTCOMES:

- Direction of gyroscopic couple (in relation to precession and rotor spin directions).
- Magnitude of gyroscopic couple (in relation to precession and rotor spin velocities).

The rotor of an electric motor shares a horizontally supported shaft with a flywheel, forming the gyroscope. A second electric motor turns a belt that turns a turntable under the gyroscope, causing precession about a vertical axis. Both motors work in clockwise and anticlockwise rotation and with variable velocity.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

VDAS® TM1005

CENTRIFUGAL FORCE

For experiments in centrifugal force and angular velocity.

- Demonstrates the relationship between centrifugal force, mass of a rotating body, its distance from the axis, and its angular velocity
- Balanced arm mechanism for accurate readings
- Interlocked, transparent dome allows students to see the mechanism spinning in safety
- Includes a set of weights for different experiments

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

A base unit supports a mechanism that rotates under a clear dome. An electric motor turns a belt that turns a turntable under the mechanism. The motor works in clockwise and anticlockwise rotation and with variable velocity. A sensor measures the rotational velocity of the mechanism.

LEARNING OUTCOMES:

Finding the relationship between centrifugal force, the mass of a rotating body, its distance from the axis of rotation (radial position) and the speed of rotation.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Centrifugal Force Kit (ES16) 21

VDAS® TM1027

GOVERNORS

Demonstrates how different governors work, including Hartnell, Porter and Proell governors.

HARTNELL GOVERNOR SHOWN FITTED

PORTER GOVERNOR

PROELL GOVERNOR

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Includes three easy-to-fit governors: Hartnell, Porter and Proell
- Interlocked, transparent dome allows students to observe the governors spinning in safety
- Includes additional weights to change the mass of the Porter and Proell governor sleeves
- Supplied with different springs and rotating masses for the Hartnell governor

A base unit contains a variable-speed motor. The motor turns each of three different governors: Proell, Porter and Hartnell.

NOTE: Only one governor can be tested at a time.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

LEARNING OUTCOMES:

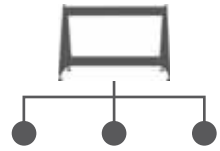
- Finding characteristic curves of governor speed against sleeve lift.
- Comparison of governor types in terms of sensitivity, stability and effort.
- On the Porter and Proell governors, the effects of varying centre sleeve mass.
- On the Hartnell governor, the effect of varying:
  - arm length
  - spring rate
  - spring compression
  - rotating mass
- Demonstration of the isochronous condition (Hartnell governor).

TM160

FREE VIBRATIONS TEST FRAME

Sturdy frame for use with TecQuipment's Free Vibrations Experiments.

MODULAR SYSTEM



FEATURES:		BENEFITS:
Rigid and lightweight construction	→	Ensures repeatability of results and long service life, yet light enough to move around the classroom
Supplied with all the tools needed for assembly	→	Quick and easy set up time – optimises experiment time during laboratory sessions
Includes a storage tray for safe storage of any tools and smaller parts of the optional experiments	→	Reduces risk of losing components – greater longevity

For use with TecQuipment's Free Vibrations Experiments, the test frame fits on any standard desk or bench top. Students, teachers or lecturers fit the parts of their free vibrations experiments to the test frame to study or demonstrate a free vibrations topic.

AVAILABLE EXPERIMENT MODULES:

- Simple and Compound Pendulums (TM161) 225
- Filar Pendulums (TM162) 226
- Centre of Percussion (TM163) 227
- Free Vibrations of a Mass-Spring System (TM164) 228
- Free Torsional Vibrations (TM165) 229
- Free Vibrations of a Cantilever (TM166) 230
- Free Vibrations of a Beam and Spring (TM167) 231

SHOWN WITH ONE OF THE AVAILABLE EXPERIMENT MODULES

TM161

SIMPLE AND COMPOUND PENDULUMS

Studies simple harmonic motion and the factors that affect the period of oscillation of pendulums.

- Back panels with referenced scales and sliding indicators for accurate positioning of pendulum parts
- The simple pendulum has unique quick-change spheres and adjustable cord length – no tools required
- Includes simple, compound and Kater's pendulums for a range of experiments
- Quick and easy assembly
- Contains all parts needed for the experiments – including a stopwatch and simple tools

This product is part of a range that explores free vibrations in simple 'one degree of freedom' systems and introduces students to key scientific terms such as:

- Simple harmonic motion (SHM) and period of oscillation
- Mass moment of inertia
- Radius of gyration
- Routh's rule

LEARNING OUTCOMES:

- Cord length and period of a simple pendulum
- Mass and period of a simple pendulum
- Using a simple pendulum to find the acceleration due to gravity
- Centre of gravity and period of a compound pendulum
- How an adjustable mass affects the period of a compound pendulum
- Using a Kater's pendulum to find the acceleration due to gravity

ESSENTIAL BASE UNIT:

- Free Vibrations Test Frame (TM160) 224

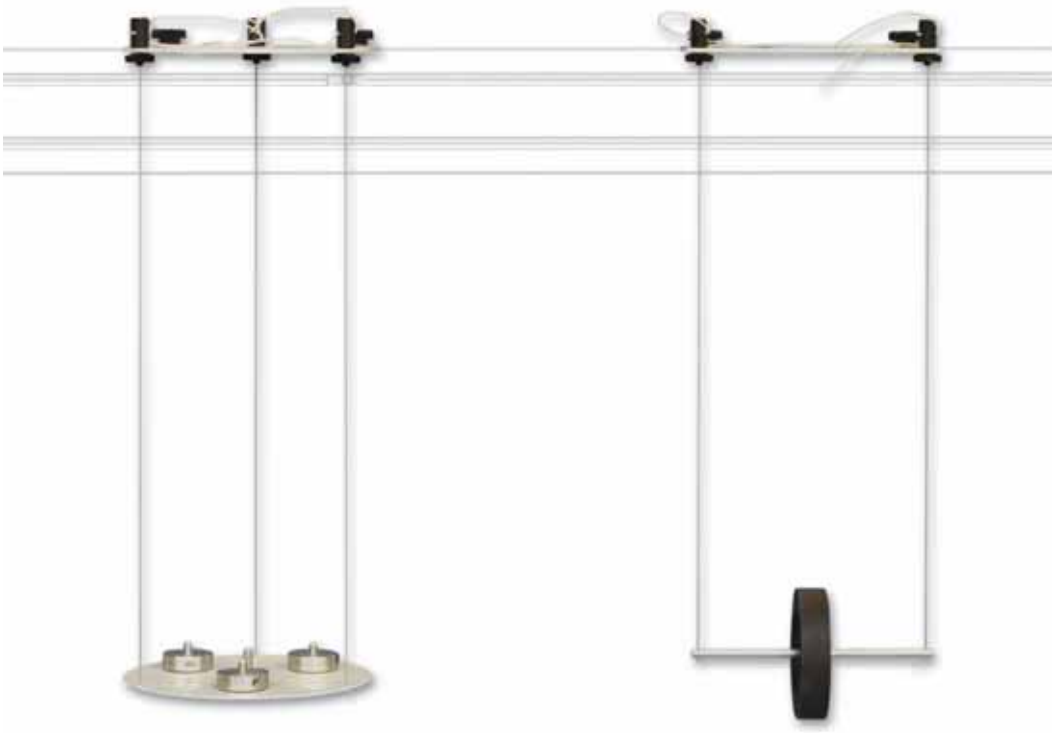
ALTERNATIVE PRODUCTS:

- Simple Harmonic Motion Kit (ES7) 14

TM162

FILAR PENDULUMS

Studies simple harmonic motion and the factors that affect the period of oscillation of bifilar and trifilar pendulums.



- Flexible and modular – fits onto the Test Frame (TM160) for experiments and classroom demonstrations
- Different pendulum designs, lengths, mass and inertia – for a range of experiments
- Quick and easy assembly
- Contains all parts needed for the experiments – including an 'example machine element', stopwatch, steel rule and simple tools

This product is part of a range that explores free vibrations in simple 'one degree of freedom' systems and introduces students to key scientific terms such as:

- Simple harmonic motion (SHM) and period of oscillation
- Mass moment of inertia
- Radius of gyration
- Axis of rotation
- Parallel axis theorem

ESSENTIAL BASE UNIT:

- Free Vibrations Test Frame (TM160) 224

ALTERNATIVE PRODUCTS:

- Simple Harmonic Motion Kit (ES7) 14

LEARNING OUTCOMES:

- Cord length and period of bifilar and trifilar pendulums
- Cord (support) positions and period of bifilar and trifilar pendulums
- Mass and period of bifilar and trifilar pendulums
- Position of mass on bifilar and trifilar pendulums
- Finding moment of inertia of an 'example machine part' in two different axes

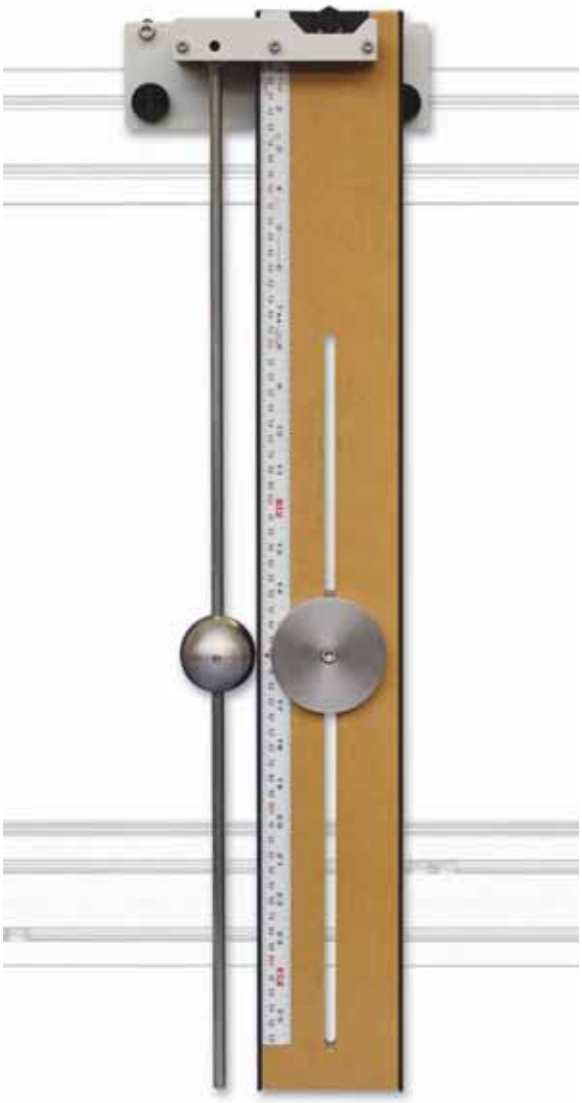
SHOWN WITH THE TEST FRAME (TM160)

TM163

CENTRE OF PERCUSSION

Illustrates how to calculate and find a compound centre of percussion pendulums.

- Flexible and modular – fits onto the Test Frame (TM160) for experiments and classroom demonstrations
- Realistic scale – for highly visual and accurate experiments in complete safety
- Quick and easy assembly
- Contains all parts needed for the experiments – including a stopwatch and simple tools



LEARNING OUTCOMES:

- Centre of gravity, period of oscillation and radius of gyration of a compound pendulum
- Centre of percussion of a compound pendulum

This product is part of a range that explores free vibrations in simple 'one degree of freedom' systems and introduces students to key scientific terms such as:

- Simple harmonic motion (SHM) and period of oscillation
- Radius of gyration
- Centre of gravity
- Centre of percussion (CoP) and the 'sweet spot'
- Impact reactions

ESSENTIAL BASE UNIT:

- Free Vibrations Test Frame (TM160) 224

SHOWN WITH THE TEST FRAME (TM160)

VDAS® TM164

FREE VIBRATIONS OF A MASS-SPRING SYSTEM

Uses simple harmonic motion theory to demonstrate how to calculate the frequency of oscillation in simple mass-spring systems.

SCREENSHOT OF THE VDAS® SOFTWARE

SHOWN FITTED WITH THE OPTIONAL DAMPER KIT (TM164A)

- Flexible and modular – fits onto the Test Frame (TM160) for experiments and classroom demonstrations
- Optional dashpot for extra experiments in oscillation damping
- Non-contacting measurement sensors for negligible damping
- Additional acceleration sensor for comparison with software-derived waveform
- Works with TecQuipment's Versatile Data Acquisition System (VDAS® mkII) for real-time display of the mass-spring oscillations

LEARNING OUTCOMES:

- Spring extension and force (spring constant) and Hooke's law
- Frequency of oscillation, spring constant and varying mass
- Phase difference between displacement and its derivatives
- Comparison of measured and derived acceleration
- Oscillation damping and coefficient (needs optional Damper Kit)

This product is part of a range that explores free vibrations in simple 'one degree of freedom' systems and introduces students to key scientific terms such as:

- Simple harmonic motion (SHM) and frequency of oscillation
- Spring constant and Hooke's law
- Oscillation damping
- Phase difference between displacement and its derivatives

ESSENTIAL BASE UNIT:

- Free Vibrations Test Frame (TM160) 224

RECOMMENDED ANCILLARIES:

- Damper Kit (TM164a)

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – bench-mounted version (VDAS-B mkII) 293

NOTE: This equipment needs the new VDAS® mkII and will not work with earlier versions of VDAS®. Contact TecQuipment or your local agent if unsure.

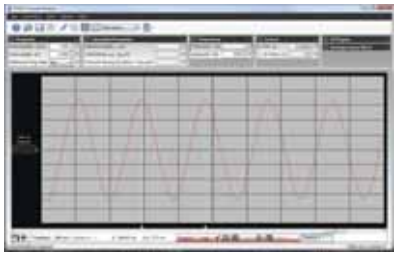
ALTERNATIVE PRODUCTS:

- Free and Forced Vibrations (TM1016) 233

VDAS® TM165

FREE TORSIONAL VIBRATIONS

Demonstrates the oscillatory motion of a disc attached to a slender rod.



SCREENSHOT OF THE VDAS® SOFTWARE

SHOWN FITTED WITH THE OPTIONAL DAMPER KIT (TM165A)

- Uses the rotational movement of a disc suspended from a circular rod for a highly visual and intuitive display of simple harmonic motion
- Optional Damper Kit (TM165a) for extra experiments in oscillation damping
- Includes a selection of specimen rods and an additional inertia ring for a range of experiments
- Non-contacting displacement sensor to see and measure oscillatory motion with negligible damping effect
- Works with TecQuipment's VDAS® (mkII) for real-time display of the displacement waveform and its derivatives

This product is part of a range that explores free vibrations in simple 'one degree of freedom' systems and introduces students to key scientific terms such as:

- Simple harmonic motion (SHM)
- Frequency of oscillation
- Shear modulus
- Polar moment of area
- Mass moment of inertia
- Phase difference between displacement and its derivatives

LEARNING OUTCOMES:

- Rod diameter and frequency of oscillation
- Rod length and frequency of oscillation
- Inertia and frequency of oscillation
- Phase difference between displacement and its derivatives
- Damped torsional oscillations (needs optional Damper Kit)

ESSENTIAL BASE UNIT:

- Free Vibrations Test Frame (TM160) 224

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – bench-mounted version (VDAS-B mkII) 293

NOTE: This equipment needs the new VDAS® mkII and will not work with earlier versions of VDAS®. Contact TecQuipment or your local agent if unsure.

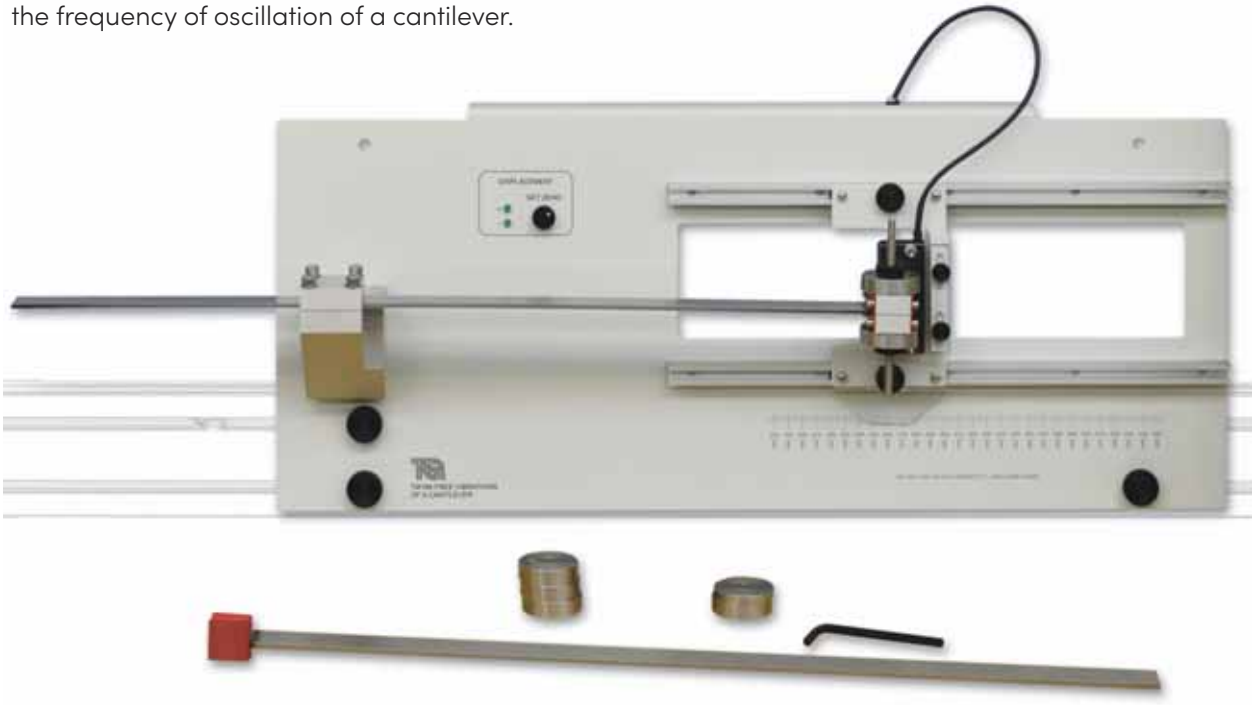
RECOMMENDED ANCILLARIES:

- Damper Kit (TM165a)

VDAS® TM166

FREE VIBRATIONS OF A CANTILEVER

Uses fundamental theory and Rayleigh's approximation to calculate the frequency of oscillation of a cantilever.



- Quick and easy assembly
- Mounts both vertically and horizontally for alternative analysis
- Includes a plain cantilever and a weighted cantilever with 'tip mass' for a range of experiments
- Non-contacting displacement sensor to see and measure oscillatory motion with negligible damping effect

This product is part of a range that explores free vibrations in simple 'one degree of freedom' systems and introduces students to key scientific terms such as:

- Simple harmonic motion (SHM) and frequency of oscillation
- Beam stiffness
- Rayleigh's method
- Dunkerley's method
- Second moment of area
- Phase difference between displacement and its derivatives

ESSENTIAL BASE UNIT:

- Free Vibrations Test Frame (TM160) 224

SCREENSHOT OF THE VDAS® SOFTWARE

LEARNING OUTCOMES:

- Predicting oscillation frequency using Rayleigh's method and the simplified method assuming that the beam is 'light'
- Phase difference between displacement and its derivatives
- Horizontal cantilever length and frequency of oscillation
- Using Dunkerley's method to predict the 'beam only' frequency
- Comparison of vertical and horizontal cantilevers

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – bench-mounted version (VDAS-B mkII) 293

NOTE: This equipment needs the new VDAS® mkII and will not work with earlier versions of VDAS®. Contact TecQuipment or your local agent if unsure.

ALTERNATIVE PRODUCTS:

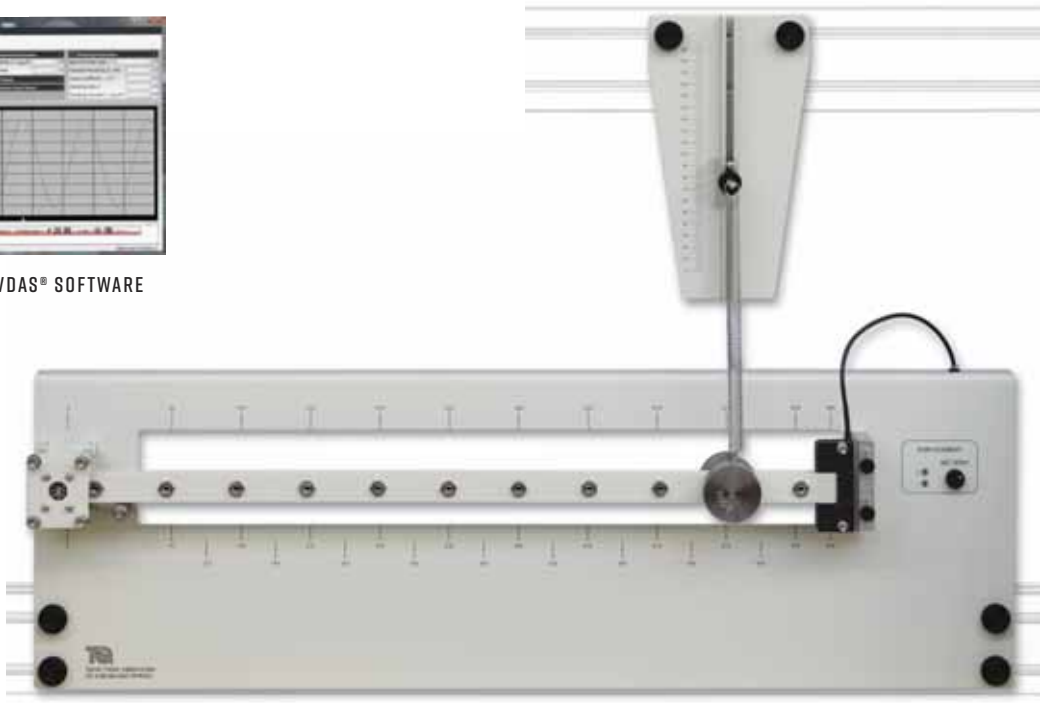
- Free and Forced Vibrations (TM1016) 233

VDAS® TM167

FREE VIBRATIONS OF A BEAM AND SPRING

Demonstrates the oscillatory motion of a rigid beam, pivoted at one end and suspended by a spring at the other.

SCREENSHOT OF THE VDAS® SOFTWARE



- Uses a pivoted beam with spring for a highly visual display of simple harmonic motion
- Integral scales to save time and for convenient use
- Optional Damper Kit (TM167a) for extra experiments in oscillation damping using safe, easily-available fluids
- Non-contacting displacement sensor to see and measure oscillatory motion with negligible damping effect

SHOWN FITTED WITH THE OPTIONAL DAMPER KIT (TM167A)

LEARNING OUTCOMES:

- Spring extension and force (spring constant), and Hooke's law
- Phase difference between displacement and its derivatives
- Frequency of oscillation and varying mass moment of inertia by varying mass value
- Frequency of oscillation and spring constant
- Frequency of oscillation and varying mass moment of inertia by varying mass position
- Oscillation damping and coefficient (needs optional Damper Kit)

This product is part of a range that explores free vibrations in simple 'one degree of freedom' systems.

It introduces students to key scientific terms such as:

- Simple harmonic motion (SHM) and frequency of oscillation
- Moment of inertia
- Oscillation damping
- Spring constant and Hooke's law
- Phase difference between displacement and its derivatives

CONTINUED ON NEXT PAGE

SHOWN FITTED TO THE TEST FRAME (TM160) AND CONNECTED TO VDAS® MKII

ESSENTIAL BASE UNIT:

- Free Vibrations Test Frame (TM160) 224

RECOMMENDED ANCILLARIES:

- Damper Kit (TM167a)

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – bench-mounted version (VDAS-B mkII) 293

NOTE: This equipment needs the new VDAS® mkII and will not work with earlier versions of VDAS®. Contact TecQuipment or your local agent if unsure.

ALTERNATIVE PRODUCTS:

- Free and Forced Vibrations (TM1016) 233

VDAS® TM165

UNIVERSAL VIBRATIONS APPARATUS

This bundle includes all products from the Vibration section of TecQuipment's Theory of Machines range (TM160–TM167 and TM1016). It offers multiple experiments in both free and forced vibrations, and includes our Versatile Data Acquisition System (VDAS®).

VDAS® TM1016

FREE AND FORCED VIBRATIONS

Investigates the free and forced vibrations of a rigid beam with a spring, and a simply supported beam.

SCREENSHOT OF THE VDAS® SOFTWARE

FEATURES:		BENEFITS:
Two different vibration systems in one self-contained unit: a 'rigid' beam with a spring and a pinned-pinned (simply supported) 'flexible' beam	→	Increased experimental scope with minimal set up time
Non-contacting displacement sensor	→	Frictionless measurement of displacement – minimises influence on experiment results
High-quality servomotor 'exciter' – for forced vibrations at a constant speed	→	Minimises cyclical variations – enhances accuracy and repeatability
Offset mass position sensor	→	Demonstrates the phase relationship between applied force and displacement
Built-in accelerometer for comparison of derived and measured acceleration waveforms	→	High level functions deepen students' understanding
Works with TecQuipment's VDAS® mkII for real-time display of the vibrations	→	Advanced software eliminates need for additional expensive oscilloscope

CONTINUED ON NEXT PAGE

LEARNING OUTCOMES:

- Free and forced vibrations of a rigid beam and spring
- Free and forced vibrations of a flexible pinned–pinned (simply supported) beam
- Using Rayleigh's approximation to predict vibration frequency
- Frequency of oscillation and varying mass
- Finding the 'beam only' frequency using Dunkerley's method
- Phase difference between displacement, its derivatives and measured acceleration
- Damped free and forced oscillations and damping coefficient
- Phase relationship between the applied force and beam position for different damping values
- Demonstration of a 2 degree of freedom (2DOF) system
- Demonstration of an undamped vibration absorber

A bench-top unit to demonstrate free and forced vibrations of two mass-beam systems:

1. A 'rigid' beam with a pivot at one end and a spring at the other – the spring provides the elasticity.
2. A 'flexible' pinned-pinned beam with a pivot at one end and a roller pivot at the other – the beam itself provides the elasticity.

ESSENTIAL ANCILLARIES:

- Versatile Data Acquisition System – bench-mounted version (VDAS-B mkII) 293

NOTE: This equipment needs the new VDAS® mkII and will not work with earlier versions of VDAS®. Contact TecQuipment or your local agent if unsure.

ALTERNATIVE PRODUCTS:

- Free Vibrations of a Mass-Spring System (TM164) 228
- Free Vibrations of a Cantilever (TM166) 230
- Free Vibrations of a Beam and Spring (TM167) 231

SHOWN CONNECTED TO VDAS® MKII

THERMODYNAMICS

THERMODYNAMIC PRINCIPLES	237
HEAT TRANSFER	240
TEMPERATURE	260
STEAM	261
COMPRESSORS	262

"

BAE Systems Defence Information, Training and Services have recently used TecQuipment to support training activities in the Kingdom of Saudi Arabia through the procurement of two gas turbine trainers. Throughout the procurement, manufacturing and installation period TecQuipment have performed well and supported extra requirements such as product safety justification reports. The experience and expertise of their commissioning engineer was first class and in-country activities went well.

N CHERRY
TRAINING PROCUREMENT WARTON, BAE SYSTEMS (OPERATIONS) LIMITED

THERMODYNAMICS

SAFE, PRACTICAL AND REALISTIC

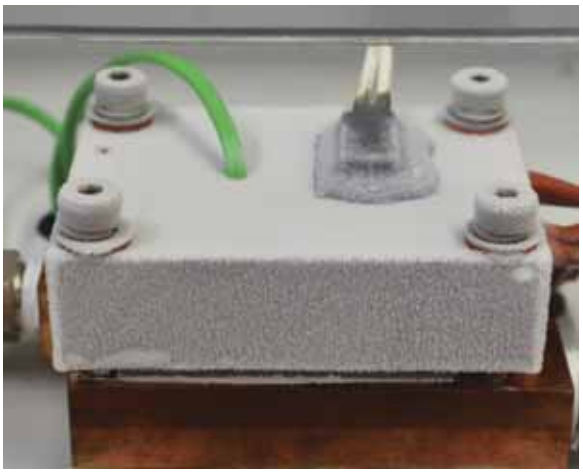
As thermodynamics experiments can often take many hours, the range has been designed to reduce the experiment time to a practical and realistic level, with safety as the key aspect.

BROAD RANGE

This broad range of experimental apparatus allows the comprehensive teaching of thermodynamics, from principles through to complex systems.

KEY FEATURES AND BENEFITS:

- **SAFE AND PRACTICAL DESIGN:** Reduced experiment times.
- **BROAD RANGE OF PRODUCTS:** Covers from basic principles to gas turbines.
- **AUTOMATIC DATA ACQUISITION:** Thermodynamics experiments need several minutes of constant monitoring to achieve thermal equilibrium, making automatic data acquisition a useful tool.



AUTOMATIC DATA ACQUISITION VDAS®

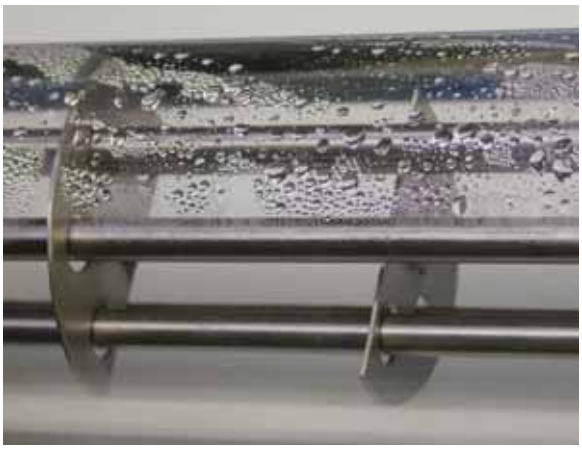
Check out the products in this range that work with TecQuipment's unique Versatile Data Acquisition System (VDAS®).

SEE PAGE 293

MODULAR FLUID POWER

Our Modular Fluid Power range includes products that can be analysed in terms of thermodynamic performance, such as compressors.

SEE PAGES 132-146



VDAS® TD1000

IDEAL GASES – BOYLE'S LAW

Demonstrates the relationship between pressure and volume of an ideal gas at a fixed temperature.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- A self-contained bench-top experiment – no power supply needed
- Highly visual experiment using a 'liquid piston' for reliability and accurate, repeatable results
- Includes a thermocouple and digital display to help maintain constant temperature and demonstrate how compression and decompression of a gas can affect its temperature
- Supplied with hand-operated pumps to compress or decompress the gas (air) above and below atmospheric pressure

LEARNING OUTCOMES:

- Demonstrations of gas temperature change during compression and decompression
- Proving Boyle's law by experiment

The bench-mounted equipment includes a backplate that holds two clear-walled cylinders containing oil (supplied). Students use hand-operated pumps (supplied) to increase or decrease the pressure in the left-hand cylinder (the reservoir) which moves a "liquid piston" of oil in the right-hand cylinder (the test cylinder). This piston compresses or decompresses a trapped column of air in the test cylinder.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Ideal Gases – Gay-Lussac's Law (TD1001) 238
- Expansion of Perfect Gas (TD1004) 239

VDAS® TD1001

IDEAL GASES – GAY-LUSSAC'S LAW

Demonstrates the relationship between pressure and temperature of a fixed volume of ideal gas.

- Demonstrates Gay-Lussac's law relating pressure and temperature of an ideal gas (air)
- Simple and safe – needs no tools, uses low pressures and a thermally-insulated heater
- Includes thermocouples and a pressure sensor connected to a digital display
- Electronic controller to accurately regulate temperature

LEARNING OUTCOMES :

- Demonstrates change of pressure of a fixed volume of gas during heating
- Proving Gay-Lussac's law by experiment
- The principle of a vapour pressure thermometer

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

The bench-mounted equipment includes a backplate that holds a low-pressure vessel. The vessel holds a fixed volume of air surrounded by an insulated heater, controlled by an electronic temperature controller.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Ideal Gases – Boyle's Law (TD1000) 237
- Expansion of Perfect Gas (TD1004) 239

VDAS® TD1004

EXPANSION OF PERFECT GAS

Bench-top apparatus to demonstrate the behaviour and expansion processes of a perfect gas.

SCREENSHOT OF THE VDAS® SOFTWARE

- A self-contained bench-top experiment, for convenient use in a laboratory
- Highly visual experiment with accurate and repeatable results
- Simple and safe to use – needs no tools
- Supplied with an electric pump for easy compression and decompression of the gas (air)
- VDAS® connectivity included featuring data acquisition via USB

The apparatus consists of two frame-mounted, interconnected transparent and rigid vessels, with one vessel equipped for operation under pressure and the second vessel under vacuum.

LEARNING OUTCOMES:

- The non-flow energy equation
- Clément Desormes experiment
- The behaviour of a perfect gas and its describing equations
- Adiabatic reversible process (isentropic expansion)
- Constant volume process
- Constant internal energy process
- Polytropic process

ALTERNATIVE PRODUCTS:

- Ideal Gases – Boyle's Law (TD1000) 237
- Ideal Gases – Gay-Lussac's Law (TD1001) 238

VDAS® TE78

FILMWISE AND DROPWISE CONDENSATION AND BOILING

Demonstrates heat transfer during different boiling and condensing processes.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Has a glass vessel so students can see what is happening
- Demonstrates nucleate, film and sub-cooled boiling
- Demonstrates condensation on different surface finishes
- Demonstrates filmwise and dropwise condensation

LEARNING OUTCOMES:

- Boiling heat transfer
- Condensing heat transfer

Gives students an understanding of heat transfer during boiling and condensing. The equipment heats and condenses water, and includes a separate control module with a digital display.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

HIGH QUALITY - SHORT LEAD TIMES

To ensure high quality and short lead times, products are designed and manufactured in the in-house facility near Nottingham in the UK.

VDAS® TD1011

EMISSIVITY – NATURAL CONVECTION AND RADIATION

Demonstrates students how different types of heat can transfer over a range of pressures.

SCREENSHOT OF THE VDAS® SOFTWARE

- Helps students to understand natural 'free' convection, radiation, emissivity and the Stefan Boltzman equation
- Includes a pressure vessel to allow tests above and below atmospheric pressure
- All instruments and vacuum pump included
- Test results are accurate enough to allow extrapolation down to a complete vacuum
- VDAS® connectivity included featuring data acquisition via USB

LEARNING OUTCOMES:

- Determination of emissivity
- Verification of the Stefan Boltzmann constant

The Natural Convection and Radiation equipment allows the study of heat transfer at different pressures and partial vacuums. It demonstrates the differences between radiation and natural 'free' convection. It allows students to find the emissivity of a surface and verify the Stefan Boltzman equation. It also gives students an understanding of the non-dimensional characteristics using Nusselt, Grasof, Prandtl and Knudsen numbers.

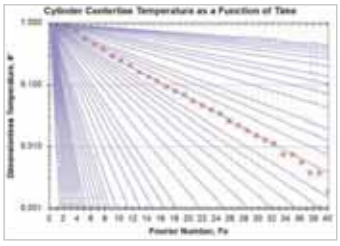
ALTERNATIVE PRODUCTS:

- Free and Forced Convection (TD1005) 249
- Radiant Transfer Experiments (TD1003) 256

VDAS® TD1009

UNSTEADY STATE HEAT TRANSFER

Measures unsteady state heat transfer to bodies of different shape and thermal conductivity.



HEISLER CHART CREATED BY THE VDAS® SOFTWARE

TEST SHAPES

- Includes TecQuipment's Versatile Data Acquisition System (VDAS®)
- Includes a set of different solid shapes of different materials – for multiple experiments
- Simple to use – needs no tools
- Water temperature controller for consistent results
- Clear digital displays of all readings – a computer is not required to operate or take readings from the equipment

LEARNING OUTCOMES:

- Transient temperature changes with sudden immersion (unsteady state)
- How shape and surface area affect heat transfer
- How materials of different thermal conductivity affect heat transfer

A sturdy, bench-mounting frame contains a hot water vessel and instrumentation. The test shapes are of different dimensions and material to give different heat transfer areas and thermal conductivities. This gives multiple experiments in heat transfer.

TD1

FORCED CONVECTION HEAT TRANSFER

Demonstrates forced convection in pipes and heat transfer theory.

- Constant-speed fan with variable flow-control valve for better flow control
- Heater interlock for safety
- Includes Pitot tube traverse for velocity profile measurements, and traversing thermocouple to measure temperature distribution across the test pipe
- Includes thermocouples along the test pipe to measure heat transfer

LEARNING OUTCOMES:

- Derivation of the value of Nusselt number (*Nu*) and comparison with empirical formula
- Calculation of the local heat transfer coefficient (*h*)
- Determination of the Stanton number (*St*)
- Calculation of the friction factor (*f*) and comparison with experimental value
- Determination of the validity of the Reynolds analogy for air

A basic knowledge of forced convection heat transfer theory is valuable in many engineering fields, especially heat-exchanger design. TecQuipment's Forced Convection Heat Transfer apparatus allows students to examine the theory and associated formulae related to forced convection in pipes.

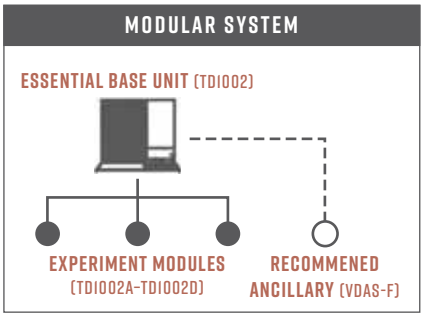
ALTERNATIVE PRODUCTS:

- Cross-Flow Heat Exchanger (TE93) 255
- Free and Forced Convection (TD1005) 249
- Water-to-Air Heat Exchanger (TD1007) 257

VDAS® TD1002

HEAT TRANSFER EXPERIMENTS BASE UNIT

Base unit for a range of optional experiments that study different methods of heat transfer.



FEATURES:		BENEFITS:
A self-contained bench-top base unit with four optional experiments	→	Modular approach reduces total laboratory costs
Foolproof fittings allow students to change and connect the optional experiments quickly and easily (needs no tools)	→	Simple and safe to use – self-sealing connectors prevents spillage of water
Clear digital displays of all readings	→	No computer needed to operate it or take readings – simplified approach enhances student learning
The experiments each have a bedplate with a clear schematic diagram to show students how they connect, and the measuring point positions	→	Maximises teaching effectiveness – simple to set up and students can easily understand the experiment

The Heat Transfer Experiments Base Unit (TD1002) is the core of the TD1002 range. It provides cold water and heater power to the optional experiments and all the instruments needed to measure their performance.

AVAILABLE EXPERIMENT MODULES:

- Linear Heat Conduction Experiment (TD1002a) 245
- Radial Heat Conduction Experiment (TD1002b) 246
- Extended Surface Heat Transfer Experiment (TD1002c) 247
- Conductivity of Liquids and Gases Experiment (TD1002d) 248

RECOMMENDED ANCILLARIES:

- VDAS-F (frame-mounted version of the Versatile Data Acquisition System) 293

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

ALTERNATIVE PRODUCTS:

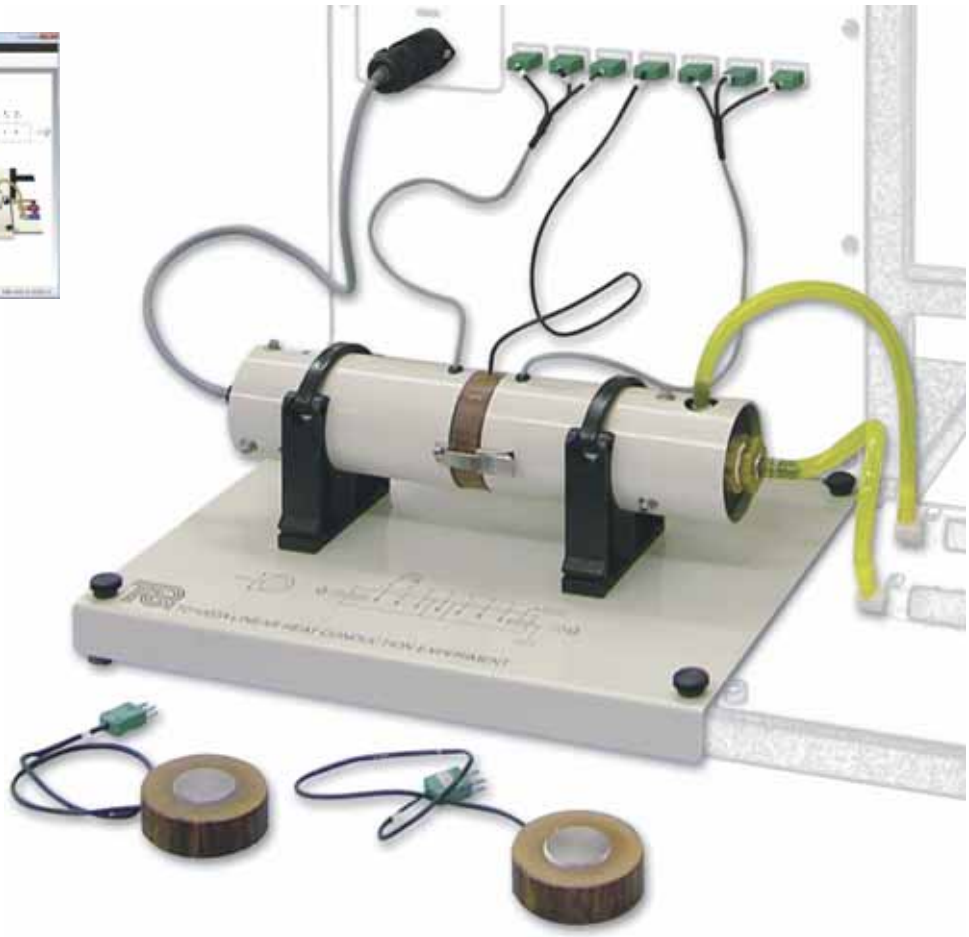
- Free and Forced Convection (TD1005) 249
- Radiant Transfer Experiments (TD1003) 256

TD1002A

LINEAR HEAT CONDUCTION EXPERIMENT

Introduces students to the principles of linear heat conduction and thermal conductivity.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE



- One of four optional experiments for the Heat Transfer Experiments Base Unit (TD1002)
- Fits quickly and easily onto the Heat Transfer Experiments Base Unit and water connections have self-sealing quick connectors – needs no tools
- Demonstrates the principles of linear heat conduction along a rod of uniform diameter
- Clear schematic printed on the baseplate aids student understanding

LEARNING OUTCOMES:

- Demonstration and calculations of linear heat conduction
- Calculation of the thermal conductivity (k value)
- Demonstration of the effectiveness of thermal paste
- Demonstration and calculations of thermal resistances (R value) in series
- Demonstration of 'thermal lag'

This experiment has a solid brass bar of circular cross-section, made in two sections with an interchangeable middle section. It mounts on a base plate with a clear schematic of the experiment layout.

ESSENTIAL BASE UNIT:

- Heat Transfer Experiments Base Unit (TD1002) 244

TD1002B

RADIAL HEAT CONDUCTION EXPERIMENT

Introduces students to the principle of radial heat conduction and thermal conductivity.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- One of four optional experiments for the Heat Transfer Experiments Base Unit (TD1002)
- Fits quickly and easily onto the base of the Heat Transfer Experiments Base Unit and water connections have self-sealing quick connectors – needs no tools
- Demonstrates the principles of radial heat conduction around a disc of uniform diameter
- Clear schematic printed on the baseplate aids student understanding

LEARNING OUTCOMES:

- Demonstration and calculations of radial heat conduction
- Calculation of the thermal conductivity (k value)

This experiment has a solid brass disc with an electric heater (heat source) at its centre and a circular cross-section cooling tube (heat sink) around its circumference. It mounts on a base plate with a clear schematic of the experiment layout.

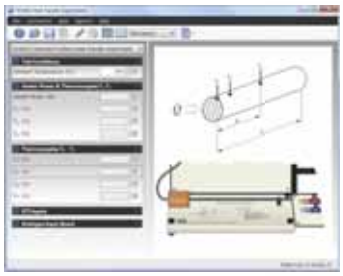
ESSENTIAL BASE UNIT:

- Heat Transfer Experiments Base Unit (TD1002) 244

TD1002C

EXTENDED SURFACE HEAT CONDUCTION EXPERIMENT

Demonstrates an example of conduction combined with losses due to radiation and convection.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- One of four optional experiments for the Heat Transfer Experiments base unit (TD1002)
- Fits quickly and easily onto the Heat Transfer Experiments Base Unit and water connections have self-sealing quick connectors – needs no tools
- Demonstrates how a long thin rod conducts heat along it and how heat is lost due to radiation and convection
- Clear schematic printed on the baseplate aids student understanding

LEARNING OUTCOMES:

- To demonstrate how heat transfers from the surface of a solid bar or rod.
- To demonstrate the temperatures on, and heat flow through, the solid bar to its surroundings.

This experiment has a thin solid bar with an electric heater (heat source) at one end. It mounts on a base plate with a clear schematic of the experiment layout.

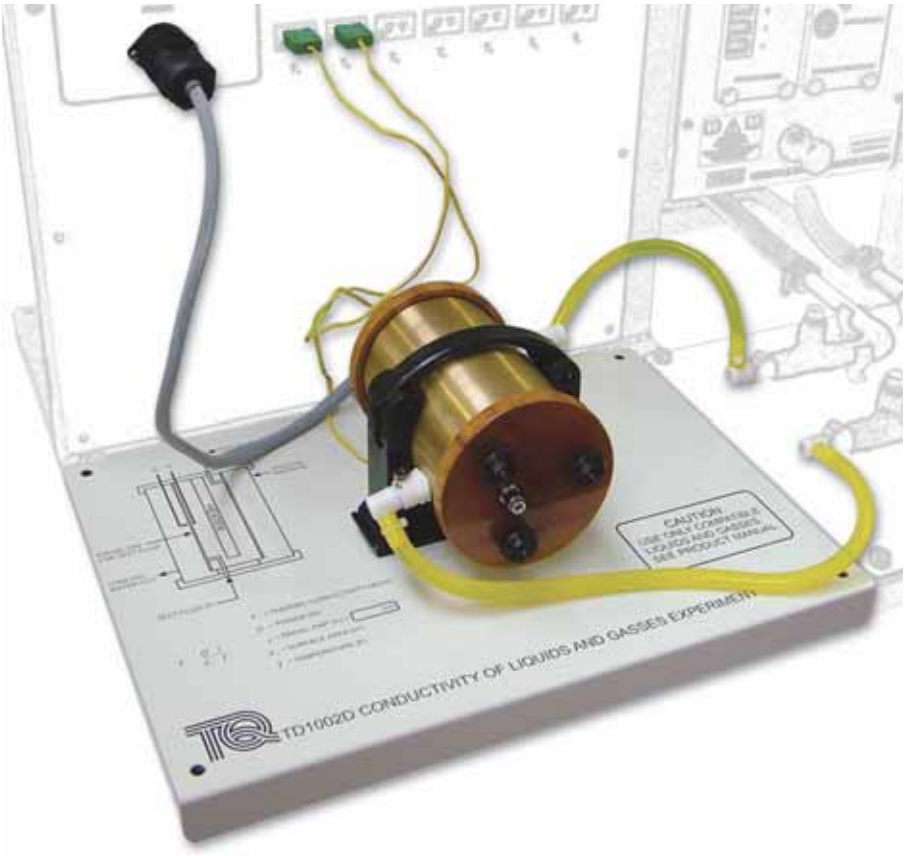
ESSENTIAL BASE UNIT:

- Heat Transfer Experiments Base Unit (TD1002) 244

TD1002D

CONDUCTIVITY OF LIQUIDS AND GASES EXPERIMENT

Allows students to test various fluids to find their thermal conductivity.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- One of four optional experiments for the Heat Transfer Experiments base unit (TD1002)
- Fits quickly and easily onto the Heat Transfer Experiments Base Unit and water connections have self-sealing quick connectors – needs no tools
- Allows students to measure the thermal conductivity of various compatible liquids and gases
- Clear schematic printed on the baseplate aids student understanding

LEARNING OUTCOMES:

- Calibration of the unit using air as the known medium.
- Finding the thermal conductivity (k) of various liquids and gases and comparing them to typical published values .

This experiment has three concentric cylinders. The inner cylinder contains an electric heater (the heat source). The test liquid or gas forms a second, thin cylinder around the heat source. The third cylinder, cooled by water, surrounds them both to make a heat sink. The whole assembly is mounted on a base plate with a clear schematic of the experiment layout.

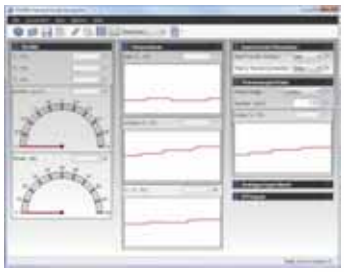
ESSENTIAL BASE UNIT:

- Heat Transfer Experiments Base Unit (TD1002) 244

VDAS® TD1005

FREE AND FORCED CONVECTION

Illustrates free and forced convection from different heat transfer surfaces.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Includes three of the most common heat transfer surfaces – flat plate, pinned and finned
- Thermocouples and a sensitive anemometer measure temperatures and air velocity – shown on a digital display
- Additional hand-held thermocouple probe included – to measure temperatures along the length of the pins and fins of two heat transfer surfaces
- Variable-speed fan and variable-power heat source for a range of tests

LEARNING OUTCOMES:

- Comparing free and forced convection for different surfaces
- Comparison of free convection from vertical and horizontal (finned) surfaces
- Comparison of heat transfer surface efficiency
- Comparing the coefficient of heat transfer and Nusselt number for forced and free convection
- Temperature distribution along finned and pinned surfaces

The bench-top equipment includes a vertical duct that holds the chosen heat transfer surface and all instruments needed. TecQuipment include three different common heat transfer surfaces with the equipment.

RECOMMENDED ANCILLARIES:

- Bench-mounted version of the Versatile Data Acquisition System (VDAS-B) 293

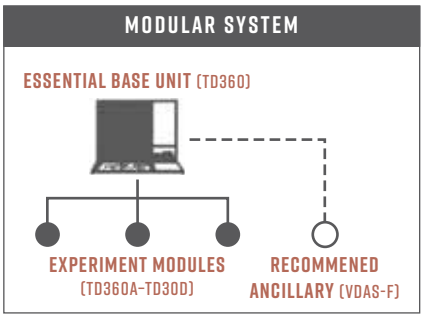
ALTERNATIVE PRODUCTS:

- Forced Convection Heat Transfer (TD1) 243
- Heat Transfer Experiments (TD1002) 244
- Emissivity – Natural Convection and Radiation (TD1011) 241
- Cross-Flow Heat Exchanger (TE93) 255
- Water-to-Air Heat Exchanger (TD1007) 257

VDAS® TD360

BENCH-TOP HEAT EXCHANGERS SERVICE MODULE

Examines and compares small-scale heat exchangers to help students understand how they work.



FEATURES:	BENEFITS:
A bench-top service module with optional small-scale demonstration heat exchangers – designed for teaching	→ Efficient use of valuable laboratory space
Optional heat exchangers include most common types used in industry (tubular, plate, shell and tube, and a jacketed vessel with coil and stirrer)	→ Qualitative and quantitative comparison of main heat exchanger designs
Foolproof fittings allow students to change and connect the optional experiments quickly and easily (needs no tools)	→ Simple and safe to use – self-sealing connectors prevents spillage of water
Heat-exchangers each have a bedplate with a clear schematic diagram to help students understand how to connect it	→ Easy to set up and operate – maximises students' practical time

The Bench-top Heat Exchangers Service Module (TD360) is the core of the bench-top heat exchangers range. It provides hot and cold water to the heat exchangers and all the instruments needed to measure their performance.

AVAILABLE EXPERIMENT MODULES:

- Concentric Tube Heat Exchanger (TD360a) 251
- Plate Heat Exchanger (TD360b) 252
- Shell and Tube Heat Exchanger (TD360c) 253
- Jacketed Vessel with Coil and Stirrer (TD360d) 254

RECOMMENDED ANCILLARIES:

- Frame-mounted version of the Versatile Data Acquisition System (VDAS-F) 293

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

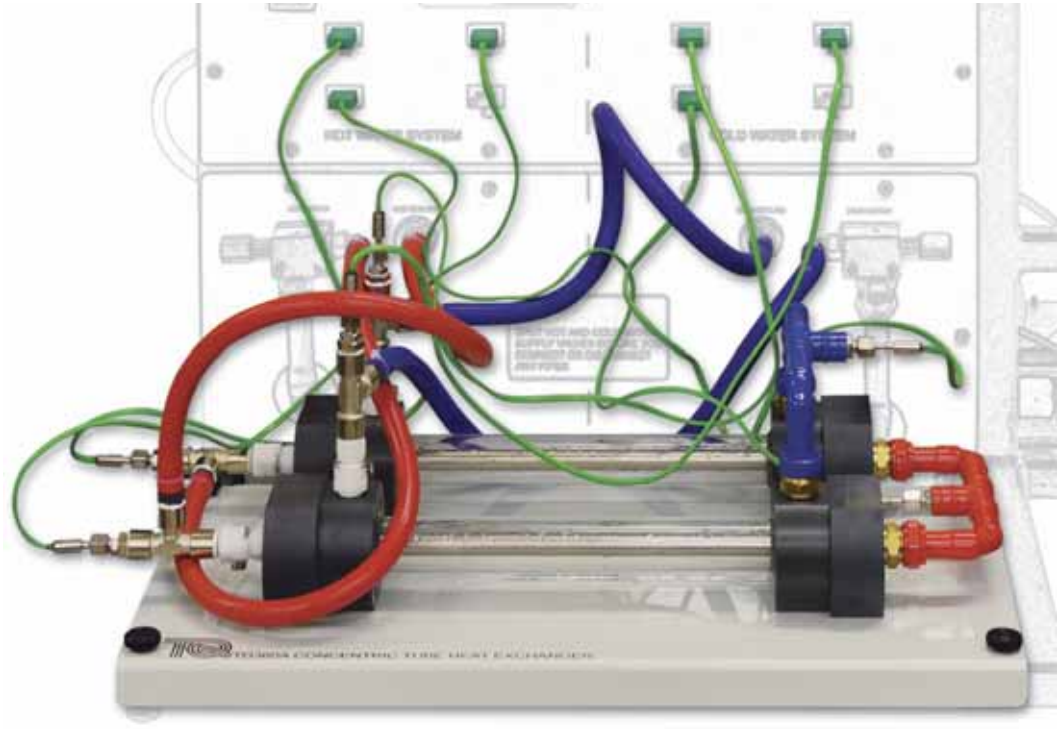
ALTERNATIVE PRODUCTS:

- Cross-Flow Heat Exchanger (TE93) 255
- Water-to-Air Heat Exchanger (TD1007) 257

TD360A

CONCENTRIC TUBE HEAT EXCHANGER

Illustrates how a simple concentric shell and tube heat exchanger works.



- One of a set of optional heat exchangers for use with TecQuipment's TD360 Service Module
- Simple and safe to use – foolproof fittings allow students to change and connect the heat exchanger quickly and easily (needs no tools)
- Clear outside casing, so students can see its construction
- Bedplate with a clear schematic diagram to help students understand how to connect the heat exchanger

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Demonstration of heat transfer from one fluid to another through a solid wall.
- Energy balance and efficiency calculations.
- Demonstration of parallel-flow and counter-flow operation of heat exchangers.
- Measurement of the heat transfer coefficient, and the effect of fluid flow rates and the driving force (temperature differential) upon it.
- Introduction to the logarithmic mean temperature difference in heat exchangers.
- Comparison of different types of heat exchanger in terms of performance, size and relative cost (only if two or more optional heat exchangers have been bought).

This is the simplest of the optional heat exchangers. It has two tubes, one inside the other. One tube carries hot fluid, the other carries cold fluid.

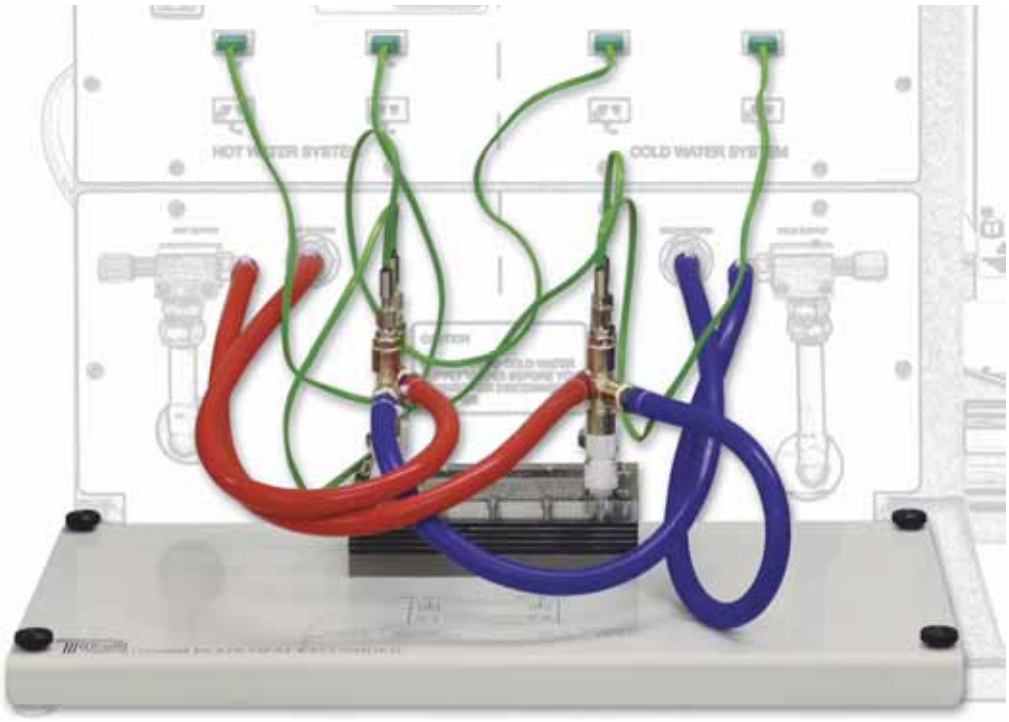
ESSENTIAL BASE UNIT:

- Service Module (TD360) 250

TD360B

PLATE HEAT EXCHANGER

Illustrates how a compact plate heat exchanger works.



- One of a set of optional heat exchangers for use with TecQuipment's TD360 Service Module
- Simple and safe to use – foolproof fittings allow students to change and connect the heat exchanger quickly and easily (needs no tools)
- Clear outside casing, so students can see its construction
- Bedplate with a clear schematic diagram to help students understand how to connect the heat exchanger

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Demonstration of heat transfer from one fluid to another through a solid wall.
- Energy balance and efficiency calculations.
- Demonstration of parallel-flow and counter-flow operation of heat exchangers.
- Measurement of the heat transfer coefficient, and the effect of fluid flow rates and the driving force (temperature differential) upon it.
- Introduction to the logarithmic mean temperature difference in heat exchangers.
- Comparison of different types of heat exchanger in terms of performance, size and relative cost (only if two or more optional heat exchangers have been bought).

This heat exchanger is a set of metal plates separated by spacers (gaskets). The plates and gaskets have holes that make the hot and cold flow run on alternate sides of the plates, thereby transferring heat.

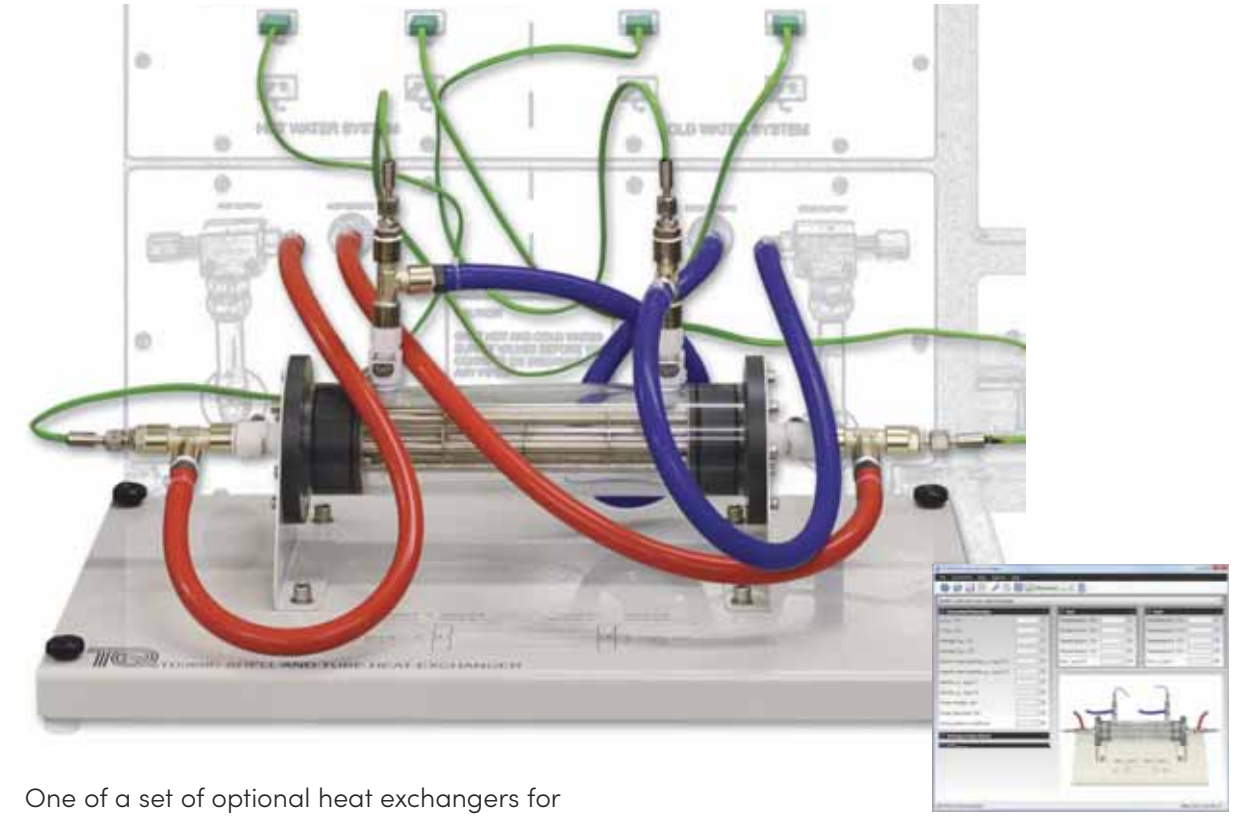
ESSENTIAL BASE UNIT:

- Service Module (TD360) 250

TD360C

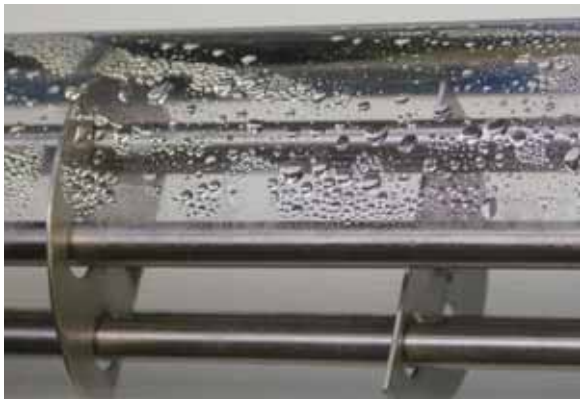
SHELL AND TUBE HEAT EXCHANGER

Illustrates how a compact shell and tube bundle heat exchanger works.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- One of a set of optional heat exchangers for use with TecQuipment's TD360 Service Module
- Simple and safe to use – foolproof fittings allow students to change and connect the heat exchanger quickly and easily (needs no tools)
- Clear outside casing, so students can see its construction
- Bedplate with a clear schematic diagram to help students understand how to connect the heat exchanger



LEARNING OUTCOMES:

- Demonstration of heat transfer from one fluid to another through a solid wall.
- Energy balance and efficiency calculations.
- Demonstration of parallel-flow and counter-flow operation of heat exchangers.
- Measurement of the heat transfer coefficient, and the effect of fluid flow rates and the driving force (temperature differential) upon it.
- Introduction to the logarithmic mean temperature difference in heat exchangers.
- Comparison of different types of heat exchanger in terms of performance, size and relative cost (only if two or more optional heat exchangers have been bought).

This heat exchanger is one of the most common types used in industry. This is because it is compact, but can work at higher pressures than other designs. It is a large tube (shell) which surrounds several smaller tubes (a bundle).

ESSENTIAL BASE UNIT:

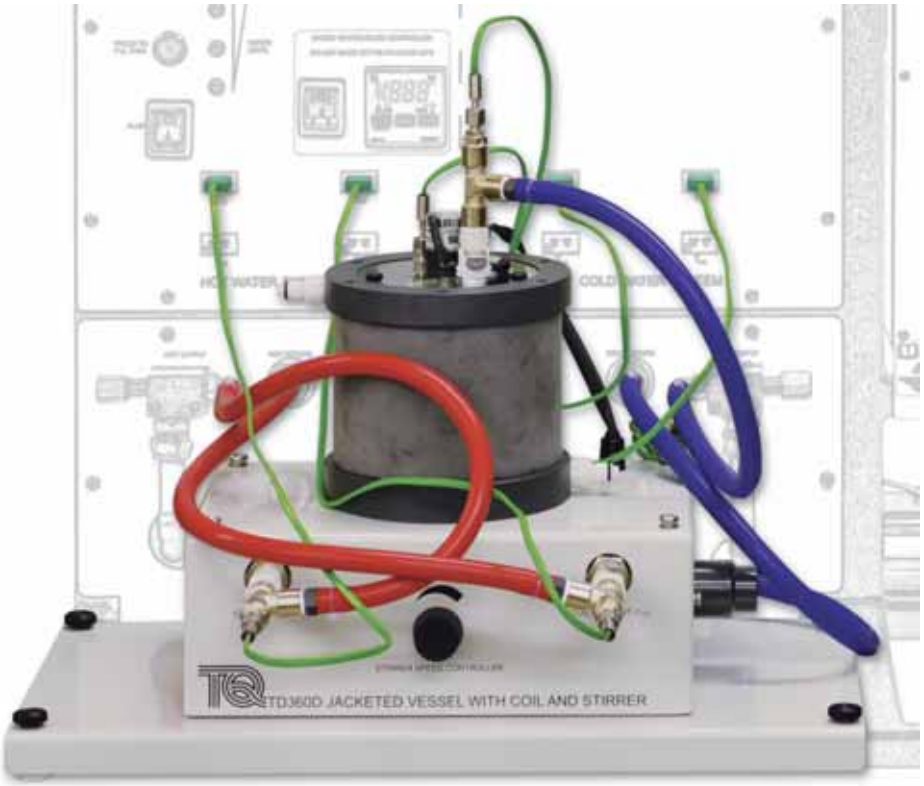
- Service Module (TD360) 250

TD360D

JACKETED VESSEL WITH COIL AND STIRRER

Illustrates how a 'jacketed vessel' heat exchanger works and how stirring affects heat transfer.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE



- One of a set of optional heat exchangers for use with TecQuipment's TD360 Service Module
- Simple and safe to use – foolproof fittings allow students to change and connect the heat exchanger quickly and easily (needs no tools)
- Clear top cover, so students can see its construction
- Jacketed vessel with internal coil and stirrer for batch or continuous heating tests

LEARNING OUTCOMES:

- Demonstration of heat transfer from one fluid to another through a solid wall.
- Introduction to the logarithmic mean temperature difference in heat exchangers.
- Comparison of different types of heat exchanger in terms of performance, size and relative cost (only if two or more optional heat exchangers have been bought).
- Flow-through and batch heating, with or without stirring, using a heating jacket or a coil.

This heat exchanger mimics those used in the process industry. It can demonstrate heat transfer by using the outer skin (or 'jacket') of the vessel, or by a coil inside the vessel. You can set a continuous feed to the vessel for heating, or you set a fixed batch for heating.

ESSENTIAL BASE UNIT:

- Service Module (TD360) 250

VDAS® TE93

CROSS-FLOW HEAT EXCHANGER

For studies into the principles and performance of heat exchangers.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- For full understanding of heat exchange by forced convection and measurement of heat transfer
- Consists of wind tunnel with fully controllable air flow and heat exchanger rod matrix
- Separate pre-heated element with built-in thermocouple can take the place of any heat exchanger rod
- Instrumentation unit also includes controlled heat source to pre-heat element

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Forced Convection Heat Transfer (TD1) 243
- Bench-top Heat Exchangers (TD360) 250
- Free and Forced Convection (TD1005) 249
- Water-to-Air Heat Exchanger (TD1007) 257

For comprehensive studies into the principles and performance of heat exchangers. The equipment allows students to quickly assess heat transfer rates by forced convection. They monitor the rate of cooling of a body of known thermal capacity in an air flow.

LEARNING OUTCOMES:

Typical experiments include:

- Determining the pressure losses created by the heat exchange rods and creating a chart of pressure drop against upstream pressure.
- Calculating the inlet velocity and the mean velocity through the rods.
- Determining the rate at which the heated rod cools down, within a bank of rods and by itself.
- Plotting 'cooling curves' and using them to find the coefficient of heat transfer (h) for the heated rod at various positions in the heat exchanger.
- Determining the velocity distribution (profile) downstream of the rods.
- Converting results into dimensionless values (typically using Nusselt, Prandtl and Reynolds equations).
- Comparing results and producing heat transfer coefficient curves.

VDAS® TD1003

RADIANT TRANSFER EXPERIMENTS

Demonstrates the laws of radiant transfer from heat and light sources.

- Uses a safe, low-voltage heat source and thermopile (heat flux sensor) for radiant heat transfer experiments
- Includes plates of different heat absorption properties and apertures for extra experiments in heat transfer
- Uses a safe, low-voltage 'integrating sphere' light source and lux meter (light meter) for light transfer experiments
- Includes different optical filters for extra experiments in light transfer

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

HEAT:

- Inverse square law (or Lambert's distance law/area law) – demonstrating that radiation is inversely proportional to distance squared.
- Stefan Boltzmann law – demonstrating the relationship between radiation and source temperature.
- Kirchhoff's law – demonstrating that a body with good emissivity also has good absorptivity.
- Area factor – demonstrating that radiation transfer depends on the exposed area of the radiant source.

LIGHT:

- Inverse square law (or Lambert's distance law/area law) – demonstrating radiation is inversely proportional to distance squared.
- Lambert's direction law (or cosine law) – demonstrating that radiation is proportional to the cosine of the angle between the emitter and the receiver.
- Transmittance and absorbance – demonstrating that optical filters can reduce light intensity.

The equipment has two parts: an aluminium experiment frame and a control box. The frame holds all the experiment parts and allows the user to slide the parts along easily for experiments of transfer over distances. The control box contains the electrical controls and displays of the measured readings.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Heat Transfer Experiments (TD1002) 244
- Emissivity – Natural Convection and Radiation (TD1011) 241

DATASHEETS ONLINE

Download comprehensive product datasheets for full technical specifications.

TECQUIPMENT.COM

VDAS® TD1007

WATER-TO-AIR HEAT EXCHANGER

Illustrates how cross-flow water-to-air heat exchangers work.

16-TUBE HEAT EXCHANGER (TD1007A)

FINNED HEAT EXCHANGER (TD1007B)

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

FEATURES:		BENEFITS:
Includes one heat exchanger as standard	→	Complete experiment 'out of the box'
Two additional heat exchangers available for extended experiments	→	Allows quantitative comparison of different designs of heat exchanger
Heat exchangers have transparent sides and schematic diagrams	→	Enhanced learning capabilities – helps students understand how they work and how to connect them
Foolproof fittings allow students to change and connect the optional experiments quickly and easily (needs no tools)	→	Simple and safe to use – self-sealing connectors prevents spillage of water

CONTINUED ON NEXT PAGE

LEARNING OUTCOMES:

- Heat transfer between fluids through a solid wall
- Energy balance and efficiency
- Finding the heat transfer coefficient and Log Mean Temperature Difference (LMTD)
- Effect of water temperature (the 'driving force')
- Comparison of heat exchangers of different construction and heat transfer area (needs optional TD1007a and TD1007b)

Many thermodynamic applications use water-to-air heat exchangers. Examples include using circulated water to heat or cool air in an HVAC installation, or to cool hot water using a flow of air, as in the radiator of a combustion engine.

The TecQuipment Water-to-Air Heat Exchanger mirrors air heating and water cooling applications. It fits on a bench top and includes a hot water supply, a cooling air duct and all instruments needed for tests on cross-flow heat exchangers. The heat output of the design produces good results without greatly affecting the temperature of a reasonably-sized classroom or laboratory.

RECOMMENDED ANCILLARIES:

- 16-Tube Heat Exchanger (TD1007a)
- 16-Tube Finned Heat Exchanger (TD1007b)
- VDAS-F (frame-mounted version of the Versatile Data Acquisition System) 293

ALTERNATIVE PRODUCTS:

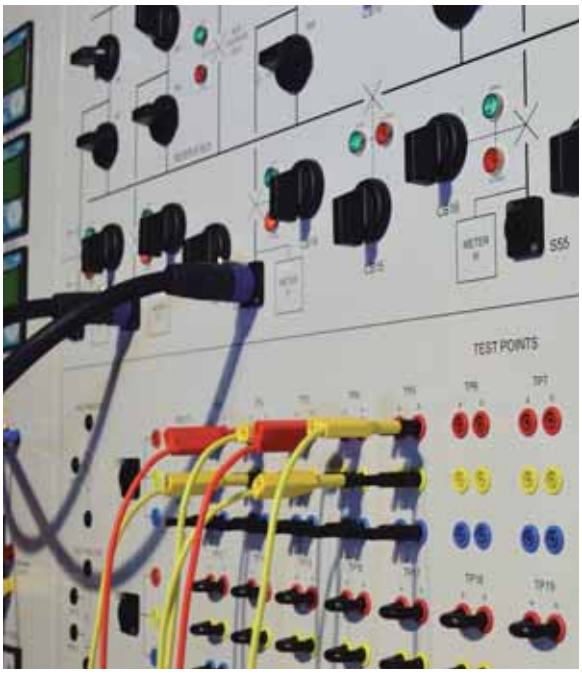
- Bench-Top Heat Exchangers (TD360) 250
- Cross-Flow Heat Exchanger (TE93) 255
- Free and Forced Convection (TD1005) 249
- Forced Convection Heat Transfer (TD1) 243

ELECTRICAL POWER SYSTEMS RANGE

The TecQuipment Electrical Power Systems range is the most advanced and comprehensive educational range for power systems in the industry, covering all elements of a power system including:

- Generation
- Transmission
- Transformation
- Utilisation
- Protection
- Distribution

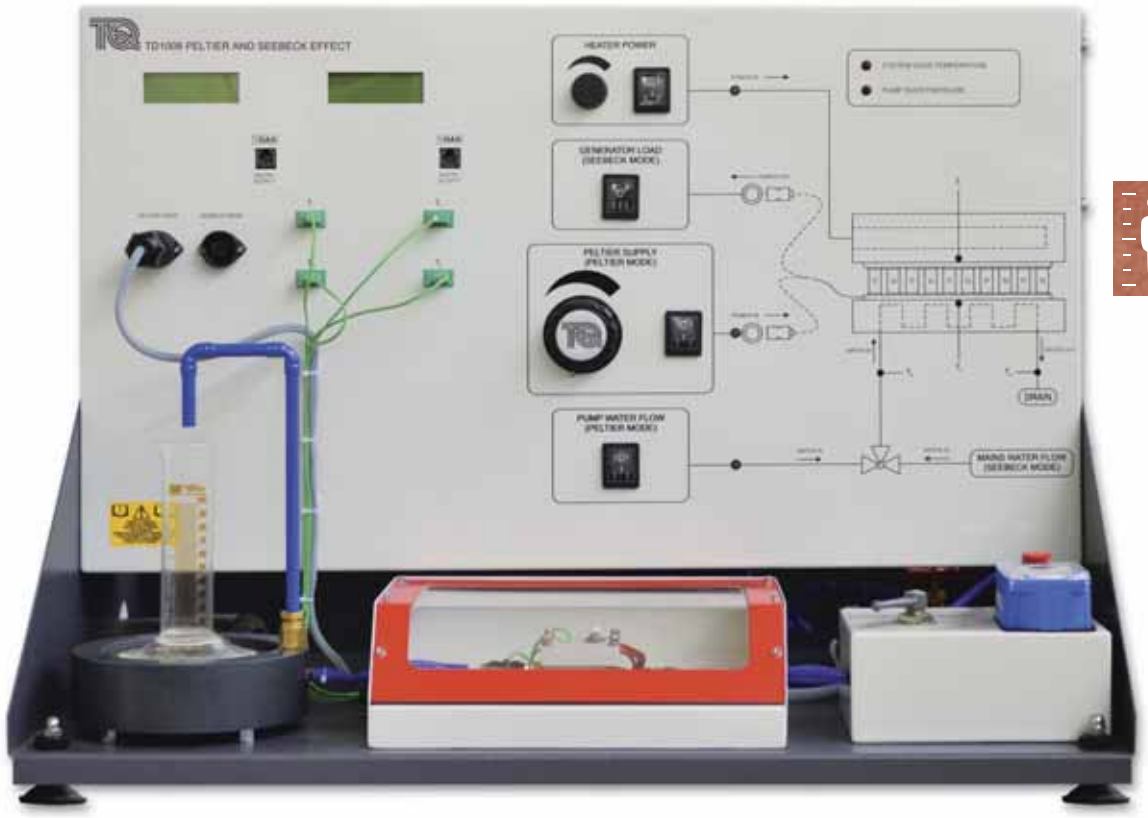
Visit HTTPS://INDUSTRIAL.TECQUIPMENT.COM for more information.



VDAS® TD1008

PELTIER AND SEEBECK EFFECT

Examines the performance of a thermoelectric device when connected for Peltier or Seebeck tests as a heat pump or generator.



SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

ICE CRYSTALS FORMING ON THE MODULE

- Connects for both Peltier or Seebeck tests – giving a full set of experiments
- Schematic diagram and transparent guard to help students understand the device construction and allow simple demonstrations
- A switchable load, variable heat source and device power supply for multiple test conditions
- Clear, multiline digital displays of all readings – you do not need a computer to operate it or collect data

LEARNING OUTCOMES:

- Seebeck coefficient and the performance of a thermoelectric generator (TEG)
- Peltier heat pump tests and the performance of a thermoelectric cooler (TEC)
- Coefficient of performance (COP) and energy balance
- Comparisons of manufacturers' data, theoretical performance and results from experiments
- Observation of the Lenz and Thomson effects
- Simple cooling demonstrations (determined by local conditions)

The increasing need for smaller and more portable electrically powered equipment has produced a need for low maintenance, smaller and more portable cooling. To satisfy this need, manufacturers now use solid-state thermoelectric devices in computers, portable refrigerators and cool boxes.

RECOMMENDED ANCILLARIES:

- VDAS-B (bench-mounted version of the Versatile Data Acquisition System) 293

VDAS® TD400

TEMPERATURE MEASUREMENT AND CALIBRATION

Studies the accuracy, linearity and important characteristics of popular temperature measuring devices.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Uses a platinum resistance thermometer as a reference to accurately calibrate the other devices
- Demonstrates how electrical resistance devices and thermocouples work, their characteristics and how to connect them correctly to reduce measurement errors
- Hand-held digital thermometer for thermal infrared measurements
- Built-in water heater tank with protective guard and drain tap for safe experiments
- Built-in pressure sensor (barometer) with display of local water boiling temperature

LEARNING OUTCOMES:

- Simulation of two, three and four wire connection of a platinum resistance thermometer (PRT)
- Constant current and voltage sources
- Calibration and linearity of temperature measurement devices and temperature lag
- Thermal infrared temperature measurement on surfaces of different emissivity
- Thermocouples in series, parallel and the Seebeck effect
- Resistance in thermocouple circuits

The Temperature Measurement and Calibration apparatus fits on a desk or bench top. It includes eight different temperature measurement devices and demonstrates their characteristics and how to calibrate them against a standard.

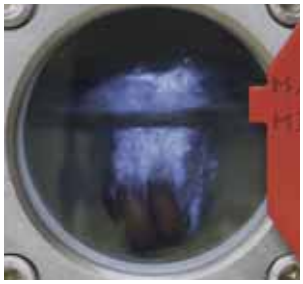
RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

VDAS® TD1006

SATURATED STEAM – THE MARCET BOILER

Illustrates the pressure and temperature relationship for saturated steam.



- Proves the Antoine equation for saturated steam
- Vessel (boiler) has viewing window to see the boiling process and the water level
- Simple and safe to use – includes temperature cut-out switches and a pressure-relief valve
- Electronic sensors measure boiler temperature and pressure – shown on a digital display in both SI and traditional units (including absolute values)

LEARNING OUTCOMES:

- Variation of saturated steam pressure with temperature
- Confirmation of the Antoine equation

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

The Marcet boiler is a simple experiment to demonstrate the relationship between pressure and temperature for saturated (wet) steam for comparison with published results.

The apparatus consists of a rigid frame containing an insulated pressure vessel (boiler) and an instrumentation and control unit. The frame also has extra space for the optional VDAS® interface.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

ALTERNATIVE PRODUCTS:

- Superheated Steam Plant Performance (TD1050) 277

GT103

TWO-STAGE COMPRESSOR TEST SET

Illustrates how single and two-stage compressors work, and the thermodynamic properties.

- Works as single-stage, two-stage or two-stage intercooled compressor
- Independently controlled compressor units, both with variable-speed dynamometer drives
- Clear, fully-instrumented control panel with mimic diagram
- Completely fail-safe operation – interlocks and pressure-relief valves prevent misuse

This test set has two independently-controlled, motor-driven compressors, intercooler and air receiver. It works as a single-stage, two-stage or two-stage compressor with intercooler. All controls and instrumentation are on an easy-to-operate mimic panel.

RECOMMENDED ANCILLARIES:

- Pressure Indicator (GT103a)

NOTE: You need a modern computer with a spare USB 2.0 socket to setup and analyse the pressure indicator results.

ALTERNATIVE PRODUCTS:

- Reciprocating Compressor Module (MFP104) 141

LEARNING OUTCOMES:

A range of experiments and tests based on:

- Volumetric, mechanical and isothermal efficiency
- Indicated work done
- Motor output power (compressor shaft power)
- Pressure ratio
- Temperature ratio
- Inlet dryness calculations
- P-V indicator diagram (needs optional pressure indicator)
- Effect of inter-stage cooling on compressor total power requirements and effect on cycle temperatures
- Effect of two-stage compression and inter-stage pressure on power requirements

ENGINES

INTERNAL COMBUSTION ENGINE TEST SETS	265
STEAM	277
GAS TURBINES	278

“

For a number of years we have procured laboratory-based teaching resources from TecQuipment. Operation of this equipment, coupled with the robust build quality, provides our students with a clear understanding of the intrinsic features behind thermo-fluids and mechanical principles. This instills confidence for a safe, hands-on experience demonstrating these principles in practice. Furthermore, the build quality of TecQuipment products also gives assurance that the investment made satisfies our ongoing teaching needs well into the future.

GRAHAM PREECE
FACULTY OF COMPUTING, ENGINEERING AND SCIENCES, STAFFORDSHIRE UNIVERSITY

ENGINES

POWERFUL SOFTWARE

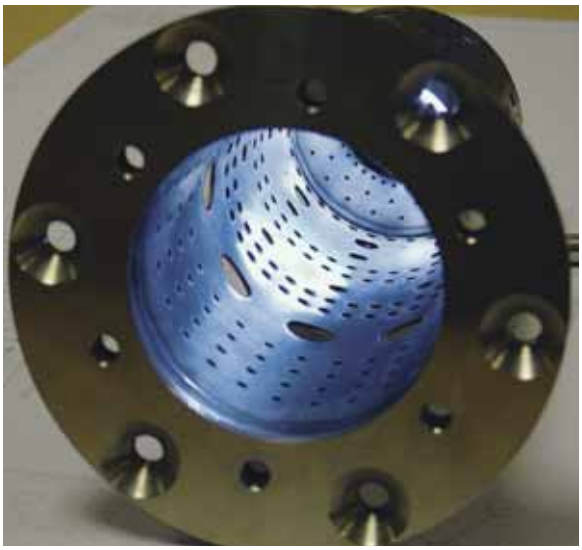
All of the products in the Engines range work with specialist software for detailed data acquisition and engine cycle analysis. The different software options are designed specifically for each unit and provide a powerful tool for students' understanding of complex principles.

WIDE RANGE

Steam, internal combustion engines and gas turbines – the range offers the opportunity for students to understand how mechanical power is produced and their relevant efficiencies with various different techniques.

KEY FEATURES AND BENEFITS:

- **MODULAR:** Entry level packages with further options available.
- **DESIGNED FOR SAFETY:** Suitable for all university student levels.



FOR ALL TERTIARY EDUCATION LEVELS

The Engines range offers equipment to meet entry level requirements through to final-year studies. Students can learn about simple four-stroke engines, before progressing to engine cycle analysis and a variety of gas turbines.

AUTOMATIC DATA ACQUISITION

VDAS® Check out the products in this range that work with TecQuipment's unique Versatile Data Acquisition System (VDAS®).
SEE PAGE 293

ADA TecQuipment's gas turbine products work with our unique Gas Turbine software.

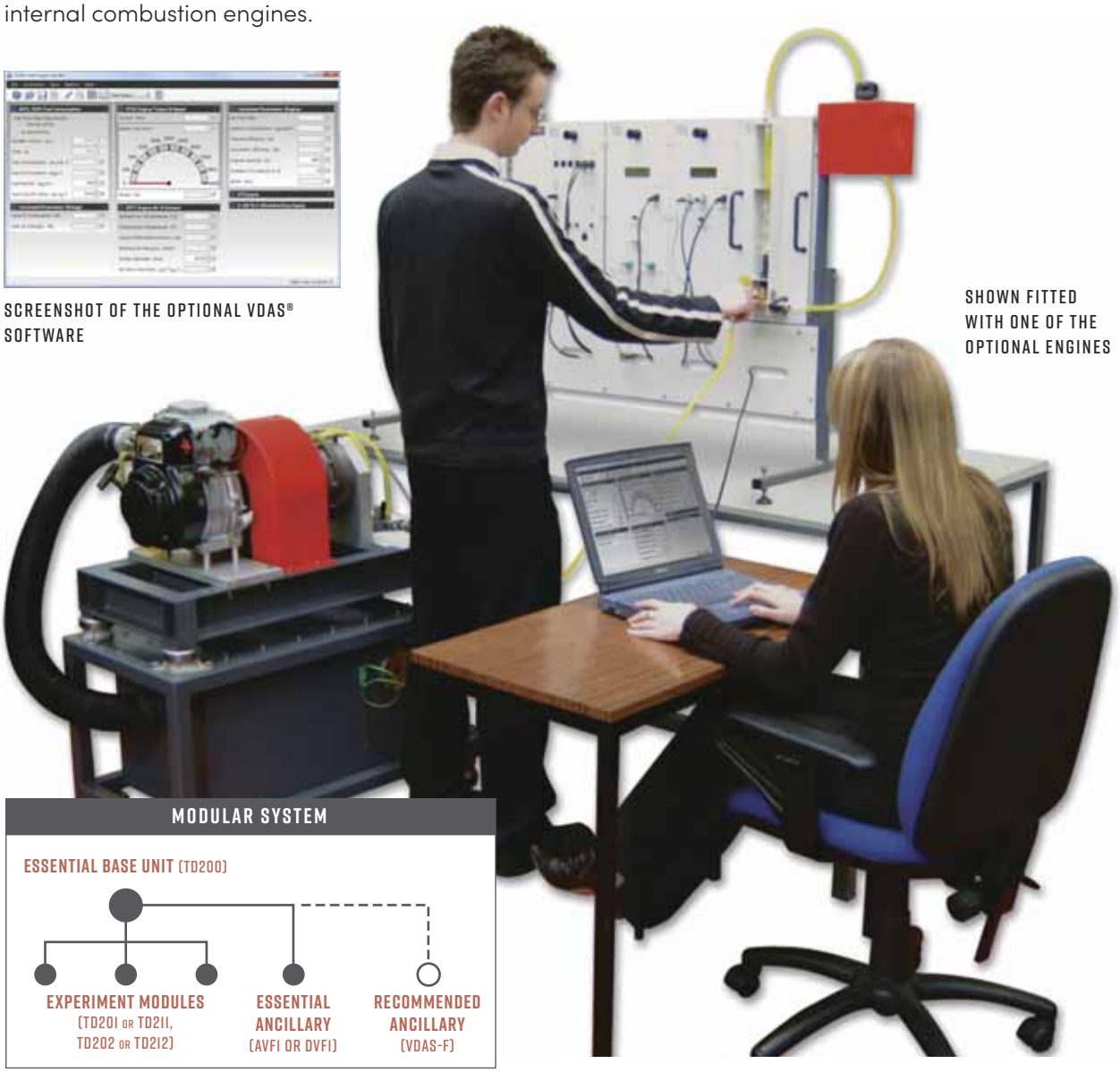
VDAS®	ADA	PRODUCT PAGE	PAGE
✓		Small Engine Test Set (TD200)	265
✓		Regenerative Engine Test Set (TD300)	270
✓		Exhaust Gas Calorimeter (TD300a)	274
✓		Automatic Volumetric Fuel Gauge (DVF1)	275
✓		Superheated Steam Plant Performance (TD1050)	277
	✓	Turbojet Trainer (GT100)	278
	✓	Turbojet Trainer with Reheat (GT100RS)	279
	✓	Two-Shaft Gas Turbine (GT185)	280

VDAS® TD200

SMALL ENGINE TEST SET

Versatile engine test bed and instrumentation for investigations into the fundamental features of internal combustion engines.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE



SHOWN FITTED WITH ONE OF THE OPTIONAL ENGINES

MODULAR SYSTEM

FEATURES:		BENEFITS:
Fully equipped test set that supports a choice of internal combustion engines	→	Saves space and reduces costs
Optional petrol and diesel engines	→	Allows comparative tests of different engines
Several engine and instrument options	→	Expands the range of studies
Separate instruments and test bed	→	Avoids transmission of vibration to give accurate, repeatable results
Robust, simple hydraulic dynamometer	→	Reliability and long life
Easy set-up – it takes minutes to remove and fit an engine	→	Maximises experiment time
Works with VDAS®	→	Quick and reliable tests with data capture

CONTINUED ON NEXT PAGE

SMALL ENGINE TEST SET (TD200) CONTINUED FROM PREVIOUS PAGE

LEARNING OUTCOMES:

A comprehensive range of investigations into the features of single-cylinder, four-stroke petrol and diesel engines including:

- Torque, speed and power relationship
- Brake mean effective pressure
- Engine performance curves
- Air and fuel consumption
- Volumetric and thermal efficiencies
- Willans line for a diesel engine

By using the recommended ancillaries and engine choices, students can investigate more features including:

- Plotting p-θ and p-V diagrams
- Engine cycle analysis
- Indicated mean effective pressure
- Indicated power
- Comparison of brake and indicated mean effective pressures
- Mechanical efficiency of the engine

A versatile hydraulic engine test bed with comprehensive instrumentation. The equipment requires minimum services, installation and outlay. When used with one of TecQuipment's optional single-cylinder engines, it safely and effectively enables study and demonstrations of the most important features of the engine.

AVAILABLE EXPERIMENT MODULES:

- Four-Stroke Petrol Engine (TD201 or TD211) 266 /268
- Four-Stroke Diesel Engine (TD202 or TD212) 267 /269

ESSENTIAL ANCILLARIES:

- Manual Volumetric Fuel Gauge (AVF1) or 275
- Automatic Volumetric Fuel Gauge with Digital Read-Out (DVF1) 275

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

ALTERNATIVE PRODUCTS:

- Regenerative Engine Test Set (TD300) 270

TD201
FOUR-STROKE PETROL ENGINE

A four-stroke, single-cylinder petrol engine for use with TecQuipment's Small Engine Test Set (TD200).

- High-quality yet cost-effective engine specially modified for educational use
- Wide range of investigations possible
- Quickly and accurately mounts on the test bed
- Includes colour-coded fuel tank with quick-release couplings

High-quality and cost-effective four-stroke, single-cylinder petrol engine. Adapted specially for education to enable effective laboratory testing and demonstrations, the engine includes an exhaust thermocouple, a half-coupling to link to the test set dynamometer and all essential hoses and fittings.

LEARNING OUTCOMES:

When used with TecQuipment's Small Engine Test Set (TD200), investigations into the performance and characteristics of a four-stroke petrol engine, including:

- Torque, speed and power relationship
- Brake mean effective pressure
- Engine performance curves
- Air and fuel consumption
- Volumetric and thermal efficiencies

ESSENTIAL BASE UNIT:

- Small Engine Test Set (TD200) 265

ALTERNATIVE PRODUCTS:

- Four-Stroke Diesel Engine (TD202) 267
- Modified Four-Stroke Petrol Engine (TD211) 268
- Modified Four-Stroke Diesel Engine (TD212) 269
- Four-Stroke Petrol Engine (TD301) 272
- Four-Stroke Diesel Engine (TD302) 273

TD202

FOUR-STROKE DIESEL ENGINE

A four-stroke, single-cylinder diesel engine for use with TecQuipment's Small Engine Test Set (TD200).

- High-quality yet cost-effective engine specially modified for educational use
- Wide range of investigations possible
- Quickly and accurately mounts on the test bed
- Includes colour-coded fuel tank with quick-release couplings

LEARNING OUTCOMES:

When used with TecQuipment's Small Engine Test Set (TD200), investigations into the performance and characteristics of a four-stroke diesel engine, including:

- Torque, speed and power relationship
- Brake mean effective pressure
- Engine performance curves
- Air and fuel consumption
- Volumetric and thermal efficiencies
- Willans line

TECQUIPMENT CAN SUPPLY ELECTRIC START ENGINES

High-quality, cost-effective four-stroke, single-cylinder diesel engine. Adapted specially for education to enable effective laboratory testing and demonstrations, the engine includes an exhaust thermocouple, a half-coupling to link to the test bed dynamometer and all essential hoses and fittings.

ESSENTIAL BASE UNIT:

- Small Engine Test Set (TD200) 265

ALTERNATIVE PRODUCTS:

- Four-Stroke Petrol Engine (TD201) 266
- Modified Four-Stroke Petrol Engine (TD211) 268
- Modified Four-Stroke Diesel Engine (TD212) 269
- Four-Stroke Petrol Engine (TD301) 272
- Four-Stroke Diesel Engine (TD302) 273

ACCOMPANYING DOCUMENT PACK

ALL THE INFORMATION YOU NEED TO GET UP AND RUNNING

With all products you receive a pack of documents containing:

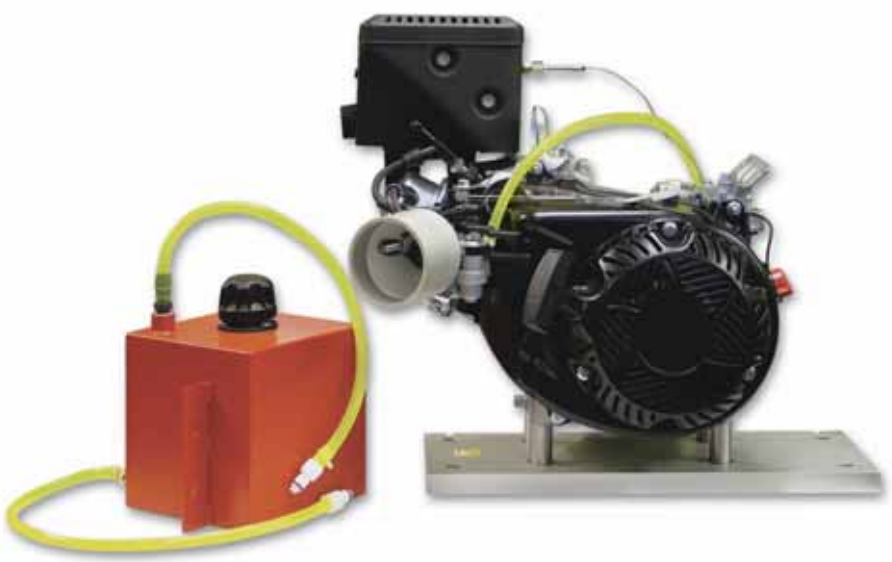
- **USER MANUAL:** How to use the product along with instructions on experiment set-up and supporting enginering principles for guiding learning.
- **PACKING CONTENTS LIST:** All the parts that make up the complete product.
- **TEST CERTIFICATE:** Your peace of mind that the product has been thoroughly tested before dispatch.

TD211

MODIFIED FOUR-STROKE PETROL ENGINE

A four-stroke, single-cylinder petrol engine with modified cylinder head and crank, for use with TecQuipment's Small Engine Test Set (TD200).

- Modified for use with optional Pressure (ECA101) and Crank Angle (ECA102) Transducers and Engine Cycle Analyser (ECA100)
- Wide range of investigations possible
- Quickly and accurately mounts on the test bed
- Includes colour-coded fuel tank with quick-release couplings



LEARNING OUTCOMES:

When used with TecQuipment's Small Engine Test Set (TD200), investigations into the performance and characteristics of a four-stroke petrol engine, including:

- Torque, speed and power relationship
- Brake mean effective pressure
- Engine performance curves
- Air and fuel consumption
- Volumetric and thermal efficiencies

When used with TecQuipment's Small Engine Test Set (TD200), Cylinder Head Pressure Transducer (ECA101), Crank Angle Encoder (ECA102) and Engine Cycle Analyser (ECA100), students can investigate further features including:

- Plotting p-θ and p-V diagrams
- Engine cycle analysis
- Indicated mean effective pressure
- Indicated power
- Comparison of brake and indicated mean effective pressures
- Mechanical efficiency of the engine

High-quality and cost-effective four-stroke, single-cylinder petrol engine. Adapted specially for education to enable effective laboratory testing and demonstrations, the engine includes an exhaust thermocouple, a half-coupling to link to the test set dynamometer and all essential hoses and fittings.

ESSENTIAL BASE UNIT:

- Small Engine Test Set (TD200) 265

RECOMMENDED ANCILLARIES:

- Engine Cycle Analyser (ECA100) 276
- Cylinder Head Pressure Transducer (ECA101)
- Crank Angle Encoder (ECA102)

ALTERNATIVE PRODUCTS:

- Four-Stroke Petrol Engine (TD201) 266
- Four-Stroke Diesel Engine (TD202) 267
- Modified Four-Stroke Diesel Engine (TD212) 269
- Four-Stroke Petrol Engine (TD301) 272
- Four-Stroke Diesel Engine (TD302) 273

TD212

MODIFIED FOUR-STROKE DIESEL ENGINE

A four-stroke, single-cylinder diesel engine with modified cylinder head and crank, for use with TecQuipment's Small Engine Test Set (TD200).

- Modified for use with optional Pressure (ECA101) and Crank Angle (ECA102) Transducers and Engine Cycle Analyser (ECA100)
- Wide range of investigations possible
- Quickly and accurately mounts on the test bed
- Includes colour-coded fuel tank with quick-release couplings

LEARNING OUTCOMES:

When used with TecQuipment's Small Engine Test Set (TD200), investigations into the performance and characteristics of a four-stroke diesel engine, including:

- Torque, speed and power relationship
- Brake mean effective pressure
- Engine performance curves
- Air and fuel consumption
- Volumetric and thermal efficiencies
- Willans line

When used with TecQuipment's Small Engine Test Set (TD200), Cylinder Head Pressure Transducer (ECA101), Crank Angle Encoder (ECA102) and Engine Cycle Analyser (ECA100), students can investigate further features including:

- Plotting p-θ and p-V diagrams
- Engine cycle analysis
- Indicated mean effective pressure
- Indicated power
- Comparison of brake and indicated mean effective pressures
- Mechanical efficiency of the engine

High-quality and cost-effective four-stroke, single-cylinder diesel engine. Adapted specially for education to enable effective laboratory testing and demonstrations, the engine includes an exhaust thermocouple, a half-coupling to link to the test bed dynamometer and all essential hoses and fittings.

ESSENTIAL BASE UNIT:

- Small Engine Test Set (TD200) 265

RECOMMENDED ANCILLARIES:

- Engine Cycle Analyser (ECA100) 276
- Cylinder Head Pressure Transducer (ECA101)
- Crank Angle Encoder (ECA102)

ALTERNATIVE PRODUCTS:

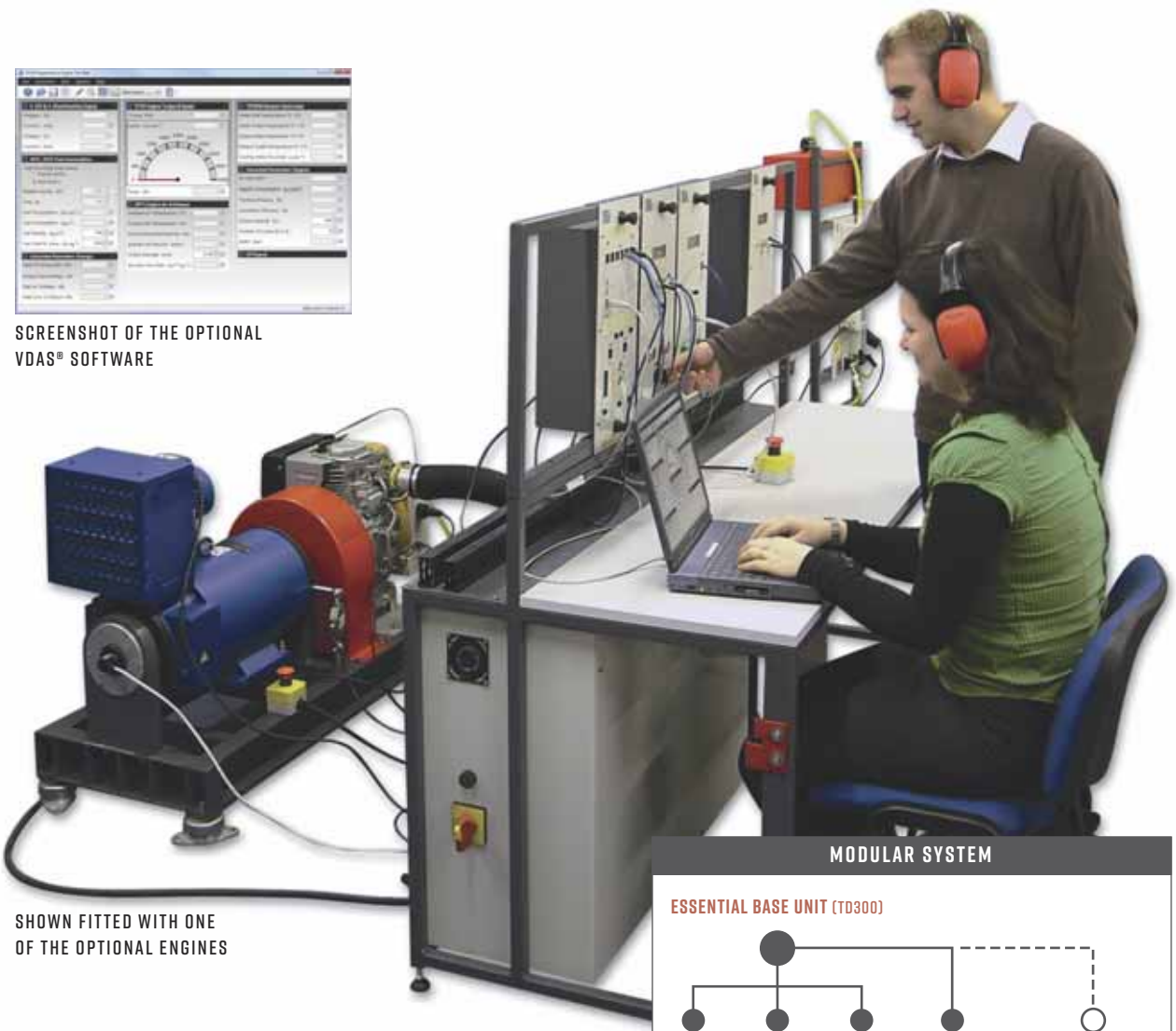
- Four-Stroke Petrol Engine (TD201) 266
- Four-Stroke Diesel Engine (TD202) 267
- Modified Four-Stroke Petrol Engine (TD211) 268
- Four-Stroke Petrol Engine (TD301) 272
- Four-Stroke Diesel Engine (TD302) 273

VDAS® TD300

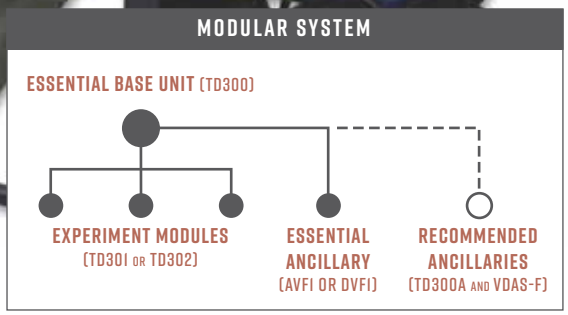
REGENERATIVE ENGINE TEST SET

Versatile engine test bed with instrumentation for comprehensive investigations into the features and operating characteristics of internal combustion engines.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE



SHOWN FITTED WITH ONE OF THE OPTIONAL ENGINES



FEATURES:		BENEFITS:
Fully equipped test set that supports a choice of internal combustion engines	→	Saves space and reduces costs
Optional petrol and diesel engines	→	Allows comparative tests of different engines
Several engine and instrument options	→	Expands the range of studies
Separate instruments and test bed	→	Avoids transmission of vibration to give accurate, repeatable results
Precision four-quadrant drive to start and load the engines	→	Accurate loading with no need for pull-cord starting
Easy set-up – engines can be removed and fitted in minutes	→	Maximises experiment time
Works with VDAS®	→	Quick and reliable tests with data capture

LEARNING OUTCOMES:

A comprehensive range of investigations into the features of single-cylinder, four-stroke petrol and diesel engines including:

- Torque, speed and power relationship
- Brake mean effective pressure
- Engine performance curves
- Air and fuel consumption
- Volumetric and thermal efficiencies

By using the recommended ancillaries and engine choices, students can investigate more features including:

- Plotting p-θ and p-V diagrams
- Engine cycle analysis
- Indicated mean effective pressure
- Indicated power
- Comparison of brake and indicated mean effective pressures
- Mechanical efficiency of the engine

A versatile regenerative engine test set with comprehensive controls and instrumentation. When used with one of TecQuipment's optional single-cylinder engines (rated up to 10 kW), it safely and effectively enables study and demonstrations of the features and characteristics of the engine. In addition, optional ancillaries are available to extend the range of study, demonstrations and investigations even further.

AVAILABLE EXPERIMENT MODULES:

- Four-stroke petrol engine (TD301) 272
- Four-stroke diesel engine (TD302) 273

ESSENTIAL ANCILLARIES:

- Manual Volumetric Fuel Gauge (AVF1) 275

OR

- Automatic Volumetric Fuel Gauge with Digital Read-out (DVF1) 275

RECOMMENDED ANCILLARIES:

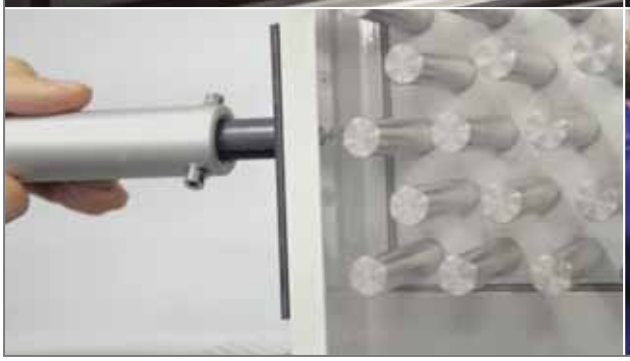
- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293
- Exhaust Gas Calorimeter (TD300a) 274

ALTERNATIVE PRODUCTS:

- Small Engine Test Set (TD200) 265

WATCH EQUIPMENT IN ACTION

Visit our YouTube channel to see demonstrations and promotional videos:
YOUTUBE.COM/C/TECQUIPMENT



TD301

FOUR-STROKE PETROL ENGINE

A four-stroke, single-cylinder petrol engine with modified cylinder head and crank, for use with TecQuipment's Regenerative Engine Test Set (TD300).

- Modified for use with optional Pressure (ECA101) and Crank Angle (ECA102) Transducers and Engine Cycle Analyser (ECA100)
- Quickly and accurately mounts on the test bed
- Includes colour-coded fuel tank with quick-release couplings

LEARNING OUTCOMES:

When used with TecQuipment's Regenerative Engine Test Set (TD300), investigations into the performance and characteristics of a four-stroke petrol engine, including:

- Torque, speed and power relationship
- Brake mean effective pressure
- Engine performance curves
- Air and fuel consumption
- Volumetric and thermal efficiencies

When used with TecQuipment's Regenerative Engine Test Set (TD300), Cylinder Head Pressure Transducer (ECA101), Crank Angle Encoder (ECA102) and Engine Cycle Analyser (ECA100), students can investigate further features including:

- Plotting p-θ and p-V diagrams
- The thermodynamic cycle of an internal combustion engine
- Indicated mean effective pressure
- Indicated power
- Comparison of brake and indicated mean effective pressures
- Mechanical efficiency of the engine

High-quality, cost-effective four-stroke, single-cylinder petrol engine. Adapted specially for education to enable effective laboratory testing and demonstrations, the engine includes an exhaust thermocouple, a half-coupling to link to the test set dynamometer and all essential hoses and fittings.

ESSENTIAL BASE UNIT:

- Regenerative Engine Test Set (TD300) 270

RECOMMENDED ANCILLARIES:

- Engine Cycle Analyser (ECA100) 276
- Cylinder Head Pressure Transducer (ECA101)
- Crank Angle Encoder (ECA102)

ALTERNATIVE PRODUCTS:

- Four-Stroke Petrol Engine (TD201) 266
- Four-Stroke Diesel Engine (TD202) 267
- Modified Four-Stroke Petrol Engine (TD211) 268
- Modified Four-Stroke Diesel Engine (TD212) 269
- Four-Stroke Diesel Engine (TD302) 273

TD302

FOUR-STROKE DIESEL ENGINE

A four-stroke, single-cylinder diesel engine with modified cylinder head and crank, for use with TecQuipment's Regenerative Engine Test Set (TD300).

- Modified for use with optional Pressure (ECA101) and Crank Angle (ECA102) Transducers and Engine Cycle Analyser (ECA100)
- Quickly and accurately mounts on the test bed
- Includes colour-coded fuel tank with quick-release couplings

High-quality, cost-effective, four-stroke, single-cylinder diesel engine. Adapted specially for education to enable effective laboratory testing and demonstrations, the engine includes an exhaust thermocouple, a half-coupling to link to the test bed dynamometer, and all essential hoses and fittings.

LEARNING OUTCOMES:

When used with TecQuipment's Regenerative Engine Test Set (TD300), investigations into the performance and characteristics of a four-stroke diesel engine, including:

- Torque, speed and power relationship
- Brake mean effective pressure
- Engine performance curves
- Air and fuel consumption
- Volumetric and thermal efficiencies

When used with TecQuipment's Regenerative Engine Test Set (TD300), Cylinder Head Pressure Transducer (ECA101), Crank Angle Encoder (ECA102) and Engine Cycle Analyser (ECA100) students can investigate further features including:

- Plotting p-θ and p-V diagrams
- The thermodynamic cycle of an internal combustion engine
- Indicated mean effective pressure
- Indicated power
- Comparison of brake and indicated mean effective pressures
- Mechanical efficiency of the engine

ESSENTIAL BASE UNIT:

- Regenerative Engine Test Set (TD300) 270

RECOMMENDED ANCILLARIES:

- Engine Cycle Analyser (ECA100) 276
- Cylinder Head Pressure Transducer (ECA101)
- Crank Angle Encoder (ECA102)

ALTERNATIVE PRODUCTS:

- Four-Stroke Petrol Engine (TD201) 266
- Four-Stroke Diesel Engine (TD202) 267
- Modified Four-Stroke Petrol Engine (TD211) 268
- Modified Four-Stroke Diesel Engine (TD212) 269
- Four-Stroke Petrol Engine (TD301) 272

VDAS® TD300A

EXHAUST GAS CALORIMETER

For use with TecQuipment's Regenerative Engine Test Set (TD300) to measure the heat content of engine exhaust gases.

- Safely and effectively measures the heat content of TecQuipment's test engine exhaust gases
- Specially designed for educational use
- Uses electronic transducers and a digital display for ease of use and accuracy
- Separate instrumentation unit conveniently mounts on test set console frame

LEARNING OUTCOMES:

When used with TecQuipment's Regenerative Engine Test Set (TD300), the Exhaust Gas Calorimeter enables students to assess the heat lost to exhaust in the energy balance for single-cylinder, four-stroke petrol (TD301) and diesel (TD302) engines.

The equipment measures the heat content of exhaust gases and enables students to determine the energy lost to exhaust in the energy balance for single-cylinder, four-stroke petrol (TD301, available separately) and diesel (TD302, available separately) engines.

ANCILLARY FOR:

- Regenerative Engine Test Set (TD300) 270

AVFI

MANUAL VOLUMETRIC FUEL GAUGE

Convenient and accurate fuel gauge for use with TecQuipment Engine Test Sets (TD200 and TD300 series).

- Volumetric fuel gauge for use with TecQuipment's Small Engine Test Set (TD200) and Regenerative Engine Test Set (TD300) and engines
- Convenient and accurate measurement of fuel consumption
- Easy to install and use
- Self-sealing couplings enable quick and efficient connection and disconnection of fuel lines with minimum loss or spillage of fuel

The fuel gauge consists of a precision-calibrated two-bulb pipette and control valves. It mounts on the instrumentation frame of the test set and connects between the fuel tank and the engine under test.

ANCILLARY FOR:

- Small Engine Test Set (TD200) 265
- Regenerative Engine Test Set (TD300) 270

ESSENTIAL ANCILLARIES:

- Stopwatch (SW1) 28

VDAS® DVFI

AUTOMATIC VOLUMETRIC FUEL GAUGE WITH DIGITAL READ-OUT

Automatic fuel gauge for use with TecQuipment's Engine Test Sets (TD200 and TD300 series).

- Accurately and automatically calculates fuel consumption
- Directly displays fuel consumption on digital read-out
- Can cycle continuously or run once only
- Self-sealing couplings enable quick and efficient connection and disconnection of fuel lines with minimum loss or spillage of fuel

The gauge accurately calculates fuel consumption and displays it directly on a digital read-out.

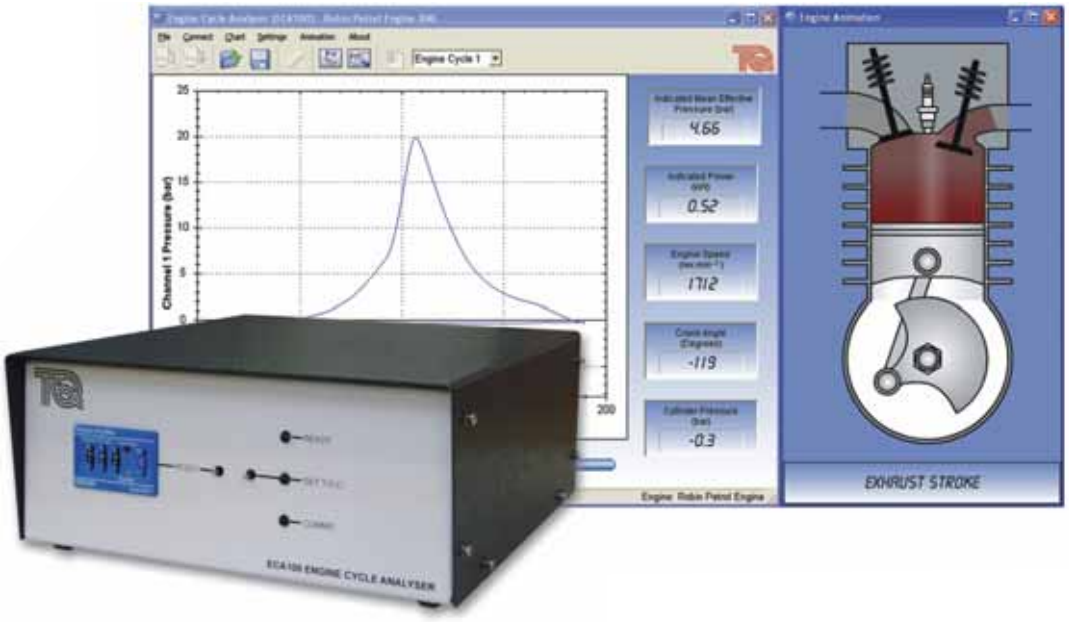
ANCILLARY FOR:

- Small Engine Test Set (TD200) 265
- Regenerative Engine Test Set (TD300) 270

ECA100

ENGINE CYCLE ANALYSER

Hardware and software to measure internal combustion engine cylinder pressure and crank angle.



- For use with TecQuipment's Small Engine Test Set (TD200) and Regenerative Engine Test Set (TD300) and engines
- Includes powerful Windows®-based software specially designed for educational use
- Automatic calculation and real-time display of p-θ and p-V plots and other important parameters
- Snap-shot, replay and animation functions
- Accurate, clear animations of crank, piston, inlet and exhaust valve positions help students visualise the engine cycle

The versatile equipment consists of both hardware and software specially designed for educational use. It enables students to investigate the relationship between crank angle or volume and the cylinder pressure in an internal combustion engine.

ESSENTIAL ANCILLARIES:

- Cylinder Head Pressure Transducer (ECA101)
- Crank Angle Encoder (ECA102)
- Suitable computer

TecQuipment also offers a complete package (the ECA100S) which includes the ECA100, one ECA101 and one ECA102.

LEARNING OUTCOMES:

When used with suitable test engines, the analyser allows investigations into a variety of internal combustion engine characteristics, including:

- The thermodynamic cycle of an internal combustion engine.
- Calculation of indicated mean effective pressure and indicated power.
- Comparison of indicated mean effective pressure and brake mean effective pressure.
- Mechanical efficiency of the test engine.
- Further work using exported data such as combustion analysis.

ANCILLARY FOR:

- Modified Four-Stroke Petrol Engine (TD211) 268
- Modified Four-Stroke Diesel Engine (TD212) 269
- Four-Stroke Petrol Engine (TD301) 272
- Four-Stroke Diesel Engine (TD302) 273

VDAS® TD1050

SUPERHEATED STEAM PLANT PERFORMANCE

A laboratory-scale steam plant that demonstrates fundamental thermodynamic principles of energy conversion and mechanical power measurement.

- Introduces students to industry-standard methods of analysing steam plant performance, including Rankine cycle analysis and using the Willans line
- Uses a simple two-cylinder steam motor and an electrically heated boiler for easy understanding of the main parts of a steam plant
- Self-contained in a mobile frame that includes all instruments needed for experiments
- Allows students to copy the Marcet boiler experiment to prove the pressure-temperature relationship for saturated steam

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

A mobile laboratory-scale steam plant for experiments in thermodynamic principles. It helps students to understand:

- Thermodynamic laws of energy conservation
- Steady flow energy equation
- Thermal efficiency and the control surface
- Rankine cycle analysis
- The Willans line

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Frame-mounted version (VDAS-F) 293

ALTERNATIVE PRODUCTS:

- Saturated Steam – Marcet Boiler (TD1006) 261

LEARNING OUTCOMES:

- Steam plant performance, including the Rankine cycle analysis and the Willans line
- Marcet boiler experiment on saturated steam (pressure temperature relationship)

ADA GT100

TURBOJET TRAINER

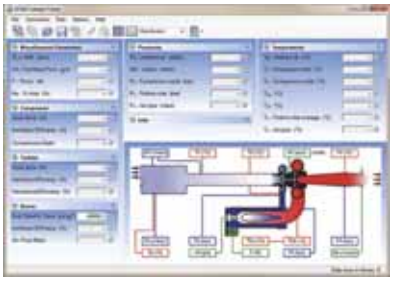
Allows detailed experiments that demonstrate how a single-shaft gas turbojet works, and tests its performance.

- Uses industrial parts, powered by kerosene for realistic tests and results
- Fully interlocked starting procedure and automatic shut-down
- Automatic data acquisition (ADA) included (supplied with software)
- Well-proven design – versions installed in universities, technical colleges and military training establishments in 30 countries worldwide

LEARNING OUTCOMES:

Various investigations into single-shaft turbine thrust jet performance, including:

- Effect on thrust generation by variation in rotational speed and propelling nozzle area
- Isentropic, polytropic and mechanical efficiencies of compressor, combustion chamber and turbine
- Pressure ratios of turbine, compressor and non-dimensional characteristics
- Combustion chamber pressure losses and combustion efficiencies
- Specific fuel consumption, thermal efficiency, air standard cycle, work ratio and heat balance



SCREENSHOT OF THE GT100 SOFTWARE

A self-contained, fully instrumented, educational single-shaft gas turbine. Powered by kerosene, the experimental abilities of this high-quality apparatus enable comprehensive, practical investigations into the principles and performance of single-shaft gas turbines.

ALTERNATIVE PRODUCTS:

- Turbojet Trainer with Reheat (GT100RS) 279
- Two-Shaft Gas Turbine (GT185) 280

ADA GT100RS

TURBOJET TRAINER WITH REHEAT

Allows detailed experiments that demonstrate how a single-shaft gas turbojet with reheat (afterburner) works, and tests its performance.

- Uses industrial parts, powered by kerosene for realistic tests and results
- Fully interlocked starting procedure and automatic shut-down
- Automatic Data Acquisition (ADA) included (supplied with software)
- Well proven design – versions installed in universities, technical colleges and military training establishments in 30 countries worldwide

SCREENSHOT OF THE GT100RS SOFTWARE

LEARNING OUTCOMES:

Turbine, reheat and nozzle tests to find key performance information such as:

- Specific thrust and fuel consumption
- Pressure losses and ratios
- Thermal, propulsive, isentropic and mechanical efficiencies
- Work and power
- Thrust with and without reheat
- How the variable area nozzle affects thrust

A self-contained, fully instrumented, educational single-shaft gas turbine with reheat. Powered by kerosene, the experimental abilities of this high-quality apparatus enable comprehensive practical investigations into the principles and performance of single-shaft gas turbines with reheat.

ALTERNATIVE PRODUCTS:

- Turbojet Trainer (GT100) 278
- Two-Shaft Gas Turbine (GT185) 280

ADA GT185

TWO-SHAFT GAS TURBINE

Allows detailed experiments that demonstrate how a two-shaft gas turbine works, and tests its performance.

- Uses industrial parts, powered by kerosene for realistic tests and results
- Fully interlocked starting procedure and automatic shut-down
- Automatic Data Acquisition (ADA) included (supplied with software)
- Direct-coupled (no belts) eddy current dynamometer for accurate loading, speed control and true shaft power measurement
- Well proven design – versions installed in universities, technical colleges and military training establishments in 30 countries worldwide

SCREENSHOT OF THE GT185 SOFTWARE

LEARNING OUTCOMES:

Turbine tests to find key performance information such as:

- Specific fuel consumption
- Pressure losses and ratios
- Thermal, isentropic and mechanical efficiencies
- Work and power

Combustion chamber:

- Pressure loss
- Combustion efficiency
- Air and fuel ratio

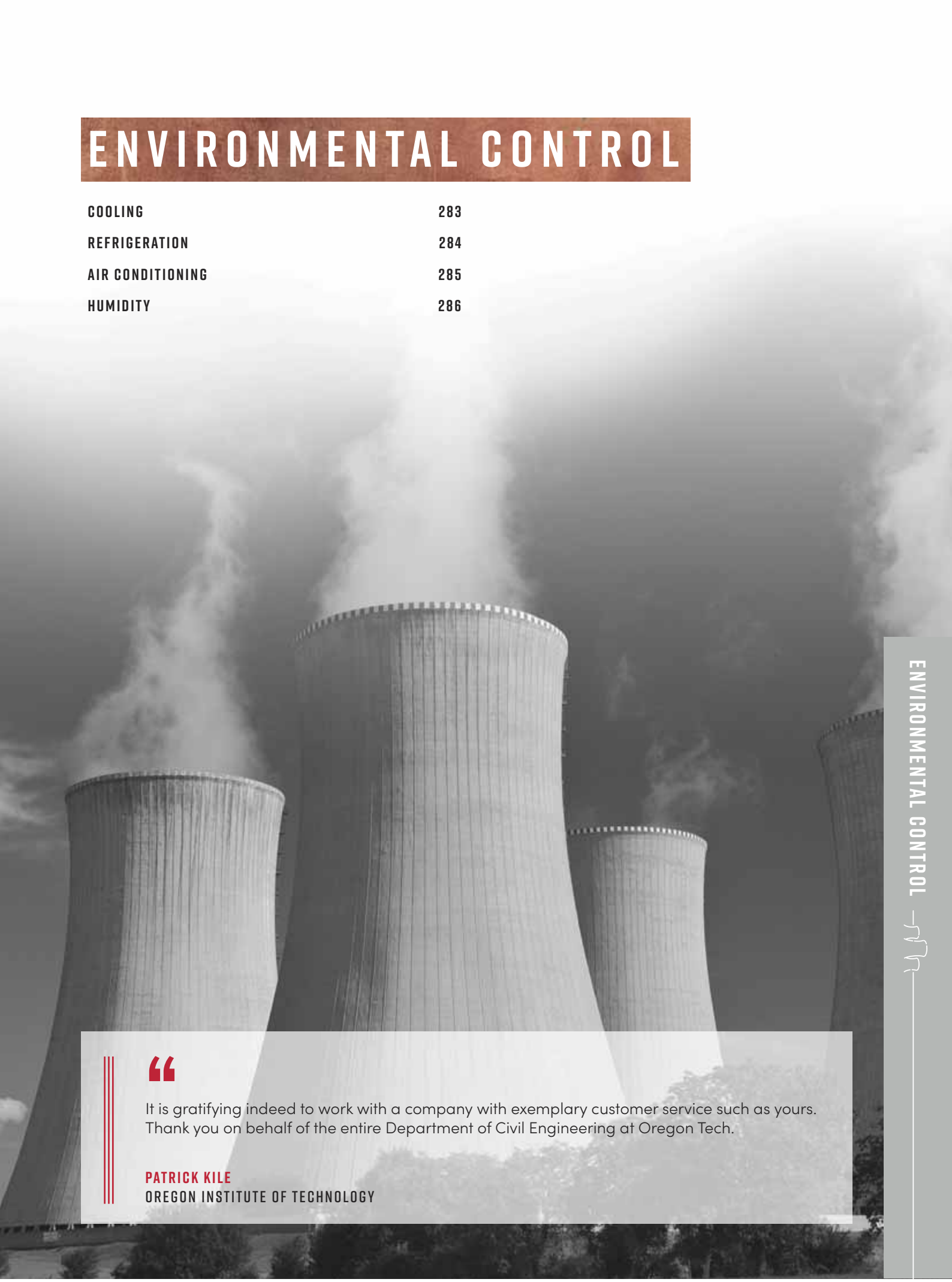
A self-contained, fully instrumented, educational two-shaft gas turbine. Powered by kerosene, the experimental abilities of this high-quality apparatus enable comprehensive practical investigations into the principles and performance of two-shaft gas turbines.

ALTERNATIVE PRODUCTS:

- Turbojet Trainer (GT100) 278
- Turbojet Trainer with Reheat (GT100RS) 279

ENVIRONMENTAL CONTROL

COOLING	283
REFRIGERATION	284
AIR CONDITIONING	285
HUMIDITY	286



> “It is gratifying indeed to work with a company with exemplary customer service such as yours. Thank you on behalf of the entire Department of Civil Engineering at Oregon Tech.”
>
> **PATRICK KILE**
> OREGON INSTITUTE OF TECHNOLOGY

ENVIRONMENTAL CONTROL

BENCH-TOP EQUIPMENT

All the units in the range are compact in size to facilitate flexible and convenient use around any laboratory.

APPLICATION OF FUNDAMENTAL PRINCIPLES

Applies the fundamental theories of thermodynamics, fluid mechanics and heat transfer to investigate the methods of environmental control in the real-world.

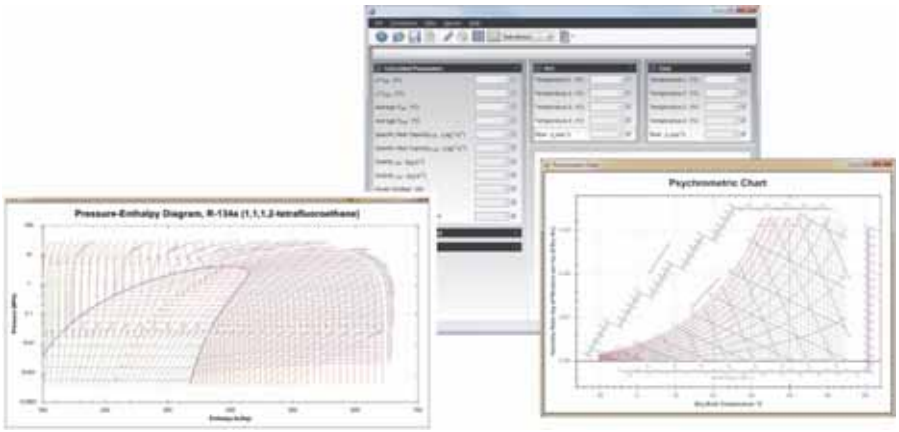
AUTOMATIC DATA ACQUISITION VDAS®

Check out the products in this range that work with TecQuipment's unique Versatile Data Acquisition System (VDAS®).

SEE PAGE 293

KEY FEATURES AND BENEFITS:

- **FUNDAMENTALS OF HVAC:** The range provides the capabilities to study the fundamental components of an HVAC course.
- **DATA ACQUISITION AS STANDARD:** Most products in the range come with TecQuipment's Versatile Data Acquisition System, offering high specification and great value.
- **INDUSTRIAL AND DOMESTIC:** With units covering air-conditioning and cooling towers, students can study the elements of both industrial and domestic environmental control.



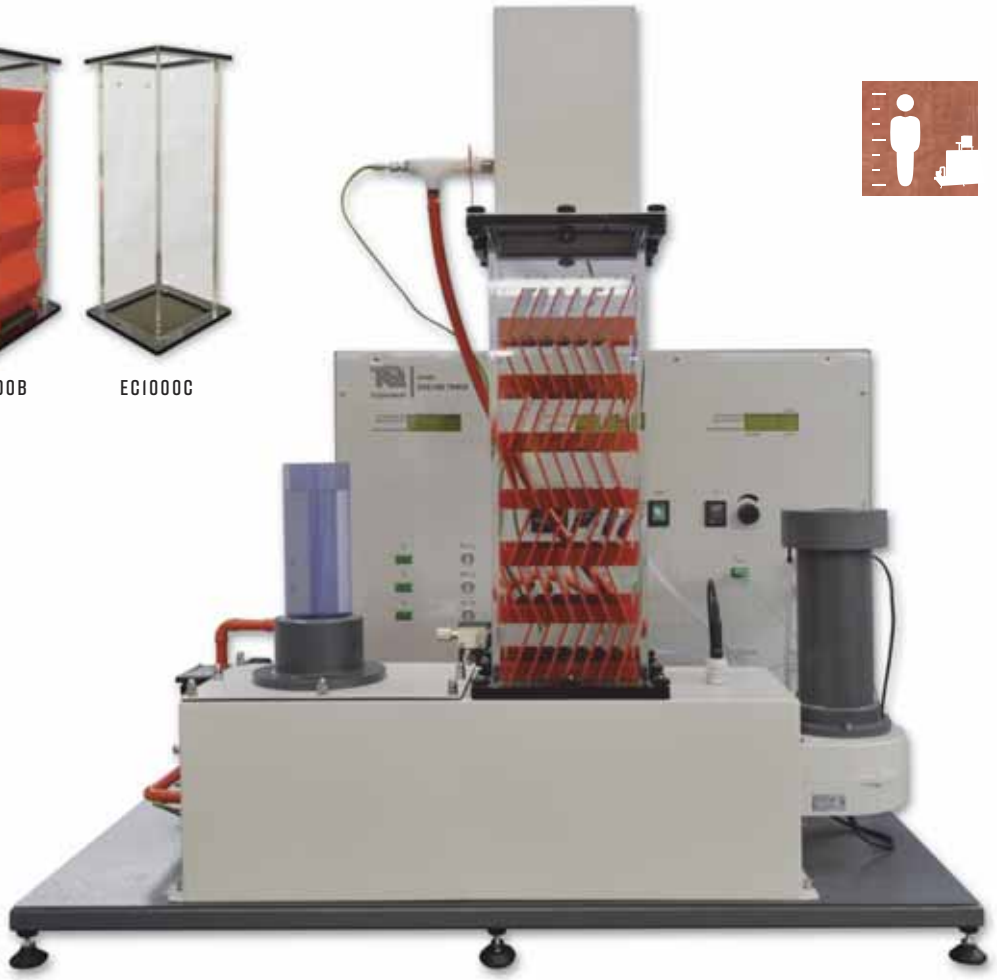
VDAS® EC1000

COOLING TOWERS

Bench-top unit demonstrates the operational characteristics of an evaporative cooling tower.

EC1000A EC1000B EC1000C

EC1000D



- The EC1000 includes one column with packing for immediate experimentation potential
- Three extra interchangeable columns, containing different packing densities and arrangements, further extend experimental capabilities
- An additional interchangeable column with no packing demonstrates free-fall cooling
- VDAS® connectivity included featuring data acquisition via USB

The apparatus provides students with the opportunity to investigate the key characteristics that affect the performance of an evaporative cooling tower. Students can observe live displays of air temperatures and relative humidity through the use of psychrometric charts, to fully understand the operation of the cooling tower.

SCREENSHOT OF THE VDAS® SOFTWARE

LEARNING OUTCOMES:

How key variables affect the performance of a cooling tower, including:

- Variation of water flow rate
- Variation of air flow rate
- Packing density and arrangement
- Variation of water temperature
- Energy and mass balance

RECOMMENDED ANCILLARIES:

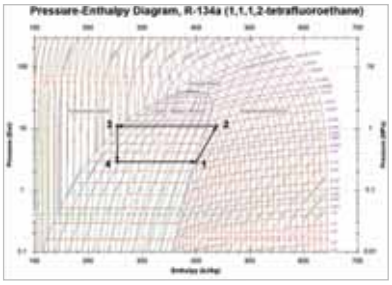
- Cooling Column Type A (EC1000a)
- Cooling Column Type B (EC1000b)
- Empty Cooling Column (EC1000c)
- Packing Characteristics Column (EC1000d)

VDAS® EC1500

REFRIGERATION CYCLE

Bench-top unit that allows students to investigate the stages of refrigeration.

- Pressure and temperature measurements taken around the refrigeration circuit
- VDAS® connectivity included featuring data acquisition via USB
- VDAS® Software allows students to visualise experimental parameters using Pressure – Enthalpy Charts
- LCD display of all measured parameters (temperature and pressure)



SCREENSHOT OF THE VDAS® SOFTWARE

LEARNING OUTCOMES:

- Learn to use a P-H Chart
- Determine Coefficient of Performance (COP)
- Determine superheat and sub-cooling

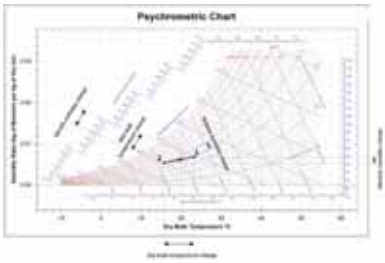
This simple refrigeration cycle unit allows students to learn the stages of refrigeration at an entry level. Students learn about Pressure-Enthalpy charts and use them to determine the Coefficient of Performance (COP), superheat and sub-cooling from the enthalpy changes.

VDAS® EC1501

AIR CONDITIONING TRAINER

Bench-top trainer, allows students to investigate the fundamental principles of air conditioning.

- Pressure and temperature measurements taken around the refrigeration circuit
- Relative humidity and temperature measured either side of the evaporator
- VDAS® connectivity included featuring data acquisition via USB
- Software allows students to visualise experimental parameters using psychrometric charts
- LCD display of all measured parameters (relative humidity, temperature and pressure)



SCREENSHOT OF THE VDAS® SOFTWARE

LEARNING OUTCOMES:

- Learn to use P-H charts
- Learn to use psychrometric charts
- Determine Coefficient of Performance (CoP)
- Determine superheat and sub-cooling
- Determine enthalpy change in the air flow

This training unit allows students to investigate air conditioning at a basic level. Students can use P-H charts and psychrometric charts for their calculations and discover the enthalpy change.

TE6

HUMIDITY MEASUREMENT

Illustrates the principles of humidity measurement and compares various methods of measurement.

- Allows students to compare different humidity measuring instruments
- Includes air filter to help prevent dust and other impurities from entering instruments
- Includes mechanical and electronic instruments to measure temperature and humidity
- Variable flow-rate fan to demonstrate the effect of air flow on humidity measurement

LEARNING OUTCOMES:

- Measurement of air flow rate in a duct
- Measurement of relative humidity using different types of instrumentation
- Comparison of measurement methods for accuracy and ease of use

The Humidity Measurement unit allows students to compare different methods of humidity measurement. It demonstrates the differences in accuracy between instruments and their ease of use. It also includes a blower unit with a valve to demonstrate how air flow affects the different instruments.

PACKED AND READY FOR SHIPMENT

First-class products deserve first-class packing and shipping. You can be confident your order will arrive safely and on time.

SOLAR ENERGY

SOLAR PHOTOVOLTAIC	289
SOLAR THERMAL	290

> The TecQuipment teaching solutions and scalable teaching equipment has allowed the Thermal Engineering and Energy Department to provide training up to Masters degree level with continuous and undeniable quality.

PROFESSOR JEAN-NOËL BLANCHARD
IUT ORLEANS, FRANCE

SOLAR ENERGY

PRODUCTS FOR THE FUTURE

The Solar Energy range covers three key methods used to harness and convert solar energy. These include:

- Photovoltaic (conversion to electricity)
- Focusing (to a collector)
- Flat plate collection (direct water heating)

VERSATILE DATA ACQUISITION SYSTEM VDAS®

The Solar Energy products work with TecQuipment's unique Versatile Data Acquisition System (VDAS®).

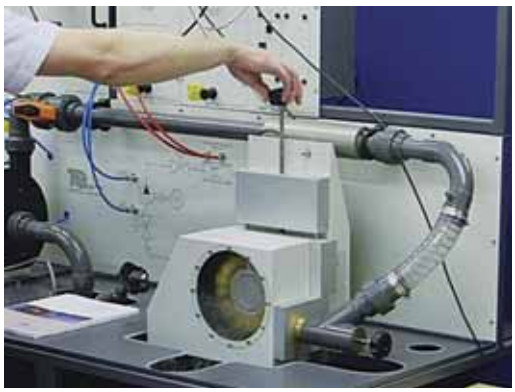
SEE PAGE 293

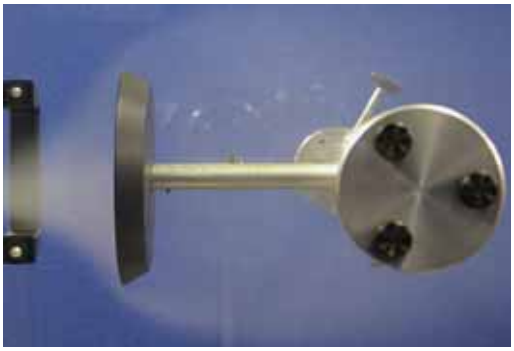
KEY FEATURES AND BENEFITS:

- **PHOTOVOLTAIC, FOCUSING AND FLAT PLATE ENERGY COLLECTION:** Demonstrates three key methods used in harnessing solar energy.
- **AUTOMATIC DATA ACQUISITION:** VDAS® is particularly useful when monitoring longer duration experiments.
- **SAFE AND EASY SET UP:** Low temperatures, safe connections and simple, hand-operated controls allow the set up an experiment safely and quickly.

CHECK OUT OUR OTHER RANGES

Other TecQuipment products link directly to renewable energy. For example, our **MODULAR FLUID POWER** products (pages 132–146) includes turbines to harness the energy in water. The **AERODYNAMICS** and **FLUID MECHANICS** ranges include experiments to demonstrate how shapes affect air and water flow. These are essential tools for engineers when designing wind or water energy systems.





VDAS® TE4
PHOTOVOLTAIC CELLS

Illustrates how effective photovoltaic cells are in capturing solar energy.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Demonstrates the performance of a high-efficiency photovoltaic cell array and battery storage system
- Includes solarimeter, charge controller and control module with digital displays and d.c. outputs
- Supplied with both high and low-rated batteries to allow students to investigate charge and discharge cycle of the system in a typical laboratory session as well as longer cycles
- Includes three different types of electrical load

LEARNING OUTCOMES:

- Performance of the solar panel
- Demonstration of float mode
- Demonstration of load cut

Demonstrates how well a photovoltaic cell array and battery storage system works. It uses a commercially available solar panel made from high-efficiency cells.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

ALTERNATIVE PRODUCTS:

- Focusing Solar Energy Collector (TE38) 290
- Flat Plate Solar Thermal Energy Collector (TE39) 291

VDAS® TE38

FOCUSING SOLAR ENERGY COLLECTOR

Illustrates the workings of a focusing solar energy collector and allows students to study its performance.

- Mobile, self-contained focusing solar energy collector specially designed for educational use
- Demonstrates principles, advantages and limitations of focusing solar energy collectors
- Includes four different sizes of collector for studies of different energy concentration ratios
- Removable transparent cover allows students to compare properties of shielded and unshielded collectors

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

LEARNING OUTCOMES:

- Demonstrations of the performance, advantages and limitations of a focusing solar energy collector
- Understanding the effective use of the direct component of solar radiation
- Measurement of the efficiency of the collector with and without a transparent cover
- Measurement of the maximum possible energy collector temperature

A focusing solar energy collector on a mobile frame. Specially designed for educational use, the apparatus demonstrates the principles, advantages and limits of this method of capturing solar energy.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293
- Stopwatch (SW1) 28

ALTERNATIVE PRODUCTS:

- Photovoltaic Cells (TE4) 289
- Flat Plate Solar Thermal Energy Collector (TE39) 291

VDAS® TE39

FLAT PLATE SOLAR THERMAL ENERGY COLLECTOR

Illustrates the workings of a flat plate solar energy collector and allows students to study its performance.

SCREENSHOT OF THE OPTIONAL VDAS® SOFTWARE

- Educational flat plate solar energy collector with full instrumentation
- Allows students to investigate the effective use of a renewable, environmentally friendly energy source
- Purpose designed and built solar panel for high quality
- Includes digital display of flow, radiation intensity and temperatures at different points throughout the apparatus

This equipment demonstrates how a flat plate solar energy collector works, allowing students to measure and analyse efficiency and heat losses.

LEARNING OUTCOMES:

- Efficiency of the collector
- Efficiency and heat losses
- Effect of collector angle.

RECOMMENDED ANCILLARIES:

- Versatile Data Acquisition System – Bench-mounted version (VDAS-B) 293

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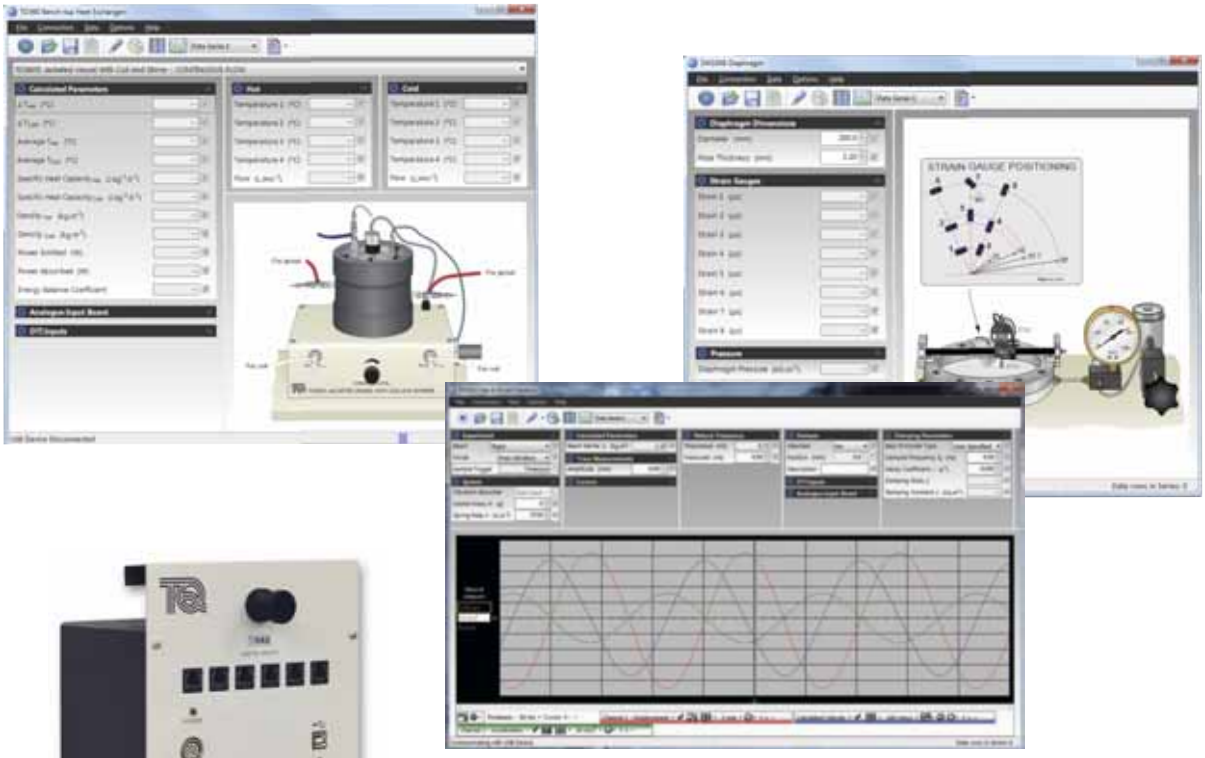
- Photovoltaic Cells (TE4) 289
- Focusing Solar Energy Collector (TE38) 290

TQ
COOLING TOWER

VERSATILE DATA ACQUISITION SYSTEM

VERSATILE DATA ACQUISITION SYSTEM VDAS®

High-capacity, accurate, efficient and user-friendly automatic data acquisition for over 60 TecQuipment products.



SAMPLE SCREENSHOTS OF THE VDAS® SOFTWARE

LATEST VDAS® SOFTWARE AVAILABLE ONLINE

TECQUIPMENT.COM/DOWNLOADS

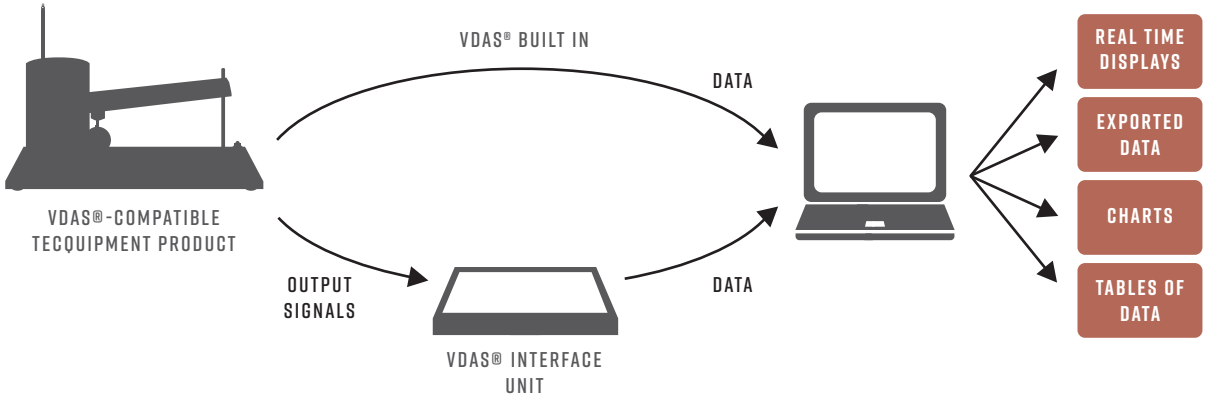
FRAME-MOUNTING VERSATILE DATA ACQUISITION SYSTEM (VDAS-F) INTERFACE UNIT

BENCH-TOP VERSATILE DATA ACQUISITION SYSTEM (VDAS-B) INTERFACE UNIT

- Cost-effective, digital, automatic data acquisition hardware, software and accessories to enhance teaching and laboratory sessions
- Real-time traces, data capture, monitoring and display of your experiment readings on a computer
- Available in both frame-mounting and bench-top options for convenience
- Similar software layout for all VDAS® compatible products – no need to learn new software when changing experiments

TecQuipment's Versatile Data Acquisition System (VDAS®) works with a growing list of over 60 TecQuipment products, enabling real-time display and capture of experiment data.

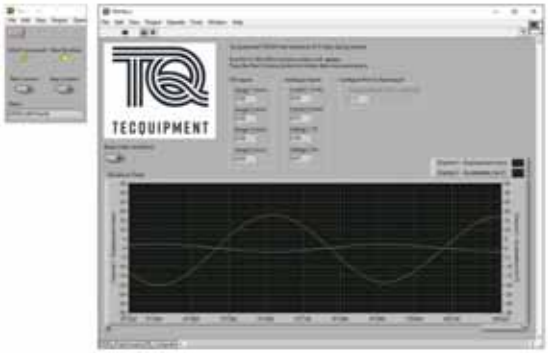
VDAS IS A REGISTERED TRADEMARK OF TECQUIPMENT LTD



WHY CHOOSE VDAS®?

LABVIEW DATA ACQUISITION

Experimental data from TecQuipment products can be acquired in real-time within National Instrument's LabVIEW software environment. All TecQuipment VDAS®-compatible products are supported by the VDAS®-LabVIEW software package which is freely available from the TecQuipment website. LabVIEW users have the flexibility to extend TecQuipment's software to perform novel data processing, presentation and analysis.



VDAS® SHOWN WORKING WITH THE FREE VIBRATIONS OF A CANTILEVER (TM166) EQUIPMENT

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Search for VDAS® on our website for the latest list of VDAS®-compatible products.

TECQUIPMENT.COM

GENERAL-PURPOSE ANCILLARIES AND INSTRUMENTS

THE FOLLOWING ITEMS ARE ANCILLARIES TO SOME OF THE OTHER PRODUCTS AND PRODUCT RANGES IN THIS CATALOGUE. SOME WILL ONLY WORK WITH TECQUIPMENT PRODUCTS, AND SOME WILL ALSO WORK AS GENERAL-PURPOSE LABORATORY EQUIPMENT.

PLEASE NOTE:

The specifications of these ancillary products are correct at the time of printing.

They are designed or chosen to work with the correct TecQuipment products or product ranges. If you need to use any of these ancillaries as general-purpose laboratory equipment, please check its datasheet or ask our experts at TecQuipment **BEFORE YOU ORDER**.

This symbol means that we keep an up-to-date datasheet on our website (www.tecquipment.com).

This symbol means that you must contact TecQuipment or your distributor for the latest specification.

OSCILLOSCOPES

H405A
DUAL BEAM STORAGE OSCILLOSCOPE

A two-channel 50 MHz digital storage oscilloscope .

Works with several TecQuipment products and is good for general-purpose use.

OSI
OSCILLOSCOPE

A dual channel 50 MHz digital oscilloscope.

Works with several TecQuipment products and is good for general-purpose use.

PRESSURE INSTRUMENTS AND EQUIPMENT

CE1B
COMPRESSOR

A laboratory-scale compressor providing ten litres a minute flow at a pressure of 3 bar (45 PSIG).

Works with several TecQuipment products and is good for general-purpose use.

STROBOSCOPES AND TACHOMETERS

STI
STROBOSCOPE

A portable, mains-powered stroboscope that gives 60 to 7,500 flashes a minute in one continuous range. Includes a display of flash speed and works with an internal or external trigger.

Works with several TecQuipment products and is good for general-purpose use.

OTI
OPTICAL TACHOMETER

A hand-held, battery-powered optical tachometer with a digital display and a speed range of 3 to 99999 rev.min^{-1} (rpm). It works with reflective surfaces or stick-on reflective tape.

Works with several TecQuipment products and is good for general-purpose use.

CONTACTING TECQUIPMENT

PURCHASE ENQUIRIES

For all purchase enquiries please contact your local agent or: SALES@TECQUIPMENT.COM

Purchase enquiries can be:

- Requests for data sheets, catalogues and further information
- Technical advice for product selection prior to purchase
- Prices and quotations

AFTERSALES

There is a dedicated team of people at TecQuipment that are committed to providing a high level of aftersales care and support to all our customers, past and present.

No matter how old the equipment is, we continue to provide support.

ANDREW RATCLIFFE,
TECHNICAL SUPPORT MANAGER

For all aftersales queries please contact: CUSTOMER.CARE@TECQUIPMENT.COM or use the form on our website at: TECQUIPMENT.COM

Aftersales queries can be:

- Requests for manuals and user guides
- Quotations for spares and consumables
- Post-sales technical advice and support

SALES AND MARKETING TEAM

KEYWORD INDEX

PLEASE NOTE: For ease of use we have only shown the main TecQuipment products relating to the keywords in this index. However, there may be other similar products that are also suitable for your needs. These are listed as alternative products in the main pages of this guide.

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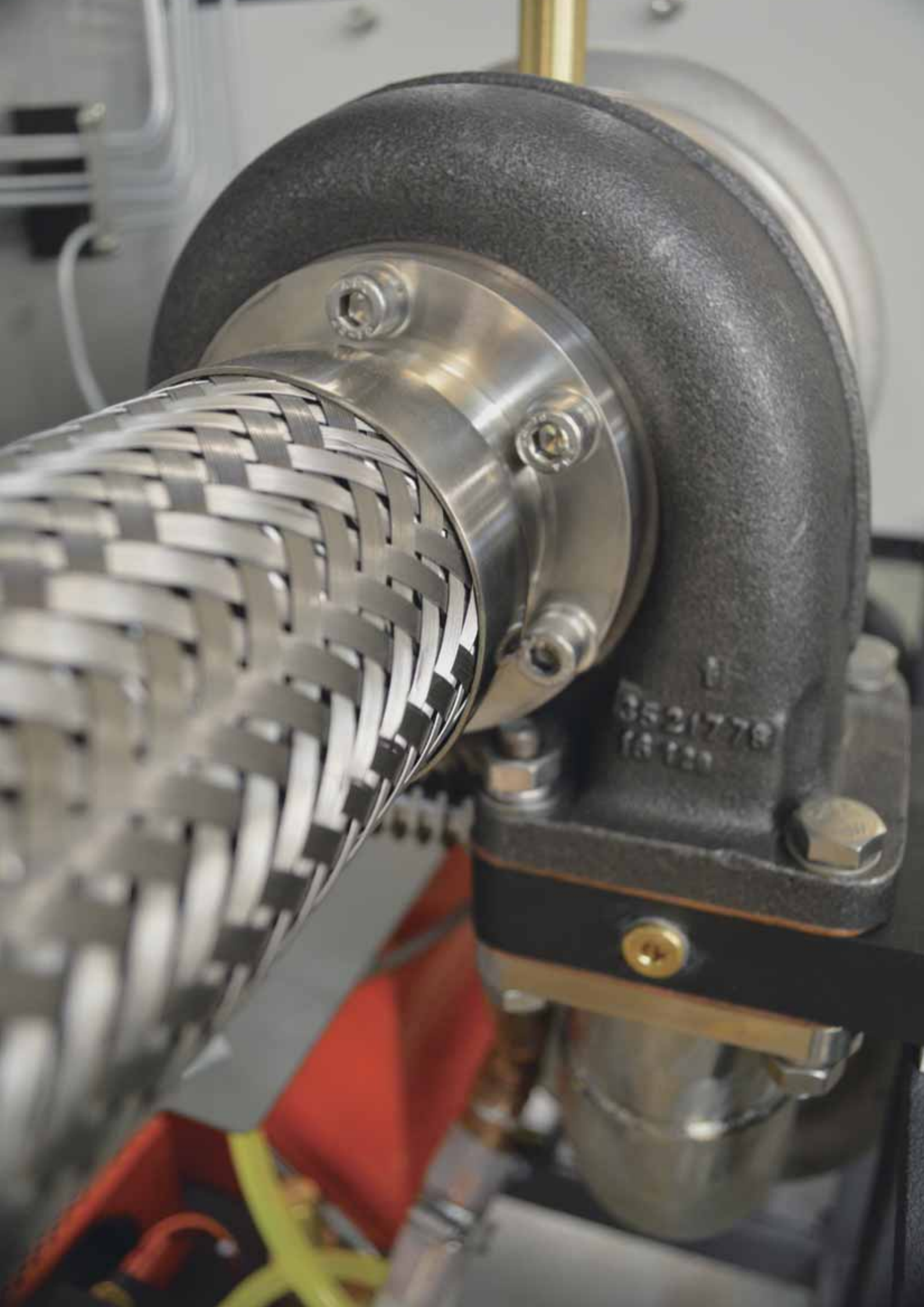

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