MATRIX

MECHANICAL ENGINEERING

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MECHANICAL **ENGINEERING**

Our range of mechanical engineering products now covers multiple topics. Fundamental Mechanics, Structures and Fluid Mechanics as well as a new product for the study of Aerodynamics; relevant to both mechanical and aerospace engineering students. All of the products in this range are designed to teach students the key principles of the topics in a practical way – linking the mathematics of engineering to practice. All products are portable and can be easily packed away and stored, meaning that your classroom can be used as both classrooms and labs.

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All Matrix Curriculum and Written Materials Are Available Translated

Translated material available on the website or direct from the sales team

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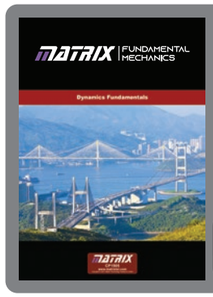
Statics Fundamentals
CP6368

Statics Fundamentals
FM1883

Materials Fundamentals
CP0876

Materials Fundamentals
FM1292



Dynamics Fundamentals
CP1505

Dynamics Fundamentals
FM3935

Mechanisms Fundamentals
CP2840

Mechanisms Fundamentals
FM0759

Dynamics Plus
CP0978

Dynamics Plus
FM5387

Mechanisms Plus
CP3085

Mechanisms Plus
FM5655

Motion Studies with Light Gates & Wireless Dynamic Carts
CP5099

Linear and Rotational Dynamics
HP5099-2

Thermodynamics
CP4261

Thermodynamics Kit
HP4159

Fundamental Fluids
CP2599

Fluids Fundamentals
FM1000

Bending Moments
CP1843

Bending Moments
ST8801

Shear Force
CP4708

Shear Force
ST4484

Reactions of a Simply Supported Beam
CP3604

Reactions of a Simply Supported Beam
ST0454

Bending Stress
CP1877

Bending Stress
ST5671

Deflection of Beams
CP1879

Deflection of Beams
ST9544

Torsion of Rods
CP8231

Torsion of Rods
ST0386

Range Coverage www.matrixtsl.com/learning

Trusses
CP1673

Trusses
ST6365-2

Indeterminate Beam
CP4173

Indeterminate Beam
ST3156

Plastic Bending of Beam
CP4922

Plastic Bending of Beam
ST4847

Simple Suspension Bridge
CP9503

Simple Suspension Bridge
ST0880

Two & Three Pinned Arch
CP4922

Two & Three Pinned Arch
ST5928

Electrical Machines Systems 2.0
CP7479

Electrical Machines Core Set
EM9922

Electrical Machines Training System
EM5154

Electrical Machines For Installation / Manual Control V2.0
CP3897

Electrical Machines Core Set
EM9922

Electrical Machines Training System
EM5154

Electrical Machines & MATLAB v2.0
CP8198

Electrical Machines Training System
EM5154

Advanced Electrical Machines & Mechanical Drives v2.0
CP6152

Electrical Machines Training System
EM5154

Transformer Add On
EM4425

Aerodynamics
CP0704

Wind Tuunel 125
AV5289

LEARNING CENTRE

Enter the product code on the learning centre to find the curriculum

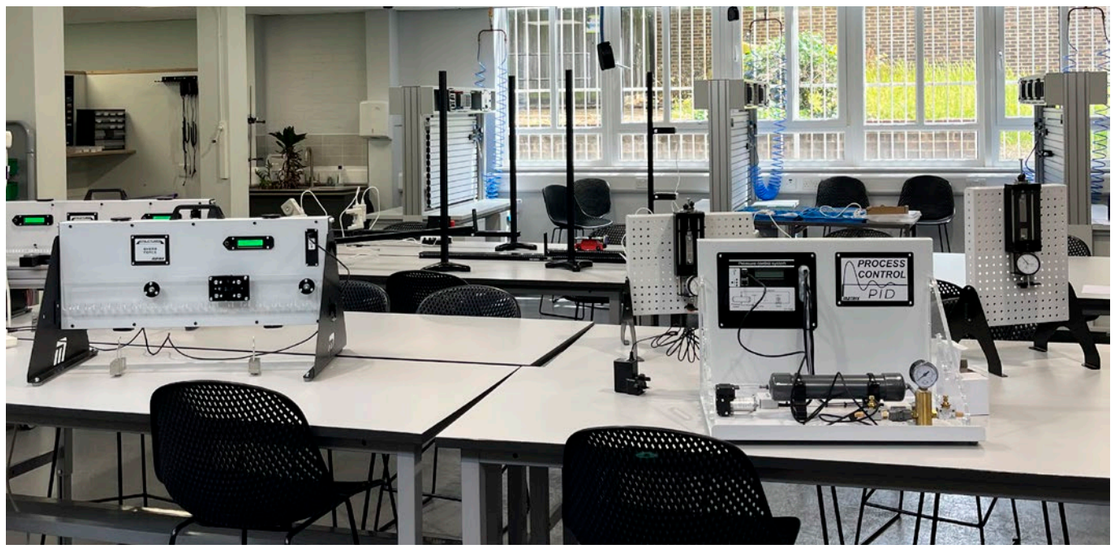
PRODUCT NAME
PRODUCT CODE

CHRIST THE KING SIXTH FORMS

UT VITAM HABEANT

“Having used Matrix equipment for delivery of BTEC Engineering qualifications for many years, we were aware of the quality of Matrix kit and the way they clearly map their curriculum and kit to the new T Levels qualification requirements. Initially we were keen to ensure we had the equipment needed to deliver the core content of T Levels, with a view to utilising as much of it as possible in our occupational specialism(s) into the future. The Matrix equipment allows our students to gain hands-on experience of real experimentation and understand the theory we teach them day to day. The portability of Matrix kit has meant it’s easier for us to utilise space to its full potential. We opted for much of Matrix’s engineering range across electrical, mechanical and manufacturing engineering.”

The Engineering Team at CTK Emmanuel, London, United Kingdom



We can fulfill all of your engineering teaching requirements

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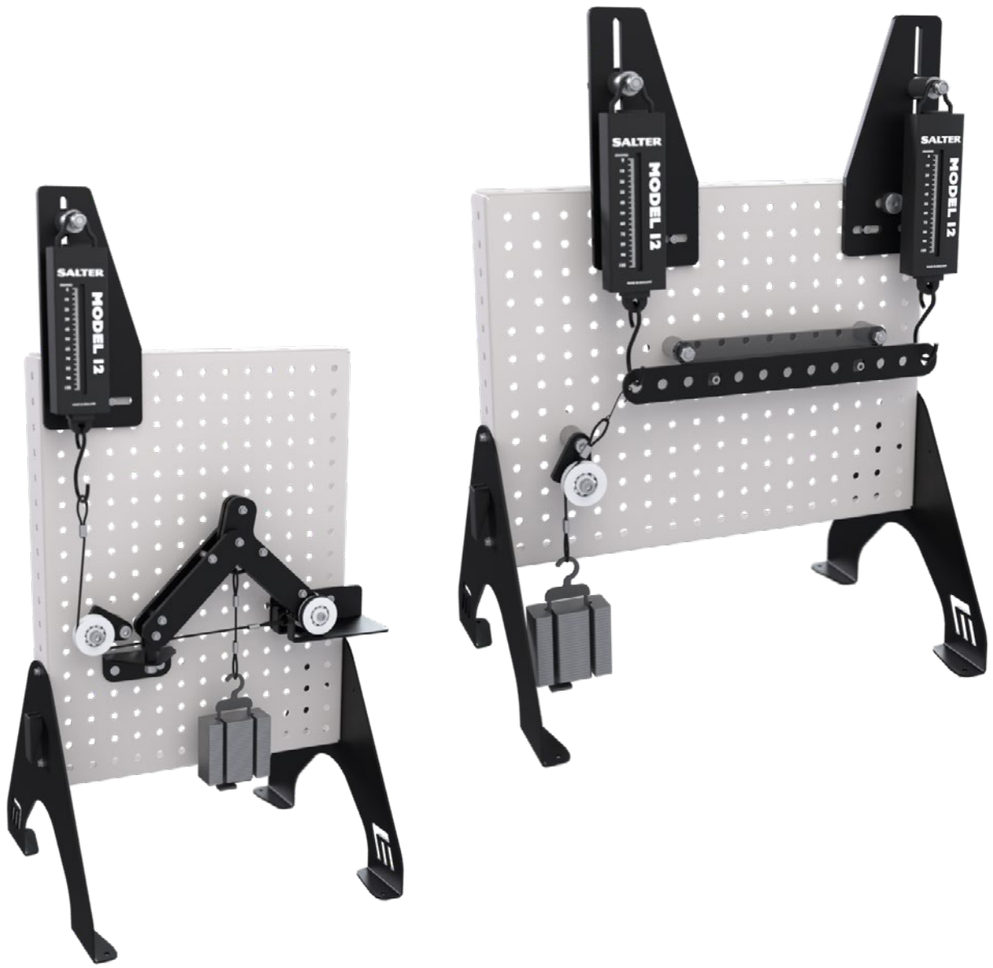
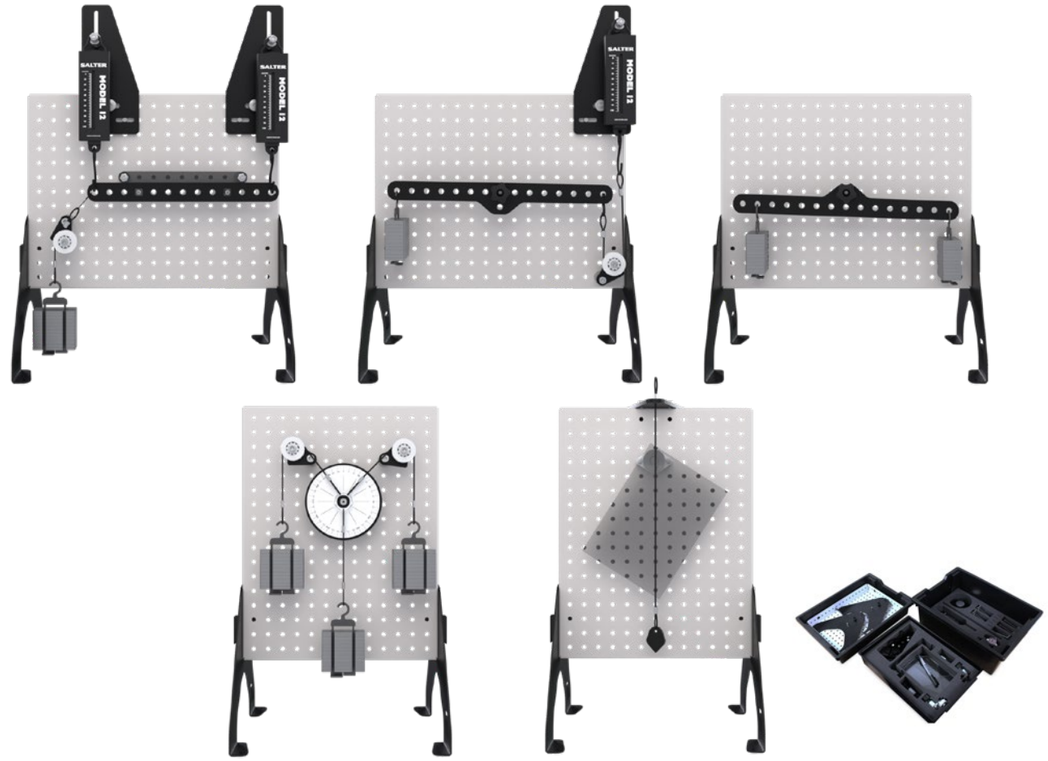
MATRIX | FUNDAMENTAL MECHANICS

The Fundamental Mechanics range allows students to study the basic principles of mechanical engineering required in many engineering courses. Four kits are available in the main fundamentals range; Fundamental statics, Fundamental materials, Fundamental dynamics and Fundamental mechanisms. A complete set combines all of these in to one easy to use, robust and storable lab system. Each kit includes a rugged metal panel with removable legs, the components needed for the experiments and a rugged storage tray. The experimental components are hard-wearing and high quality, meaning they stand up to the rigours of an educational lab. We are also able to provide experimentation kits for the study of Linear and Rotational Dynamics – including data-logging - and Thermodynamics principles.



Statics Fundamentals FM1883

This set of equipment covers the needs of students studying forces, moments, beams and more. Students use the storable work panel (included) to construct a range of experiments, which allow you to study a full course in static engineering systems. A full 10-hour workbook is included free of charge in the Learning Centre for this kit.



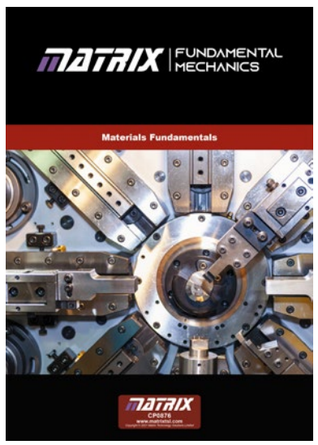
LEARNING OBJECTIVES & EXPERIMENTS:

- Forces (mass, force, weight, combining, parallelogram, triangle and polygon)
- Centre of gravity
- Units of weight and mass
- Free body diagrams
- Force vectors
- Coplanar forces
- Bow's notation
- Principles of moments and moment of forces
- Distinguishing between moments and torque
- Equilibrium of forces
- Levers and the term mechanical advantage
- Simply supported beams
- Concentrated and uniform distributed loads
- Different types of pinned supports

SCAN TO VISIT PRODUCT PAGE

Materials Fundamentals FM1292

This set of equipment covers the needs of students studying torsion, stress and strain, elastic constants, Young's Modulus and more. Students use the storable work panel (included) to construct a range of experiments, which allow you to study a full course in material principles. A full 10-hour workbook is included free of charge in the Learning Centre for this kit.



LEARNING OBJECTIVES & EXPERIMENTS:

- Torsion of rods
- What effect has Polar second moment of area on torque and modulus of rigidity
- What effect has torque, shape, length and material on rod deflection
- Tensile test using plastic, aluminium and mild steels
- Understand the terms stress and strain
- Introduction to Youngs modulus for different materials
- Terms elastic deformation and plastic deformation
- Terms yield strength and ductility
- Shear force tests
- Shear stress and shear strain
- What effect has second moment of area on beam deflection
- What effect has load, shape, length and material on beam deflection
- Different types of supports for beams

SCAN TO VISIT PRODUCT PAGE

Dynamics Fundamentals FM3935

This set of equipment covers the needs of students studying pulleys, static and sliding friction, mechanisms and energy conversion. Students use the storable work panel (included) to construct a range of experiments, which allow you to study a full course in dynamic engineering systems. A full 10 hour workbook is included free of charge in the Learning Centre for this kit.

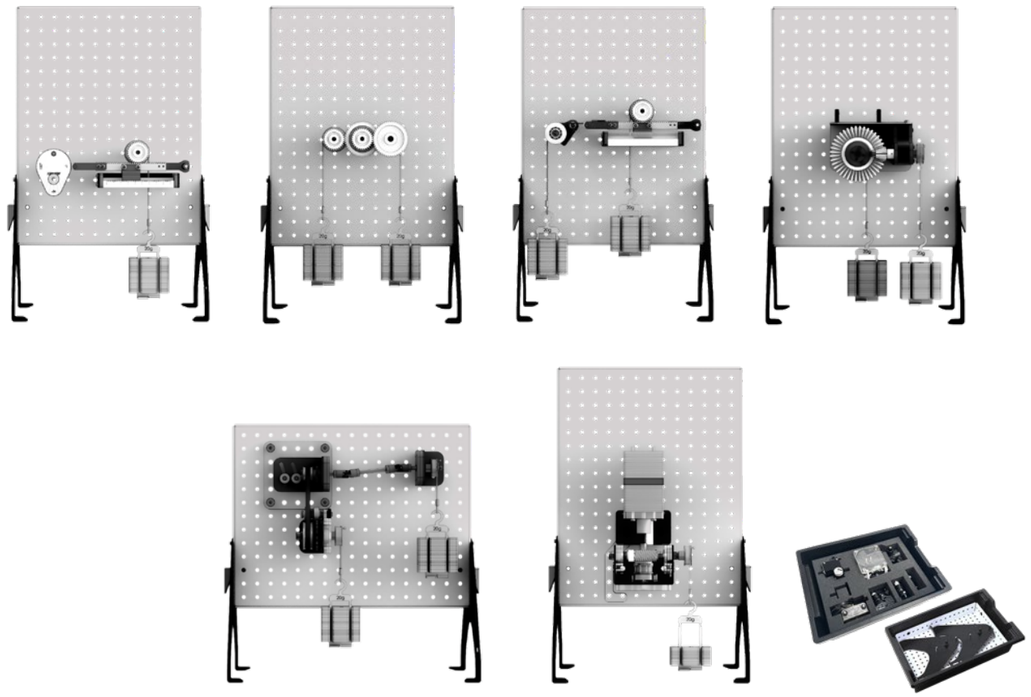
LEARNING OBJECTIVES & EXPERIMENTS:

- Kinetic and gravitational energy parameters and principles
- Dynamic parameters and principles
- Newton's Law of Motion
- Mechanical efficiency and advantage
- Flywheel experimentation
- Toggle mechanisms
- Single and compound Pulley experimentation
- Static and sliding friction on Inclined planes (with frictional surfaces and rollers)

SCAN TO VISIT PRODUCT PAGE

Mechanisms Fundamentals FM0759

This set of equipment covers the needs of students studying gears, cranks, different shapes of cam and drive systems integrated with universal joint using chain/belt transmission system. Students use the storable work panel (included) to construct a range of experiments, which allow you to study a full course in Mechanisms. A full 10 hour workbook is included free of charge in the Learning Centre for this kit.



LEARNING OBJECTIVES & EXPERIMENTS:

Gears (Mechanical Advantage (MA), Efficiency and Gear Ratio):
- Simple Gear
- Compound Gear
- Rack & Pinion Gear
- Bevel Gear
- Worm Gear
- Screw Jack

Cams (Displacement Analysis):
- Tangent Cam
- Snail Cam
- Eccentric Cam
- Crank (Force and Displacement Analysis)

Drive System (MA, Efficiency and Gear Ratio):
- Universal Joint
- Belt Transmission
- Chain Transmission

SCAN TO VISIT PRODUCT PAGE

Dynamics Plus FM5387

This kit sets out to expand on the knowledge of Matrix Dynamics Fundamentals kit (FM3935). With this kit students are now going to be able to investigate and explore new dynamic systems. Student will be able to carry out experiments including spring systems, simple harmonic motion, pendulums and look at how centripetal forces work to create a centrifugal clutch.

Students will need fundamental understanding of Dynamics to complete the learning objectives of this equipment.

LEARNING OBJECTIVES & EXPERIMENTS:

Springs:
- Ability to carry out experiment and order the springs from least stiff to most stiff.
- Rearranging of the formula $F = k\Delta x$ to obtain values of k, the spring constant.
- Plot and interpret graph.
- Become able to calculate the systems spring constant based on their configuration.

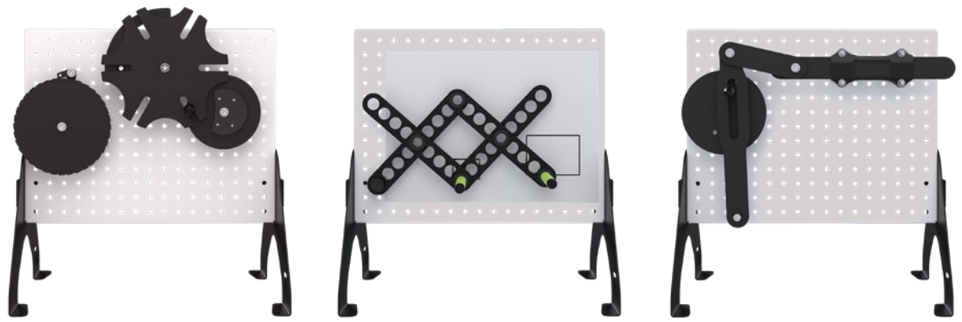
Simple Harmonic Motion:
- Use Kater's Pendulum to acquire an accurate reading of g.
- Using the provided equipment be able to explain SMH (Simple Harmonic Motion) and pendulum motion.
- Understand how centre of mass and pendulum length affects period of oscillation.

Centrifugal & Centripetal Forces:
- Be able to name where centripetal forces are used.
- Understand that weight and speed affect centripetal force.
- Be able to calculate the angular velocity and revolutions per minute.
- Understand how static friction plays a factor in motion, and where it is applicable and where it should be overcome.

Mechanisms Plus FM5655

This kit adds a further level of learning about Mechanisms in addition to our Fundamental Mechanisms kit (FM0759). This addition will look to explore mechanisms in more detail by showing students how systems utilise pivots and degrees of freedom to create specific motion. The students will also be able to see how rotary motion translate to linear motion and the unique rotary motion of Geneva and ratchet mechanisms.

No fundamental knowledge is required to complete the learning outcomes of this kit.



LEARNING OBJECTIVES & EXPERIMENTS:

Additional Mechanisms:
- Conversion of motion using the Geneva and Ratchet mechanism.

Mechanisms:
- Conversion of rotary motion to linear motion.
- Application of quick return mechanisms.
- Application of mechanisms and where they can be found in real life.

Bar Linkages:
- Understanding of the mechanisms constructed and how they utilise pivots and degrees of freedom to create a specific motion.

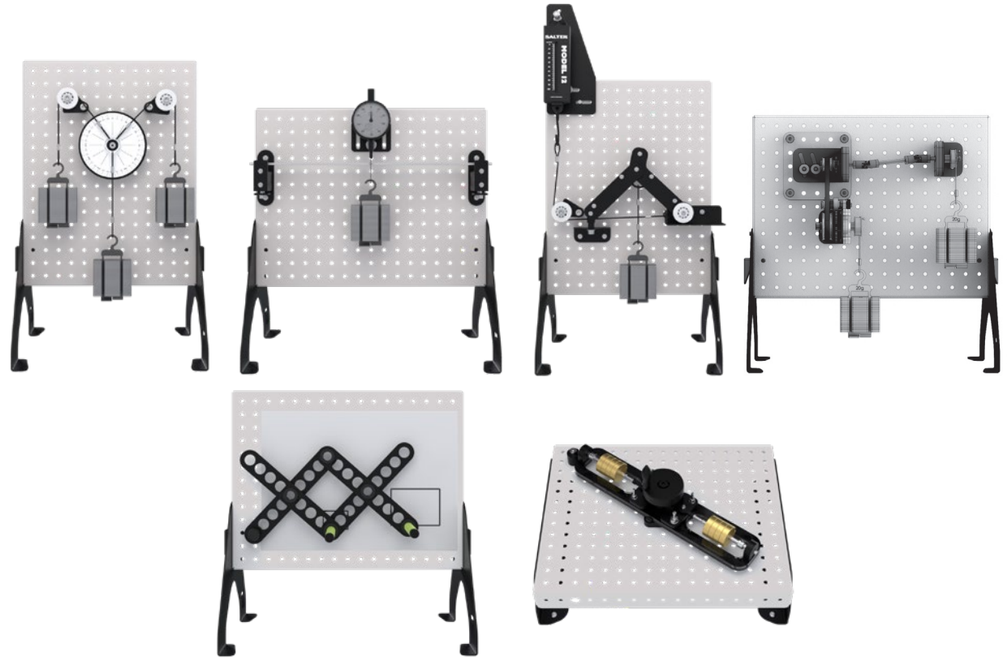
Complete Fundamentals FM9458-3

This full set of equipment allows students to understand the principles of fundamental statics, materials, dynamics and mechanism engineering systems in one portal set of equipment.

Included in this equipment are the full contents of the following kits:

Statics Fundamentals
Materials Fundamentals
Dynamics Fundamentals
Mechanisms Fundamentals
Dynamics Plus
Mechanisms Plus

The user receives everything in neat, Gratnell's trays and each solution includes a work panel (4 in total). Four, 10 hour workbooks are included free of charge in the Learning Centre for this kit.



Linear and Rotational Dynamics HP5099-2

The linear and rotational dynamics kit includes a wireless dynamics system, wireless rotary motion sensor and accessories kit and 2 wireless light gates. Being wireless, the components can be set up anywhere in the room, with results sent straight to your screen and student's devices simultaneously.

This kit allows students and teachers to carry out a range of experiments in dynamics with investigations.

The equipment is supplied with 2 curriculum workbooks, a suite of worksheets and teacher support material.

LEARNING OBJECTIVES & EXPERIMENTS:

- Velocity
- Acceleration
- Newton's law
- Forces
- Collisions
- Conversion of momentum and energy

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Thermodynamics Kit HP4159

This kit allows engineering students to carry out a wide range of practical experiments in Thermodynamics to help them understand the temperature related behaviour of mechanical systems. The kit includes experimental apparatus including metal blocks with heating elements, linear rods with heaters, Leslie cube and Jolly bulb. The kit also includes measuring instruments such as digital thermometers, energy meter, and infrared thermometer. A downloadable manual covers all experiments and includes teacher's notes. A unique feature of the kit is that all the experiments can be completed just with electricity as the heat source – no Bunsen burner is required.

Additional power supply required. Please enquire for further information.

LEARNING OBJECTIVES & EXPERIMENTS:

- Heat capacity of liquids
- Heat capacity of solids
- Linear expansion of heat
- Heat absorption
- Heat radiation
- Expansion of gases – Charles' law
- Boyle's law

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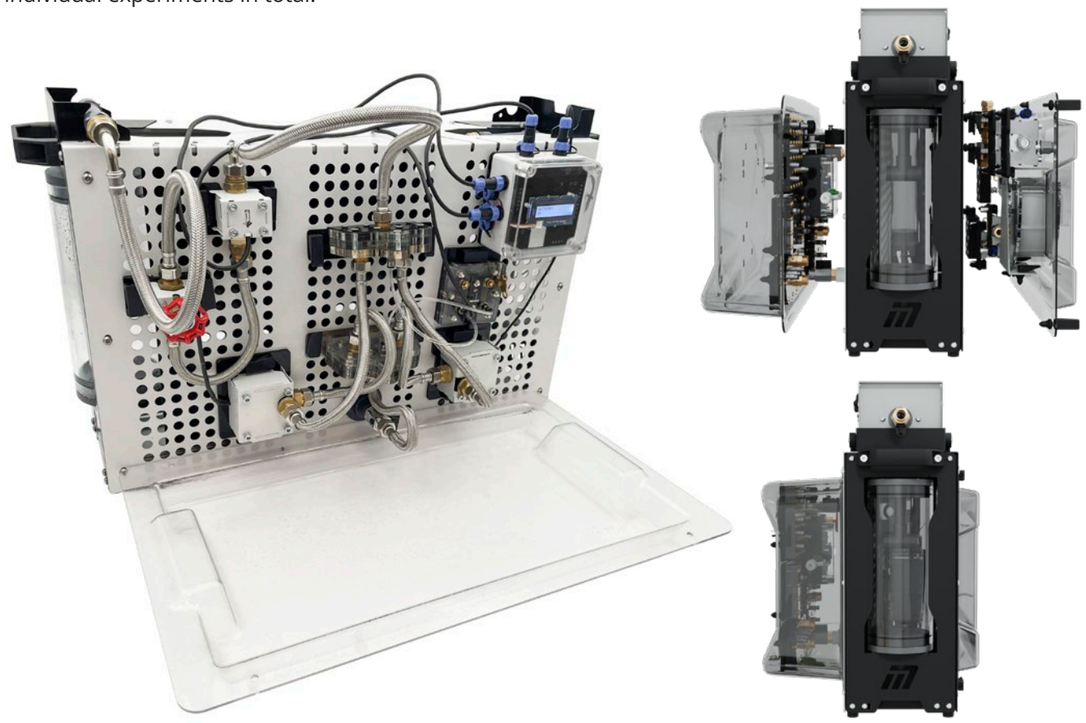
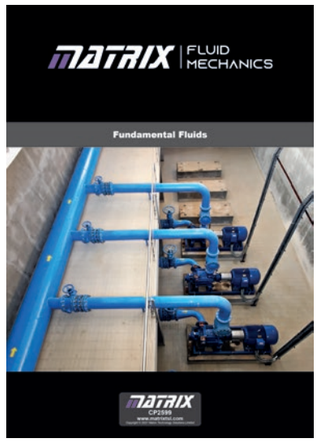
MATRIX | FLUID MECHANICS

The study of fluid mechanics and the forces on them is becoming increasingly popular. With applications in a wide range of disciplines, including mechanical, civil, chemical and biomedical engineering, the Fluid Mechanics range from Matrix allows students to gain a hands-on understanding of the key principles. A main workstation is supplied along with sixteen individual components, which allows students to build nine different experiments without the need for any additional tools. Six of the experiments are connected via USB to the pressure and flow sensors, which allows results to be automatically plotted on a graph for analysis. The remaining three experiments are carried out and plotted manually.
Each component is attached to the main workstation with quick release latches, allowing students to quickly build and dismantle each experiment. A full free curriculum is provided with easy-to-follow worksheets.

Fluid Mechanics FM1000

Our Fluid Mechanics kit is designed to meet the needs of those studying fluid mechanics principles at college and university level. The system is supplied with a series of learning apparatus (see outlined on the following pages), hoses with robust gaskets and a rugged metal workstation. The system can be packed away and stored when not in use. Each of the apparatus is attached within the workstation and two protective covers are attached to the front and back to offer protection. The flow pipes drop down into the unit and the viscosity apparatus attaches to the top of the workstation to create one compact storable unit. This kit provides nine individual experiments in total.





LEARNING OBJECTIVES & EXPERIMENTS:

- Calibration of a Bourdon gauge
- Centre of pressure on a partially and fully submerged plane
- Viscosity apparatus, demonstrating Stoke's law
- Use of manometers and different types (multitube manometer, U-tube manometer and inclined manometer)
- Bernoulli's equation and using a Venturi tube as a flow meter
- Losses in bends, measuring and comparing pressure losses of different bend geometries
- Centrifugal pump characteristics, experimentally determining the pressure/flow rate characteristics of a pump and determining the overall efficiency
- Series pumps, experimentally determining the pressure/ flow characteristics of 2 pumps connected in series configuration
- Parallel pumps, experimentally determining the pressure/ flow characteristics of 2 pumps connected in parallel configuration

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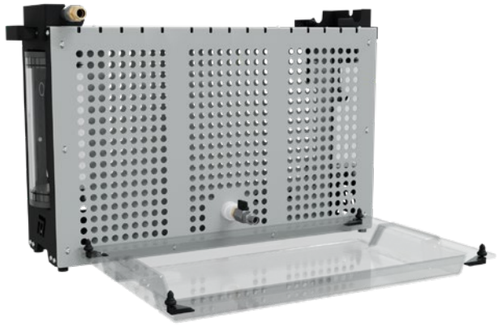


Main Workstation

The main workstation is built of rugged steel and has a built-in panel which allows you to easily clip on the required component. Two water tanks, with a combined capacity of 3L, along with inbuilt connectors, allows students to quickly set up each experiment. When in storage, the flow pipes drop down into the frame, all components are stored within, the drip tray doubles as a back panel to enhance protection.

Control Box

Working with a PC connection, the control box is the brain of the apparatus. Allowing simultaneous control of 2 pumps, while taking readings from 2 flow and 2 pressure sensors, the LCD screen gives students an instantaneous readout. The readings are passed from the control box to the PC software, which plots results for student analysis. The data can also be logged and loaded into Excel for further investigation by students.

Pump Module

The Pump module has an operating voltage of 6-24v and produces a free-flow flow rate of 13 litres/min. It works alongside the control box, to pump water around the apparatus. It features brass connection points for increased longevity

Differential Pressure Sensor

The Differential pressure sensor module is used to measure pressure in the fluid circuits, it features:

- True wet/wet differential sensing
- Easy-to-use, built-in air bleeding system
- Pressure sensing range 0-30 PSI (0-200000 Pa)
- Robust construction, simple push fit fittings using 4mm tube

Flow Sensor

The Flow sensor module houses a calibrated turbine flow sensor. It is used to provide flow rate readout in the app and on the control module screen.

It can measure 0-30l/min

It has robust brass fittings for repeated assembly/ disassembly.

Bourdon Gauge

The Bourdon gauge calibration module is used to compare a known, dead-weight acting through a piston/cylinder of known diameter with the reading on the Bourdon gauge.

The apparatus allows students to determine the accuracy of the Bourdon gauge and highlights the limitations of using these devices.

Multitube Manometer

The multitube manometer module permits comparative pressure measurement between 0 and 120mm of water (0-1200Pa).

The module features:

- Three input pressure ports at the bottom, each connecting to a single vertical limb.
- One reference pressure port that is common to all three limbs at the top.
- A pipette filler (supplied) as a convenient method of applying a reference pressure to the top pressure port.

The pressure ports are self-sealing, push-in fittings and connections are made using 4mm push-in pneumatic tubing. This allows direct comparative measurements to be made between the three input pressure ports.

U-Tube & Inclined Manometer

The U-tube and inclined manometer has a measurement range of 0-110mm.

4mm tubing is attached to the pressure ports using easy-to-use push-in fittings. The inclined manometer indexes to positions at 30°,60° and 90° from horizontal.

Fluid Mechanics FM1000

Losses in Bends Module

The losses in bends module consists of a clearly visible fluid path with 3 different 90° bend geometries.

Each of the bends have self-sealing pressure ports before and after each bend so the pressure drop can be measured using the multitube manometer module.

Viscosity Apparatus

The viscosity apparatus consists of a 100mm diameter clear acrylic tube filled with vegetable glycerine.

This assembly is housed in a sturdy metal enclosure which protects it whilst in storage or being transported.

It features ¼-turn valves at the top and bottom to enable releasing and retrieving spherical samples used in the experiment.

The experiment demonstrates Stoke's law. Students determine the viscosity of the glycerine by measuring the terminal velocity of spherical samples through the fluid.

Centre of Pressure Module

The Centre of pressure module is used for determining the centre of pressure of partially and fully submerged surfaces. This experiment is carried out manually by students who are able to take readings and plot them within the curriculum for analysis.

Venturi Tube Module

The Venturi tube module is used to investigate Bernoulli's principle.

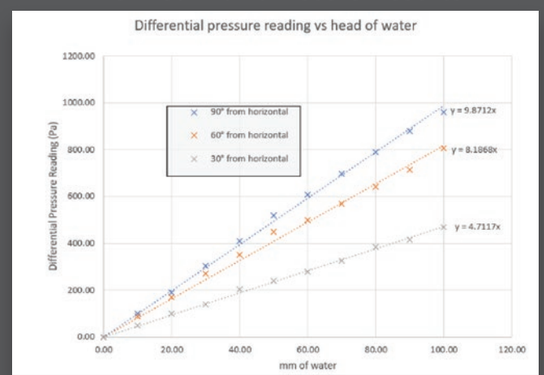
The flow section is constricted resulting in a pressure drop.

Pressure ports at the widest and narrowest section permit attaching the differential pressure sensor for automated readings or the manometer module can be attached to enable manual readings.

Fluid Mechanics Software

The Fluid Mechanics software provides real-time readouts for pumps, showing voltage, current, power, flow, and pressure data. Users can manually control the pumps via a slider or set precise voltages with an override button. Sensors are pre-calibrated and can be re-calibrated using the Fluids Configure application, which also allows filter adjustments for sensor readings. The sweep function sets the pump voltage to 24V and decreases it in defined steps, recording sensor data and generating a live graph. This data can also be logged in a timestamped .CSV file for analysis.

Inclined Manometers Results



The graph above depicts the results from the Inclined Manometer from the Fluid Mechanics kit (FM1000) and the differential pressure vs the head of water. Additional results produced as a result of tests performed using the equipment can be requested.

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

ALL MATRIX SOFTWARE IS AVAILABLE FREE OF CHARGE AS A DOWNLOAD FROM THE MATRIX WEBSITE

WWW.MATRIXTSL.COM

MATRIX | STRUCTURES

The Structures range from Matrix has eleven kits to cover teaching of the most commonly taught principles of structures across college and university level education. These kits are applicable to both mechanical and civil engineering disciplines.
Each kit features a sturdy metal work panel equipped with removable legs, a carrying handle, and a moulded plastic cover. When not in use, the legs can be attached to the back of the panel, and the cover fits over the front, providing a compact and protective storage solution.

The experimental components are rugged and designed to stand up to the challenges of an educational lab. Connection to a PC is through a simple USB, meaning users can export data from their experiments to Excel for analysis and simulation. Power is provided through the PC connection or through connection to a simple wall plug.

Each work panel is also supplied with built-in LCD's which are connected to an on-board controller and provide the user with a manual method of collecting results from their experiments.

Bending Moments — ST8801

This kit allows students to apply loads to hangers suspended along a beam held between two supports. One support allows rotational movement, acting as a pinned support, whilst the other allows translational movement, acting as roller support. A load cell measures the bending moment due to the load applied by the student and students can then create positive and negative bending moments.

Point loads and uniformly distributed loads can be applied across the beam in order for students to gain experience of various different situations for their experimentation.

An integrated load cell measures the force applied across the cut and is displayed on the built-in LCD display. The display has a push button zero feature for experimental setup.

The equipment is powered by a USB cable to PC or wall plug. If the USB is connected via a PC port, data acquisition can be output directly into Excel or further experimental analysis and simulation.

LEARNING OBJECTIVES & EXPERIMENTS:

- Bending moment at the cut due to a varying single point load
- Bending moment at the cut due to a moving single point load
- Bending moment at the cut due to a uniformly distributed load
- Bending moment at the cut due to a point load and uniformly distributed load in superposition

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

SCAN TO VISIT PRODUCT PAGE

Shear Force ST4484

This kit allows students to apply loads to hangers suspended along a beam, held between two supports. One support allows rotational movement, acting as a pinned support, whilst the other allows translational movement, acting as roller support. A load cell measures the bending moment due to the load applied by the student and students can then create positive and negative shear force.

Point loads and uniformly distributed loads can be applied across the beam in order for students to gain experience of various different situations for their experimentation.

An integrated load cell measures the force applied across the cut and is displayed on the built-in LCD display. The display has a push button zero feature for experimental setup.

The experiment is powered by a USB cable to PC or wall plug. If the USB is connected via a PC port, data acquisition can be output directly into Excel or further experimental analysis and simulation.

LEARNING OBJECTIVES & EXPERIMENTS:

- Shear force at the cut due to a varying single point load
- Shear force at the cut due to a moving single point load
- Shear force at the cut due to a uniformly distributed load
- Shear force at the cut due to a point load and uniformly distributed load in superposition

SCAN TO VISIT PRODUCT PAGE

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

Reactions of a Simply Supported Beam ST0454

This product allows student to explore the behaviour of reaction forces on beam with supports. Two ‘simply supported’ supports are attached to load cells so that a precise measure of reactional force can be measured for a loading parameter.

The load cell output is connected to the LCD displays and the USB interference for data acquisition, for further experimental analysis.

The beam has a measure indicator for accurate distance measured between supports, while both support blocks can slide along the rail for exploring the behaviour of varying length.

The beam has incremental pins for hanging weights on at different places to create different point loads and can balance the weights on top to create uniformly distributed loads. Overhanging point loads can be achieved to create negative reaction forces to show direction of forces. This allows student to explore reactional forces that are positive and negative and the principle of superposition.

LEARNING OBJECTIVES & EXPERIMENTS:

- Reactions due to point loads
- Reactions due to UDL’s
- Reactions due to overhangs
- Reactional force change due to varying distance between supports.

SCAN TO VISIT PRODUCT PAGE

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

Bending Stress ST5671

The bending stress Structures product provides students with a beam with 4 strain gauges attached to it. These strain gauges are then connected into the back panel allowing simple 4mm connections to conduct the experiment.

The experiment explores the bending stress in a beam with applied loads. Using equations for bending deflection and stress, the theoretical value can be compared to the output of the experiment. The strain gauges can be connected up using the 4mm banana cables into 3 different Wheatstone bridge configurations. Students can then explore the behaviour of a quarter bridge, half bridge and full bridge configuration. High precision resistors are used to make up the Wheatstone bridge in the absence of a strain gauge.

The LCD display shows the millivolt change of the output from the Wheatstone bridge. With a zero button to reset the experiment.

The experiment is powered by a USB cable to PC or wall plug. If the USB is connected via a PC port, data acquisition can be output directly into Excel or further experimental analysis and simulation.

LEARNING OBJECTIVES & EXPERIMENTS:

- Stress and strain relationship
- Strain gauges as instruments
- Finding the neutral axis by experiment and calculation
- Quarter, half and full Wheatstone bridge applications, with advantages and disadvantages

SCAN TO VISIT PRODUCT PAGE

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

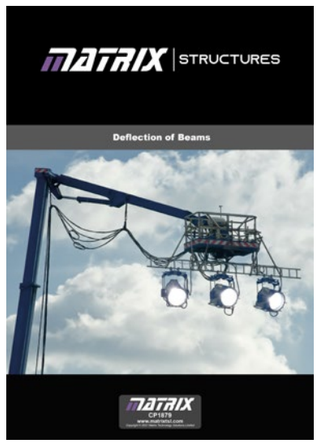
Deflection of Beams ST9544

This kit allows students to utilise a range of beams in order to understand the elastic properties of beams and cantilevers.

Beams can be fitted to one support to form a cantilever, or between two supports with different fixing methods, forming simply supported and fixed or ‘encastre’ beams.

Students apply loads and measure the deflection. This product includes a set of ‘specimens’ of different metals for comparison of the elastic properties. It also allows the student to vary the length of the beam to see how this affects the magnitude of deflection for a given load.

The Digital Mitutoyo dial has its own display, but it is connected to the USB interface to allow data acquisition via USB.



LEARNING OBJECTIVES & EXPERIMENTS:

- Beam bending formula
- Deflection due to point loads and UDLs (uniformly distributed loads)
- How beam fixings affect deflection of: Simply supported beams, Fixed or ‘encastre’ beams, Cantilever beams, Propped cantilever
- Shape of a deflected beam
- Beam length and deflection
- Beam material and deflection — the elastic (Young’s) modulus
- Beam cross-section and deflection — the Second Moment of Area (‘I’ value) – and material stiffness

SCAN TO VISIT PRODUCT PAGE

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

Torsion of Rods ST0386

This kit enables students to study the torsional elastic properties of rods. It includes a selection of test rods that can be fitted to an adjustable experimental work panel, allowing for varying rod lengths. Each chuck has pointers and a scale for precise positioning.

Students apply angular deflection to the specimen using a chuck equipped with a precision potentiometer to measure the deflection, which is displayed on an LCD screen. The other chuck is connected to a load cell that measures the resulting torque, also displayed on an LCD screen. Using textbook beam equations, students can predict the deflection-torque relationship and compare calculated results with experimental data, verifying the equations' reliability and the experiment's accuracy.

The kit includes rods made of different metals to compare their elastic properties, dimensions, and polar second moment of area ('J' value). It also allows variation of rod lengths to observe the effect on deflection magnitude for a given torque. The angle and load cell outputs connect to a USB interface for data acquisition. The kit is constructed from 2mm mild steel for strength and rigidity.

LEARNING OBJECTIVES & EXPERIMENTS:

- Torsion formula
- Rod length and angle of twist relationship
- Rod material and angular deflection—the elastic (shear) modulus (G)
- Rod cross-sectional dimensions and torsion—the polar second moment of area (J)

SCAN TO VISIT PRODUCT PAGE

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

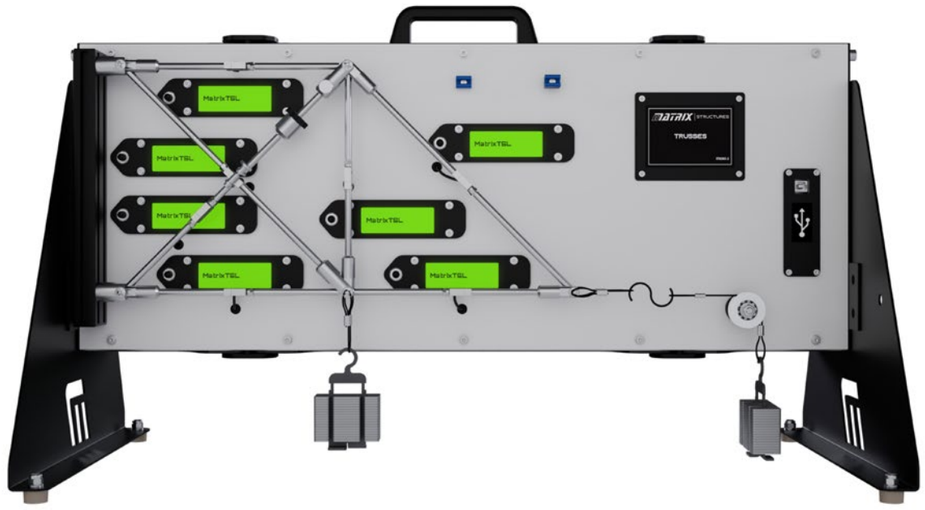
Trusses ST6365-2

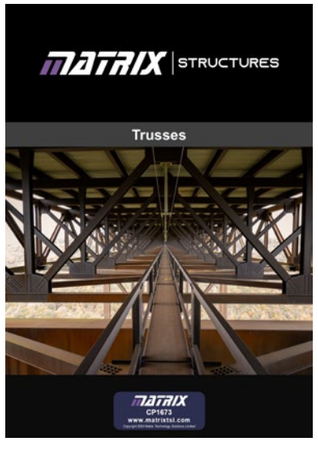
This kit allows students to apply loads to non-redundant and redundant trusses to study tension and compression forces in each truss member. Each of the 7 truss members has a load cell connected to an LCD display and a USB interface for data acquisition. The LCD shows positive or negative values indicating whether a member is in tension or compression. Zero buttons allow for resetting the load cells before each experiment.

The kit includes a redundant member that can be engaged or disengaged using thumb screws:

- Non-redundant truss: When the redundant member is disengaged, students analyze the truss using the Method of Joints, Method of Sections, and Bow's notation.
- Redundant truss: When the redundant member is engaged, students use the Method of Virtual Work, Method of Joints, and Method of Sections, and can determine redundancy using the (m+r) <=> (2j) test. The redundant member features an adjustable twisting mechanism.

Students can calculate theoretical member forces and compare them with experimental results. Two hanging positions allow for exploring redundancy and load transmission, and a magnetic pulley facilitates angled loads. The kit, made from 2mm mild steel, provides a robust base for experiments.





LEARNING OBJECTIVES & EXPERIMENTS:

- Bow's Notation
- Method of Joints
- Method of Sections
- Method of Virtual Work
- Determine Redundancy using (m+r) <=> (2j) test
- Determine tension or compression for each member forces.
- Comparison of theoretical member forces vs experimental member forces.

SCAN TO VISIT PRODUCT PAGE

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

Indeterminate Beam ST3156

This kit enables students to apply concentrated or uniformly distributed loads (UDL) on determinate or indeterminate beams to explore reaction forces under various loading scenarios. It includes three supports: a pinned support on the left, a height-adjustable and movable roller support in the middle, and a roller support on the right. Adjusting the middle support's height can transform the beam from determinate to indeterminate, and it can slide for different experimental setups. The distance between the left and right supports is fixed at 500mm.

Students can experiment with different loading scenarios such as: (a) One concentrated load with two equally spaced supports, (b) One concentrated load with three equally spaced supports, (c) Two concentrated loads with three equally spaced supports, (d) One concentrated load with three unequally spaced supports, (e) Two concentrated loads with three unequally spaced supports, (f) UDL with three equally spaced supports, and (g) UDL with three unequally spaced supports.

A tape measure on top of the beam helps determine distances between supports and loads. Students can observe positive and negative vertical reaction forces, exploring force directions and superposition principles. They can calculate and compare theoretical and experimental reaction forces. The kit is constructed from 2mm mild steel for strength and rigidity.

LEARNING OBJECTIVES & EXPERIMENTS:

- Principles of Superposition.
- Understand determinate beam and indeterminate beam.
- Comparison of theoretical reaction forces vs experimental reaction forces.

SCAN TO VISIT PRODUCT PAGE

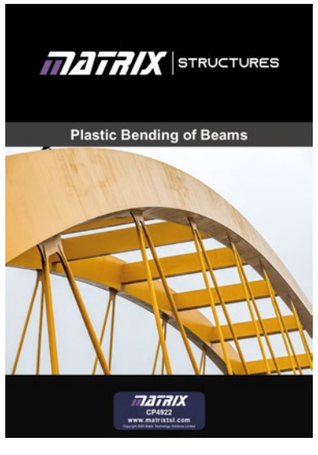
Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

Plastic Bending of Beam ST4847

This kit allows students to study the elastic and plastic properties of beams using aluminum or steel. It features an LCD display showing the applied load, with a maximum load capacity of 50 kg. Each of the two supports can be set as simply supported or fixed, enabling the beam to be configured as a simply supported beam, fixed or encastre beam, or propped cantilever beam.

Students can apply load by turning the screw jack handle and measure deflection by rotations.

The kit includes beam specimens for comparing elastic and plastic properties, allowing students to calculate and compare yield and collapse loads with experimental results. Concepts covered include Elastic Modulus, yield stress, second moment of area, collapse load, plastic moments, plastic hinges, and shape factor. The construction is made from 2mm mild steel for a strong and stiff base.



LEARNING OBJECTIVES & EXPERIMENTS:

- Material Properties, e.g. Elastic Modulus (Young's Modulus, E), Yield Stress
- Second moment of area (I)
- Collapse Load
- Plastic Moments
- Plastic Hinges
- Shape Factor
- Observe the shape of collapsed beam under 3 types of supports.
- Comparison of predicted results vs experimental results.

SCAN TO VISIT PRODUCT PAGE

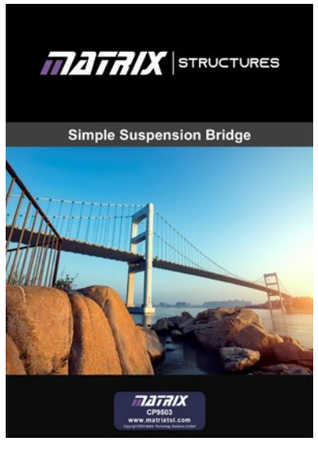
Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

Simple Suspension Bridge ST0880

This kit enables students to apply concentrated loads or uniformly distributed loads (UDL) on parabolic simple suspension bridges to explore cable tensions at both ends. By adjusting the guided pulley support on the left-hand side tower and locking it with a thumb nut, students can switch between bridges with pulley supports at the same or different height levels.

Two load cells connected to LCD displays measure tensions at both ends of the bridges. This allows students to investigate tensions under various loading scenarios, such as moving a concentrated load across the bridge span or applying UDL for the full span. They can calculate theoretical tension forces and compare them with experimental values, reinforcing their understanding of the center of gravity shift, principles of moments, and equilibrium equations.

The kit is constructed from 2mm mild steel for strength and rigidity.



LEARNING OBJECTIVES & EXPERIMENTS:

- Shift of Centre of Gravity (CoG)
- Principle of Moments.
- Equilibrium Equations.
- Comparison of theoretical tensions vs experimental tensions.

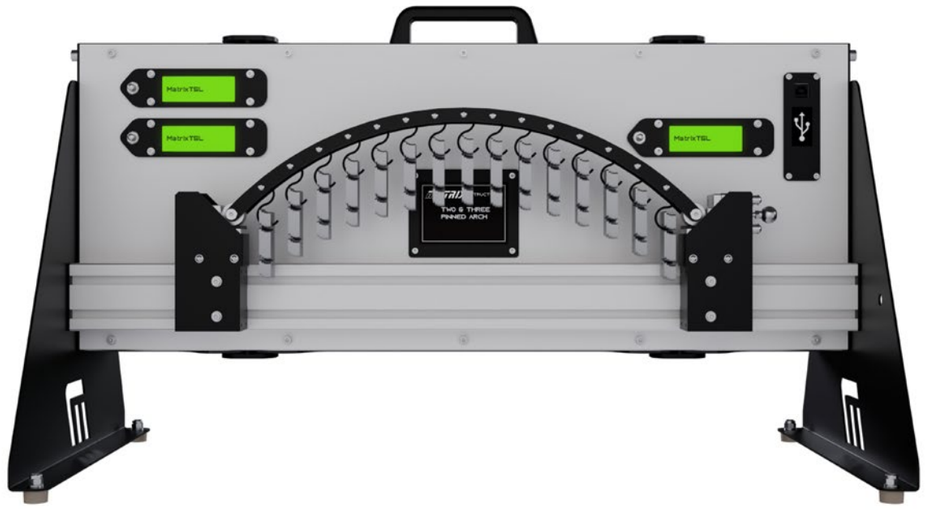
SCAN TO VISIT PRODUCT PAGE

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

Two & Three Pinned Arch ST5928

This kit enables students to apply concentrated or uniformly distributed loads on two-pinned and three-pinned circular arches to study horizontal thrust and vertical reaction forces. It allows easy swapping between the two types of arches by placing them on designated spots and includes an adjustable contact point on the left-hand side support block.

Three load cells connected to LCD displays measure vertical and horizontal reaction forces (two cells for vertical and one for horizontal). Students can set up various loading scenarios, such as moving a concentrated load across the arch span or applying UDL for half or full span, to measure and compare experimental forces with theoretical calculations. This reinforces their understanding of moments, superposition, and equilibrium principles. The kit is constructed from 2mm mild steel for strength and rigidity.



LEARNING OBJECTIVES & EXPERIMENTS:

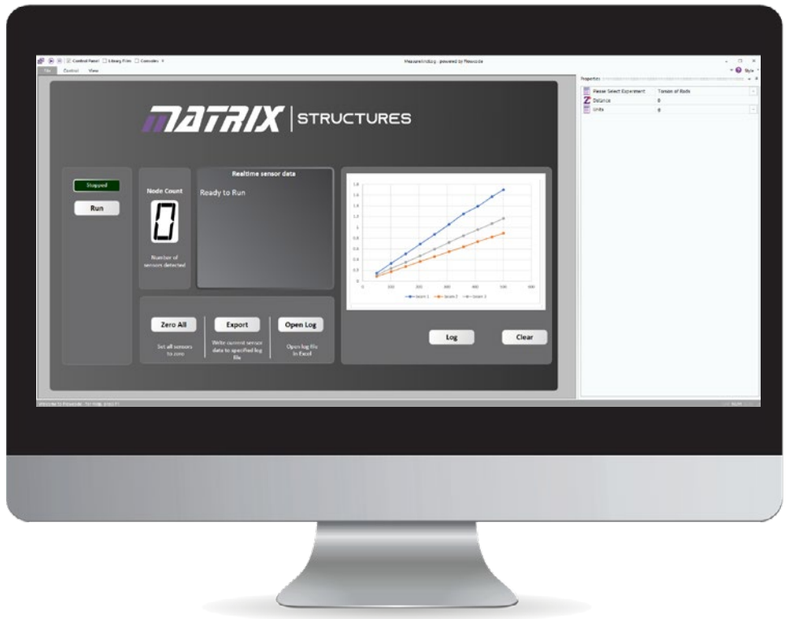
- Principle of Moments.
- Principle of Superposition.
- Equilibrium Equations.
- Comparison of theoretical forces vs experimental forces.

SCAN TO VISIT PRODUCT PAGE

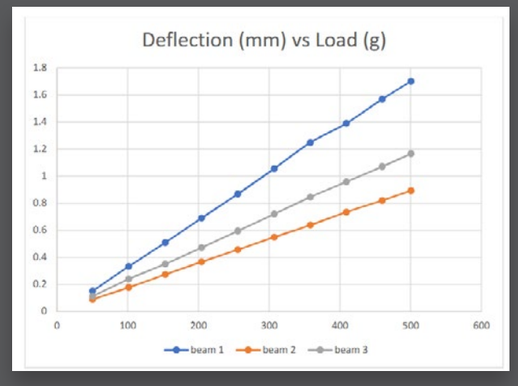
Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

Structures Software

The Structures software automatically identifies the number of nodes in the product and provides a real-time data feed from the load cell or node. Students can select the specific Structures product they are using in the properties section and input the parameters for their experiment. The software generates a dynamic graph that visually displays real-time data from the nodes. Students have the option to select displacement or weight increments for the x-axis based on the experiment's requirements. The graph data can be saved in a log file for post-processing, either by using the export button or by right-clicking the graph.



Deflection of Beams Results



The graph above depicts the results from the Deflection of Beams Structures kit (ST9544) and the impact of an increasing load being applied across three beams. Additional results produced as a result of tests performed using the equipment can be requested.

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

ALL MATRIX SOFTWARE IS AVAILABLE FREE OF CHARGE AS A DOWNLOAD FROM THE MATRIX WEBSITE

WWW.MATRIXTSL.COM

Complete Structures Kit ST1795-2

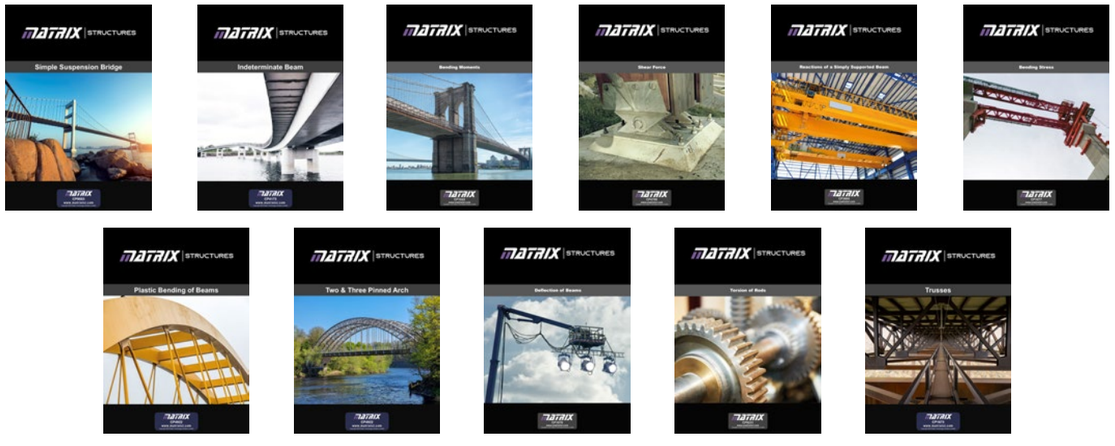
The complete set of Structures includes eleven kits to teach students the commonly taught principles of Structures across colleges and universities worldwide, spanning both mechanical and civil engineering

Each of the kits in this range features a robust metal work panel which is fitted with removable legs. The legs attach to the back of the equipment for safe storage when not in use. A carry handle and plastic moulded cover is also supplied to protect the system from any damage when not in use.

The experimental components are rugged and designed to stand up to the challenges of an educational lab. Connection to a PC is through a simple USB, meaning users can export data from their experiments to Excel for analysis and simulation. Power is provided through the PC connection or through a simple wall plug.

Each work panel is also supplied with built in LCD's which are connected to the on-board controller, in order to provide the user with a manual method of collating results from their experiments.

See individual kits for learning outcomes.



BUNDLES ARE ALSO AVAILABLE FOR MECHANICAL, MATERIAL AND CIVIL DISCIPLINES

SCAN TO VISIT PRODUCT PAGE

MATRIX ELECTRICAL MACHINES

Electrical machines, including motors, generators, and transformers, play a critical role in modern engineering applications. These machines convert electrical energy into mechanical motion and vice versa, forming the backbone of industrial automation, transportation, and power generation.

For mechanical engineers, understanding electrical machines is essential, as electromechanical systems are increasingly integrated into mechanical designs. From electric vehicles to automated manufacturing systems, the interaction between electrical and mechanical components is crucial for efficiency, performance, and sustainability. With advancements in energy efficiency and automation, mechanical engineers must grasp the principles of electrical machines to innovate and optimize designs in a competitive, technology-driven world.

As part of the development of our latest solution for electrical machines, we have developed 5 additional modules that provide a clear understanding of how each effects the performance of the motors in the electrical machines product range.

> "To facilitate hands-on student learning in our new Power Electronics lab, we invested in the Matrix Electrical Machines equipment. The Electrical Machines equipment introduces students to key DC and AC motor types, with their unique torque versus speed characteristics and relative efficiencies. We find the modular and portable nature of both the Locktronics and the Electrical Machines equipment especially beneficial. Our students enjoy using the dyno-motor-under-test arrangement finding the 24 Volt system to be very practical and well-equipped with safety features appropriate for student work."
>
> *Messiah University, United States of America*

Mechanical Modules EM8622

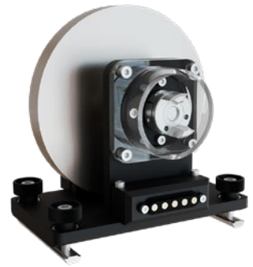
In today's electrified world, engineers across all fields, including mechanical engineers, need a solid understanding of electrical machine theory. As part of the development of our latest solution for electrical machines, we have developed 5 additional modules that provide a clear understanding of how each affects the performance of the motors in the electrical machines product range.

Backlash Module

The backlash module is designed to demonstrate the principles of intermeshing gears and the impact of backlash on motion systems. The module consists of 2 60mm diameter gears. One is coupled to the main shaft which is driven by a select motor in the Matrix electrical machines system and coupled to the dyno at the other end, or encoder positional feedback. The driven gear is coupled to a free running independent shaft which is attached to an encoder for further positional feedback. Students are able to adjust the meshing of the gears on a linear rail slide, and see the output difference in positional accuracy for the 2 shafts.

Flywheel and Clutch Module

An electromagnetic clutch is coupled to the motor side of the module, with a flywheel coupled to the dynamometer shaft allowing for slip condition and inertia testing to be conducted. PWM signal allows for variable control of the clutch engagement between 0-24v. A safety shroud contains the flywheel during operation.

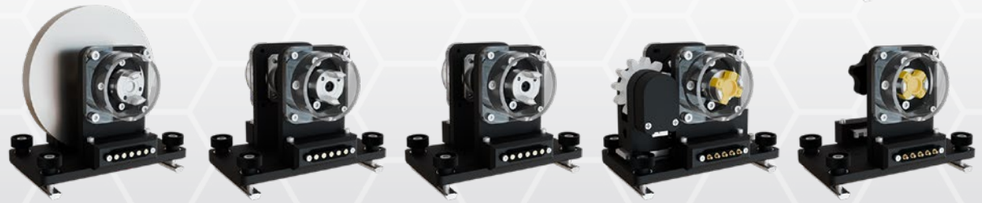


Locked Rotation Module

The locked rotor allows for zero RPM stall torque testing of the motors. Within the module is a load cell to take stall torque values for data acquisition into the software. Two positions allow for the coupler to be engaged and disengaged depending on testing.

Gearbox 1:5 / 5:1 Modules

The planetary gearbox has an efficiency of 90% with Backlash at No-load: <=30arcmin. It is a low noise gearbox at <=55dB with a IP rating of IP54. The mechanical module has the auto ID built into it.



Electrical Machines Training System (EM5154) is required to use the mechanical modules add-on kit.

Electrical Machines Training System EM5154

This kit includes the digital drive control box, dynamometer and all machine types included in the new electrical machines range. Users will then be able to follow a comprehensive course in Electrical Machines Systems, including parts of the Advanced Electrical Machines systems curriculum.

LEARNING OBJECTIVES & EXPERIMENTS:

- Key motor characteristics, including DC, AC, three phase, brushless, stepper machines and more
- Understanding speed, torque and mass
- Three phase generation
- Phase shift in motors
- Delta configuration of motors
- Motor characteristic comparisons
- Electrical Machines and MATLAB

Curriculum

There are 4 curriculum relevant when using the electrical machines training system and the mechanical modules together.

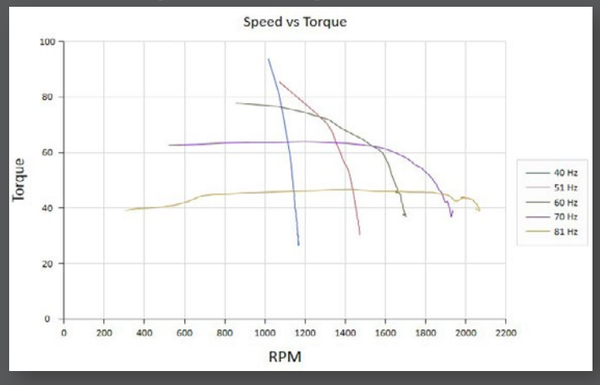
MECHANICAL LEARNING OBJECTIVES:

- Induction machine free running tests
- Induction machine locked rotor testing
- Induction motor characteristics
- Effects of friction and losses
- Simulating motor models
- Locked rotor tests on motors
- Gearbox ratios
- Flywheel and clutch dynamic systems
- Effects of backlash

Electrical Machines Software

All teaching equipment from Matrix comes with data acquisition and control software, as well as curriculum. The software allows for automatic collection of results from performed experimentation, which can then be exported for further analysis.

Speed vs Torque Results



The graph above depicts the results from the speed vs torque experiment. Additional results produced as a result of tests performed using the equipment can be requested.

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

ALL MATRIX SOFTWARE IS AVAILABLE FREE OF CHARGE AS A DOWNLOAD FROM THE MATRIX WEBSITE

WWW.MATRIXTSL.COM

MATRIX | WIND TUNNEL

The new Wind Tunnel is designed to teach students the key principles of aerodynamics. Our wind tunnel teaches students the basics of drag, lift, flow patterns, air flow, pressure distribution over aerofoils.

The wind tunnel system meets the requirements of many courses taught within mechanical engineering, as well as delivering outcomes in aerospace training, and the needs of various modules of Part 66 of the European Aviation Safety Agency syllabus, which is internationally recognised as the gold standard for training Aerospace maintenance engineers.

Wind tunnel curriculum and data acquisition software is provided at no additional cost. What's more this system is compact and storable. It is supplied in a bespoke, custom-made flight case, meaning labs can be utilised for various requirements day to day.

In aerospace, you will find new training systems focusing on areas including:

- Electrical and electronic fundamentals in aviation
- Digital techniques and principles
- Avionics EFIS system
- Wind tunnel for study of aerodynamics
- Various mechanical principles including fluids
- Electrical machines and motor drives

As is true of all our engineering solutions, our kits are low power, curriculum mapped, rugged, portable and space saving. We offer a full learning package including required hardware, software and curriculum (which is freely available to all in our online Learning Centre).

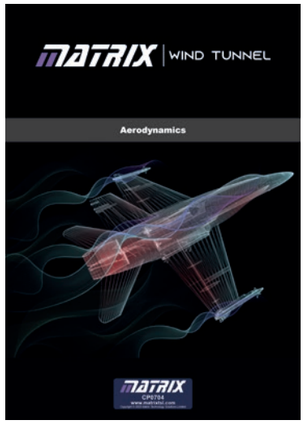
Wind Tunnel AV5289

This compact open-circuit sub-sonic wind tunnel is designed for benchtop use. The wind tunnel is designed for teaching aerodynamic principles and exploration of fluid flow. Suitable for college to undergraduate teaching, it features a computer controlled fan, data acquisition and multiple experimental setups, controlled by a touch screen interface. The wind tunnel has a 125mm transparent test section and over 35m/s wind speed.

The wind tunnel has a honeycomb structure built into the contraction nozzle (ratio 9.2:1) which ensures uniform flow through the test section. The clear test section allows for visibility and clear understand of the experimental behaviour. The air exits through a variable speed controlled fan, with a finger guard covering the back.

Built-in data acquisition allows users to have direct output of pressure readings from pitot static tube and pressure tappings. It also allows for real time lift and drag force components to be logged. Different drag shapes are provided along with multiple NACA profile aerofoils. Simple thread attachment allows students to design their own test pieces for analysis.

A smoke generator can be used to create streamline smoke trails over the test objects for visualisation of flow patterns.



LEARNING OBJECTIVES & EXPERIMENTS:

- Bernoulli's equation
- Air flow over aerofoils
- Air flows around blunt and streamlined shapes
- Pressure distribution around a cylinder and aerofoil.
- Lift and drag forces for blunt and streamlined shapes
- Flow visualisation
- Manometers

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

SCAN TO VISIT PRODUCT PAGE

Pitot Static Tube

This module includes a pitot-static tube attached to 2 pneumatic push in fittings. This allows for easy use and the maintaining of a closed test section.

6 Drag Shape Specimens

The 6 body shapes include, cone, semi-sphere, sphere, flat surface, teardrop and rough surface sphere (golf ball). Each of the shapes have the same projected surface area in the section to make experimental comparisons easier. They are manufactured out of PVC on precision CNC machines. The shapes each have a shaft for connecting it to the 2 component force module to obtain drag force readings from the load cell. The experiment allows for the concept of drag coefficient and turbulence to be explored.

Pressure Tapped Cylinder

The pressure tapped cylinder consists on 1 cylinder along the whole test section to mimic 2D analysis. The cylinder has one small pressure tapping which internally connects to a push fit pneumatic fitting for ease of use. The cylinder can be manually rotated through 5 degree notches for incremental testing. The module allows students to explore pressure distribution, lift and drag coefficients, flow visualisation and vortex's.

3 Data Acquisition Cables

The 3 data cables connect to the 2 component force module, with 1x 5 way cable and 2x 4 way cables. Controlling the stepper motor for angle of attack and the data acquisition of lift and drag.

Pressure Tapped Aerofoil

The pressure tapped aerofoil is a NACA0015 profile with 23 pressure tapping on the top and bottom side for the aerofoil. The 23 tapping are staggered to reduce wake issues. The tappings are connected to 23 silicone tubes numbered for identification which can connect to the pressure sensor in the control box. The module can manual rotation through +-12 degrees of Angle of Attack. This allows student to explore pressure distribution over an aerofoil, lift and drag forces, boundary layers and separation of air over aerofoils.

3 Aerofoil Shapes

The 3 aerofoils are NACA0015, NACA 4415 and S1223 which students to explore aerofoil geometries and its effect on lift and drag and full range of angle of attacks. The angle of attack can be controlled by the 2 component force module as the aerofoils directly attach to this module. The student can also explore concepts of stall speed and optimal operating conditions.

2 Component Force With Angle Of Attach Numerical Control

The 2 component force module has 2 load cells for lift and drag measurements and a stepper motor to computationally control the angle of attack. The module connects to the control box with the 3 data acquisition cables and allows for automatic data plotting and sweep functionalities in the software.

Wind Tunnel Flight Case AV7627

The custom build case for wind tunnel, safely holds the wind tunnel and all components. Perfect for Matrix Lab setups for multi-use classrooms, ensuring the wind tunnel is stored safely and securely. With its padded interior, the flight case provides excellent protection and durability. Additionally, the wheels make it easy to transport, allowing for convenient movement to storage or between classrooms, offering true portability.

MBO College Airport

“As ROC Amsterdam Airport, we invested in several modules for Aviation training. We use the locktronic EASA module 3 & 4 to teach our students the basics of Electrical and Electronic topics. The future (Mechanical and Avionics) engineer learn after a short theoretical introduction via practical exercises how the electronic & electrical components operate.

The locktronic system is flexible and a simple way to build all kind of aircraft circuits. After finishing the module the student know the principles for module 3 and 4, to be successful for the PART 66 exam.

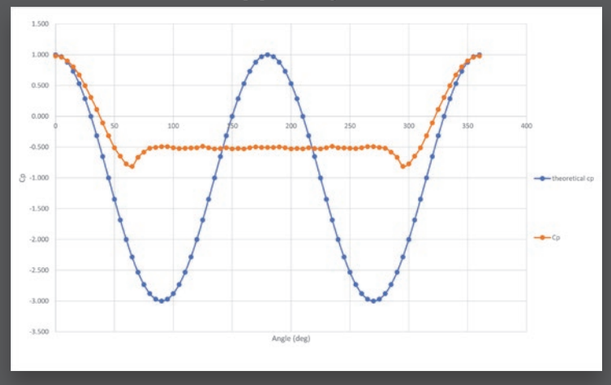
Together with locktronic we work together to improve the modules, to update the module in according with the new technology.”

Fons Laarhuis/ teacher ROC Airport

Wind Tunnel Software

The Wind Tunnel software allows students to explore its capabilities with real-time data on lift, drag, and air pressure. Air speed is shown on a dial readout, based on editable pressure data during calibration. A dropdown menu lets students select experiments and adjust fan speed or angle of attack. The property manager allows setting increment levels and performing automated sweep tests across various speeds or angles. The software also controls LED functionality and log file placement. Real-time graphs are generated for each experiment, enabling efficient and accurate data saving.

Pressure Tapped Cylinder Results



The graph above depicts the results from the pressure tapped cylinder from the Wind Tunnel kit (AV5289) and the angle of attack vs the pressure coefficient. Additional results produced as a result of tests performed using the equipment can be requested.

Software Requirements
- Processor: 1Ghz or faster
- RAM: 1Gb or more
- HDD Space: 1Gb
- OS: 32 or 64bit Windows 7, 8, 10 or 11
- Display: Recommended minimum (1920 by 1080) full HD

ALL MATRIX SOFTWARE IS AVAILABLE FREE OF CHARGE AS A DOWNLOAD FROM THE MATRIX WEBSITE

WWW.MATRIXTSL.COM

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