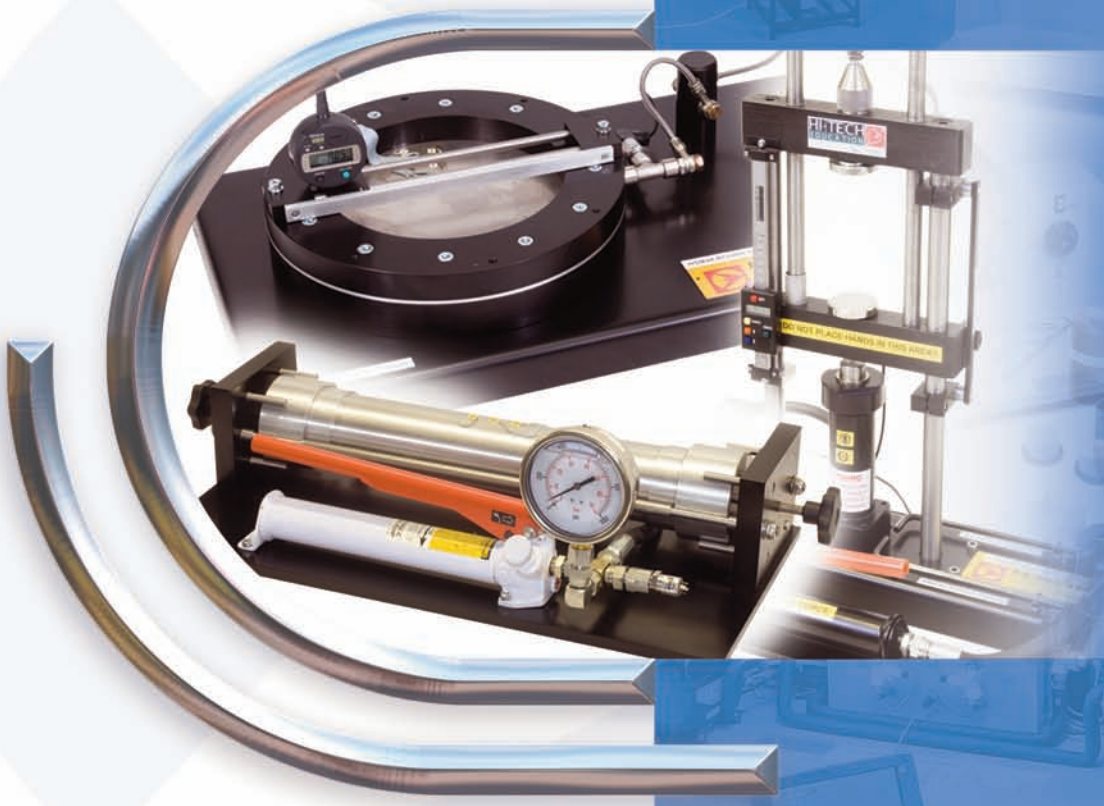
P·A·Hilton Ltd

HI-TECH EDUCATION



STRENGTH of MATERIALS

HI-TECH Education is a market leader in the manufacture and provision of teaching equipment for Universities and Technical Colleges worldwide for both degree and vocational level.

It has been designing and manufacturing "hands-on" Engineering teaching equipment for almost 50 years and has a wealth of knowledge and experience within the educational and training industry. Its worldwide network of agents guarantees a fast and professional response to all enquiries.

The STRENGTH of MATERIALS range of HI-TECH Education equipment enables clear and comprehensive learning of Materials and their properties covering a variety of theories and topics. An understanding of the way in which materials act and react, is fundamental when studying the application of loads on a variety of fixed or moving structures. The STRENGTH of MATERIALS form a comprehensive range of equipment, from fixed beams through to rotating machines apparatus, equally suitable for demonstration and experimental work.

All the STRENGTH of MATERIALS hardware operates in a standalone mode, with a large number being supplied with **Data Acquisition** Interfaces and **Software.**

2 Two Year Warranty

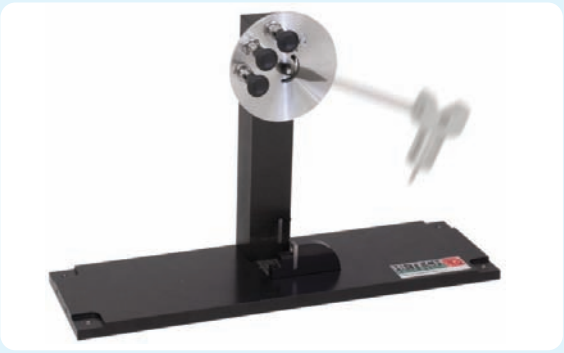
HSM1cD Advanced Beam Testing

An unlimited range of beam experiments can be performed to measure support reactions, deflections and rotations of simply supported, fixed and two span continuous beams, simple and propped cantilevers, and sinking supports. Differing material and section beams supplied are carried by pinned supports on three load-measuring piers each containing an electronic load cell which measures the vertical reaction forces. The output from each load cell is fed into the Data Acquisition Interface supplied. Data Acquisition Software captures the key experimental parameters from the hardware. Three dial gauges on movable stands measure the beam and support displacements. Supplied with hangers, calibrated weights set and set of test beams.

Optional Accessories: HSM1f, HSM1g

HSM2 Torsion of Bars

Apparatus to understand and investigate directly the relationship between the torsional load applied to a round bar and the angular twist produced and how this relationship varies with the beam material and it's cross sectional polar moment of area. Specimens are rigidly held in a clamp fixed to one end of the bench top base frame of the apparatus. A bearing at the other end contains a short shaft with an integral pulley and chuck. The pulley has cord wrapped around its periphery to allow torque to be applied using the load hanger and calibrated weights supplied. A rotation scale and pointer can be attached to any point on the specimen's length to find the angle of twist of the specimen. A specimen set is supplied with a variety of specimens in round bar and differing materials.



HSM4 Pendulum Impact Tester (4J)

A sturdy unit for the study of notched bar impact strength of materials. A base plate with protective guard houses all the components. The base plate supports an anvil and pillar which have profiles for supporting the notched specimens prior to testing. A heavy hammer swings on a pre-defined radius. The initial energy of the hammer can be varied by changing the starting weight and/or height of the hammer. As the hammer swings through its radius, it impacts on the specimen and the distance it travels passed the specimen is measured on an integral scale. The release of the hammer is controlled with a hand operated plunger. A number of test specimens are provided in differing materials, with further specimens available separately.

HSM10 Curved Bars

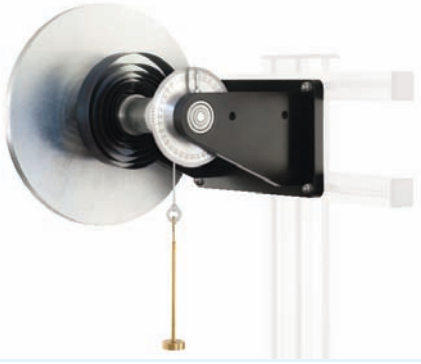
The theoretical deflections of curved shapes are most easily found by applying strain energy ideas, such as Castigliano's first theorem. The shapes chosen in this apparatus provide a relatively easy introduction to the use of such techniques. A bench mounted base supports a variety of curved bars in the form of a ring, semi-circle or quadrant/davit. Loads are applied by specially designed weight hangers so that the specimen bends. Horizontal and vertical deflections are measured by dial gauges rigidly attached to the base and surrounding pillars. The bars can be readily changed and the position of the dial gauges relocated to measure the deflections of the new configuration. All specimens, weight hangers and a set of calibrated weights are supplied.

HSM11 Combined Bending and Torsion

The object of this experiment is to determine what levels of combined bending and torsion cause elastic failure in different materials, and to compare them with various theories of failure. The apparatus uses specially machined 'necked' specimens which are clamped at one end to the base plate and at the other end to a counterbalanced circular loading plate. Regular interval graduations on the loading plate allow a special hanger to locate. The special hanger enables pure bending, pure torque or a combination of both to be applied depending on the position of the hanger. The specimen deflection is measured by a dial gauge mounted diametrically opposite the load point. A set of calibrated weights is supplied along with a set of test specimens. Further test specimens are available separately.

Optional Accessories: HSM11a, HSM11b, HSM11c

HSM16 Torsion of a Spiral Spring



Spiral springs are used to provide a resisting or restoring torque to a shaft when it is rotated through an angular displacement. They exhibit similar stiffness characteristics to linear springs, except that the effect is one of torque rather than force. The stiffness of a spiral spring depends on its physical dimensions and the rigidity of the steel strip from which it is formed. With this apparatus the student can easily calculate the theoretical stiffness of the spring, and compare the value with simple experimental results. The wall mounted unit consists of a spiral spring coiled from a length of steel strip. One end of the spring is attached to a shaft mounted in ball bearings. A load hanger and calibrated weights is used to incrementally load the spring. Spring deflection is measured with an attached 360° scale.

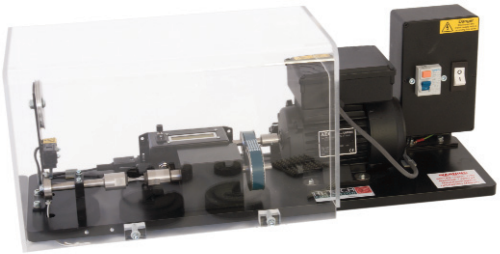
Optional accessories: HAC14

HSM18 Electrical Resistance Strain Gauge

The apparatus has been designed to illustrate the basic features of electrical resistance strain gauges and their application in measuring bending and torsion. A cantilever has a single gauge bonded onto its surface, and an identical gauge is fixed to an unstressed piece of the same material for temperature compensation. The two gauges form part of a Wheatstone Bridge which has a balancing potentiometer, and whose meter is calibrated directly in microstrains. The cantilever is loaded by the load hanger and calibrated weights hung from its free end. A torsion bar is also supplied having two gauges bonded orthogonally at 45°. A detailed label on the unit shows the wheatstone bridge arrangement and how the specimen strain gauges connect into the circuit.

Optional accessories: HSM18t, HSM18c

HSM19 Rotating Fatigue Machine



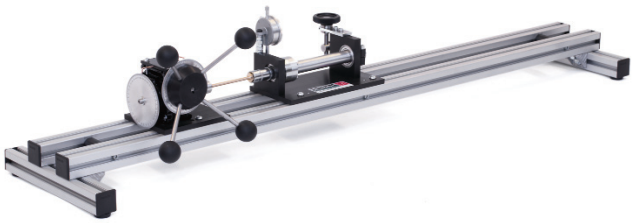
This apparatus has been designed to introduce students to the effects of fatigue. A motor rotates a specimen through a gear and pulley arrangement which can be adjusted. During the rotation the specimen is subject to sinusoidal variation of bending stress. The loading system cancels its own self-weight enabling any desired value of bending stress to be applied. Loads are applied to the test specimen using a load hanger and a set of calibrated weights. When failure occurs, a microswitch stops the motor and the cycles to failure are registered on a revolution counter. A safety guard shields all rotating parts.The apparatus is mounted on a heavy base plate and is designed to overhang the bench. Specially machined necked test specimens are provided. An additional accessory for alternating bending fatigue is available **HSM19x.**

Optional accessories: HSM19x, HSM19a, HSM19b, HSM19c

HSM30 Unsymmetrical Cantilever

This apparatus allows the vertical and horizontal deflections of the free end of a test specimen to be measured when loading occurs along a principle axis or at a known angle. A solid base holds a rigid vertical end support for the clamping of the test cantilevers. Test cantilevers in 'L', 'U' and rectangular cross section are supplied. Angular adjustment can be made easily and the angular position can be read off using the integral angular scale and pointer. The free end of the cantilever has point loads applied using the load hanger and calibrated weights. The free end movement is measured using deflection indicators. Shear centre work can also be undertaken. A framework holds the indicators relative to the rigid end of the cantilever to ensure accurate deflection measurement.

HSM31 Torsion Testing Machine (30Nm)



A sturdy bench mounted unit for studying applied torque against angle of twist, specimen failure, and test graphs. Torque is applied via the moment head to differing material test specimens using hand operated worm and wheel gearbox. The input angle of twist and revolutions can be viewed on integral protractors and a revolution counter on the moment head.
The torsion head measures the applied torque to the specimen using strain gauge technology. The unit can cater for test specimens of up to 750mm. Standard hexagon drives are used for transmitting the torque into the specimens. An angular compensation system is integral to the torsion head with a dial gauge. The strain gauge signals are fed directly into the Data Acquisition Interface supplied. Data Acquisition Software is supplied to capture the test parameters and to display the graphs relevant to further work.

Optional accessories: HSM31b

HSM32 Thick Cylinder

A heavy bench top unit for studying the stress and strain in a thick walled cylinder under internal pressures. A thick walled cylinder is mounted between two support blocks. Internal seals create oil sealing. The cylinder is specially designed to enable strain gauges to be mounted inside the cylinder wall. Radial and circumferential strains are captured and fed directly into the Data Acquisition Interface and software supplied. The internal pressure is adjusted by means of a hydraulic hand pump on the apparatus. An analogue pressure gauge displays the internal pressure whilst a pressure transducer gives feedback to the Data Acquisition Interface supplied. Data Acquisition Software is supplied which allows capture, review, analysis and manipulation of the key experimental parameters.

HSM33 Thin Cylinder

A heavy bench top unit for studying the stress and strain in a thin walled cylinder under internal pressure. A thin walled cylinder is mounted between two support blocks. Internal pistons and seals create oil sealing. A handwheel at one end of the apparatus enables the cylinder end conditions to be adjusted to either open or closed. The internal pressure is adjusted by means of a hydraulic hand pump on the apparatus. An analogue pressure gauge displays the internal pressure whilst a pressure transducer gives feedback to the Data Acquisition Interface and Software supplied. Strain gauges are arranged on the external surface of the cylinder to measure the radial and circumferential surface strain. The strain gauges are at various angles. A Data Acquisition Interface is supplied to view the pressure and strains. The Data Acquisition Software supplied allows capture, review, analysis and manipulation of the key experimental parameters.

HSM34 Creep Testing Machine

Bench top unit for studying the affect of creep in different test specimens. Necked test specimens are held in a vertical position in special clamps which do not induce bending during loading. A lever arm transmits the load from a load hanger and calibrated weights. The lever arm is counterbalance to ensure it does not induce preload to the specimens. Surrounding the test specimen is a containment tube and lid which allows the surrounding specimen temperature to be adjusted hot or cold. Temperature is recorded using the thermometer and controlled using special thermal/ice packs. A dial gauge measures the extension of the specimen during testing. Specimens in lead and polypropylene are supplied as standard. Specimens in nylon and PVC are also available as optional sets.
Optional accessories: HSM34n, HSM34p

HSM40 Torsion Testing Machine (200Nm)

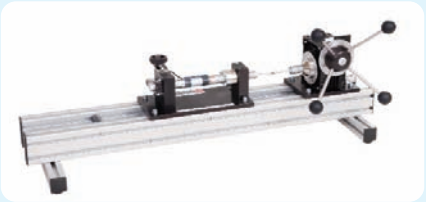
A sturdy bench top mounted unit for torsion testing of varying material test specimens to failure/destruction. Using a speed controlled electric motor torque is applied through the drive gearboxes rigidly attached at one end of the base frame. At the other end of the base frame a torsion head measures the torsion being applied. The apparatus can cater for test specimens of up to 300mm which are inserted between the fixed gearbox and the movable torsion head. Standard hexagon drives are used for transmitting the torque. The torsion from the specimen is fed directly into the Data Acquisition Interface supplied using strain-gauging technology. This Data Acquisition Interface display reads directly in Newton metres (Nm). The Data Acquisition software is supplied for capturing the torsion and allows further manipulation and editing to take place. A set of test specimens is supplied as standard.

HSM41 Pendulum Impact Tester (25J)

A unit for the study of notched bar impact strength tests. A sturdy base plate with protective guard houses all the components. The base plate has an integral anvil and pillar which have profiles for supporting the notched specimens. A heavy hammer swings on a pre-defined radius, set by the hammer arm. The initial energy of the hammer can be varied by changing the starting weight and/or height of the hammers' swing. As the hammer swings through its radius, it impacts on the specimen and the distance it travels passed the specimen is measured on an integral scale. The release of the hammer is controlled with a hand operated plunger. A number of test specimens are provided, with further specimens available separately.

HSM43 Torsion Testing Machine (100Nm)

An apparatus for manually applying torque to test specimens until failure occurs. Torque is applied to differing material test specimens using hand operated gearbox. The input angle of twist is recorded on an integral protractor and a rotary potentiometer that connects to the Data Acquisition Interface supplied. Test specimens of up to 350mm can be loaded between the torsion head and fixing head using standard hexagon drives. The fixing head slides along the base. The torsion exhibited to the test specimen is measured using strain gauge technology. The output from the strain gauges is fed directly into the Data Acquisition Interface supplied, which reads torsion directly in Nm. Data Acquisition Software is supplied for capturing the torsion and angle of twist directly and for further manipulation.

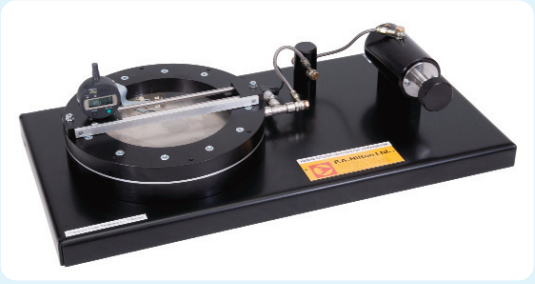


HSM44 Hydraulic Universal Material Tester

This material tester is a bench top unit for training purposes. Simple operation and robust construction make the unit suitable for student experiments. The round tensile specimens are installed between upper and lower fixings using the mating threads in each fixing. The hydraulic system applies either a tensile or compressive loading to specimens. Elongation of the specimen is monitored using a displacement transducer. An extensometer is supplied for work on stress/strain curves and the Modulus of Elasticity. The applied force to the specimens is shown on an analogue force gauge. Along with the displacement transducer there is also an electronic force sensor which allows the applied force to be captured by the Data Acquisition Software and Interface supplied. A set of tensile test specimens is supplied as standard. Further options are available for bending, shearing, compression and hardness testing amongst others.
Optional accessories: HSM44a, b, c, d, e, f, g, h, I, j, k, l, m

HSM48 Round Diaphragm Apparatus

Self contained bench top unit for determining the surface strains and deflections of a flexible diaphragm under varying internal pressures. A flexible diaphragm is clamped rigidly around its outer edge, creating an oil filled volume underneath its surface. On the top surface of the diaphragm are attached precision strain gauges at differing orientations. As the diaphragm is flexed, the strain gauge outputs are fed directly into the Data Acquisition Interface supplied. Diaphragm pressure is applied using the small screw jack mechanism. An electronic pressure sensor monitors the pressure. Traversing the surface of the diaphragm is a displacement indicator which allows the deformed profile of the diaphragm to be recorded at various radii. The Data Acquisition Interface supplied captures the key experimental parameters of surface strain, pressure and deflection in one easy to read display. Data Acquisition Software comes supplied with the apparatus allowing capture, reviewing and manipulation of the results.



HSM51 Rockwell / Brinel Combined System

This combined hardness tester is designed for measuring hardness of metals and alloys of all types (hard and soft). The specimens can be flat, or round and irregular in shape. The hardness tester is bench mounted unit. The principle of operation is based around a lever and weights. The weights are applied to the free end of a lever, which then transmits pressure onto the plunger, which then indents the specimen under test. The weights are automatically selected. A dial gauge monitors the loading, while a rubber bellows protects the elevating screw from dust and dirt ingress. 15 Rockwell scales are available to choose from. A range of indenters are also supplied with Ø1.58 ball, Ø2.5mm ball and Ø5mm ball. Two test tables are supplied in Ø50mm and Ø38mm, with the Ø38mm table incorporating a 'V' groove for holding round jobs from 6…45mm.
Test blocks are supplied to Rockwell 'C' and 'B' scale and Brinell Hardness. Rockwell superficial scale HR30N is also supplied. Work piece clamps are provided for clamping the specimens down on the apparatus.

HSM53 Vickers Hardness Tester

This accurate bench top unit is designed specifically for Vickers hardness testing. The testing range is very wide, from soft metal such as lead, up to hardened steel. The robust machine frame is designed to accommodate the high precision loading system and an optical projection screen specimen is placed on a testing table. The test cycle is fully automatic using a motorised system. The accurate load is applied on a diamond penetrator by means of a lever and weights. After a specific lapse of time the load is removed automatically. The sample specimen is then compared with the test piece and the diamond indentation is projected on the measuring screen. The diagonals of the indentation can be measured by means of the micrometer screw of the projection screen.

HSM56 Extension and Compression of Springs

A wall mounted vertical bracket houses two independent mechanisms side by side for testing tension and compression springs. The left hand side tests tension springs whilst the right hand side tests compression spring. A set of springs is supplied which allows the student to test the relationship between applied load and extension for both types of springs. The springs are easily installed and the integral deflection scale ensures accurate monitoring of the deflection during spring loading. A set of calibrated weights is supplied with this apparatus. Weights are attached to the load hanger for tension testing and added to a platform for compressive testing.

Optional accessories: HAC14

HSM57 Loading and Buckling of Struts

A sturdy bench or floor mounted apparatus for testing of struts under compressive loads. Supplied test specimens of various lengths and cross section are placed into the unit and a compressive load applied through the screw jack mechanism. A load cell at the end of the struts enables the applied force to be output to the Data Acquisition Interface supplied. A displacement indicator allows the buckling movement to be measured and fed directly into the Data Acquisition Interface. It is possible to vary the end fixing conditions of the struts; pinned/pinned, pinned/fixed, fixed/fixed. Eccentric loads can be applied by interchanging the end chucks. Varying the end fixing conditions of the struts allows the change in buckling load to be observed and recorded. The Data Acquisition Software supplied ensures the capture, display, reviewing and exporting of the experiment data.

Optional accessories: HSM57a

OTHER EXPERIMENTS AVAILABLE *(Refer to our Website for details)*

HSM1	Deflection of Beams
HSM1a	Beam Testing
HSM3	Eccentrically Loaded Tie
HSM5	Extension of wires
HSM6	Compound wires
HSM7	Extension of Springs
HSM8	Compression of Springs
HSM15	Critical condition of Struts
HSM17	Calibration of Electrical Resistance Strain Gauges
HSM19/D	Rotating Fatigue Machine Digital version
HSM20	Alternating Bending Fatigue Machine
HSM35	Torsion and Deflection Testing
HSM37	Stiffness of Materials and Structures
HSM38	Polariscope
HSM45	Transmitted Light Polariscope
HSM46	Spring Testing Kit
HSM47	Shear Web
HSM49	Tensile Tester (2kN)
HSM50	Brinell Hardness Tester
HSM52	Rockwell tester
HSM55	Pendulum Impact Tester (300J)
HSM58	Universal Materials Tester (20kN)

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