



# **P.A.Hilton Ltd**

Engineering Teaching Equipment



## **STRENGTH of MATERIALS**

P.A.Hilton Ltd 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 P.A.Hilton Ltd 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**.

**UNIVERSAL  
MATERIAL TESTER**

**HARDNESS TESTERS**

**DEFLECTION/FATIGUE**

**IMPACT TESTERS**

**POLARISCOPE**

**TORSION**

**CREEP**

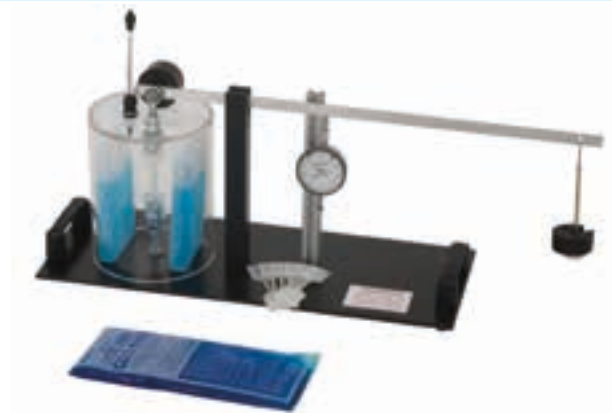
**2**

**Two Year Warranty**

## Creep

### HSM34 Creep Testing Machine

Bench top unit for studying the affect of creep in different test 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. Polypropylene specimens are supplied as standard. Specimens in nylon and PVC are also available as optional sets.



## Deflection

Also Available HSM35 Torsion & Deflection Testing Apparatus

### 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. Also supplied with data acquisition software, hangers, weights and a set of test beams.

### HSM10 Curved Bars

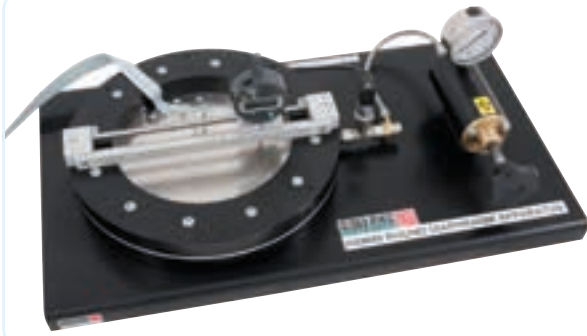
The theoretical deflections of curved shapes are most easily found by applying strain energy ideas, such as Castigliano's first theorem. The shapes chosen in this apparatus provide an ideal introduction to the use of such techniques. A bench mounted base supports a variety of curved bars in the form 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.



### HSM30 Unsymmetrical Cantilever

This apparatus allows the investigation of the deflection of unsymmetrical cantilevers under load. Suitable for teaching vertical and horizontal displacement for varying loads; Mohr's circle; maximum and minimum deflection; principle moments of area of section and shear centre location. 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.

Also Available HST21 Unsymmetrical Cantilever



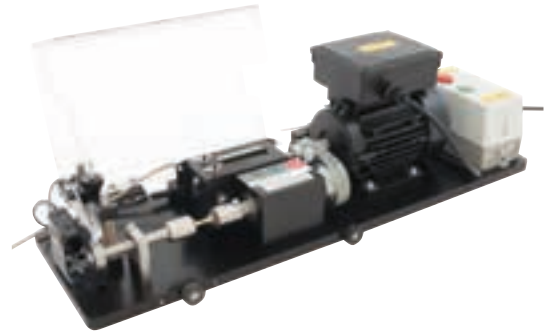
## HSM48 Round Diaphragm Apparatus

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.

## Fatigue

### HSM19D Rotating Fatigue Machine

This apparatus has been designed to introduce students to the effects of fatigue. Specimens are 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. 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. Test specimens are provided. An additional accessory for alternating bending fatigue is available **HSM19x**.



### HSM20 Alternating Bending Fatigue Machine

A further evolution of the popular HSM19 Rotating fatigue Machine. Rather than rotating a specimen to fatigue failure, the HSM20 induces an alternating displacement to the free end of a cantilevered test specimen in order to fatigue fail the part. An additional accessory for alternating rotating fatigue is available **HSM20x**.

## Hardness Testers

### HSM51

#### Rockwell / Brinell 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 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 to 45mm.



### 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 diagonals of the indentation can be measured by means of the micrometer screw of the projection screen.





## Impact Testing

### HSM4 Pendulum Impact Tester (4J)

### HSM41 Pendulum Impact Tester (25J)

### HSM55 Pendulum Impact Tester (300J)

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.



HSM4 Pendulum Impact Tester (4J)



HSM41 Pendulum Impact Tester (25J)

## Test and Measurement

### 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.

**Also Available HSM17 Calibration of Electrical Resistance in Strain Gauges**



## Polariscopes

### HSM38 Polariscope

### HSM45 Transmitted Light Polariscope

Allows the study of stress patterns and photo-elasticity resulting from geometrical changes in loaded mechanical models.

Supplied as standard with two models 'square plate' and 'rod'. Additional Model Sets Available **HSM38a** and **HSM38b**.



HSM38 Polariscope



HSM45 Transmitted Light Polariscope



Model Set A  
"Bending Moment Overlap"



Model Set A  
"Bar"



Model Set B  
"Spanner"



Model Set B  
"Crane Hook"



Model Set B  
"Shaft"



## Torsion



### 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. A set of calibrated weights is supplied along with a set of test specimens.

### 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.



### HSM31 Torsion Testing Machine (30Nm)

### HSM43 Torsion Testing Machine (100Nm)

### HSM40 Torsion Testing Machine (200Nm)

Sturdy bench top mounted unit for torsion testing of various material specimens to failure/destruction. 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).



HSM31 Torsion Testing Machine (30Nm)



HSM43 Torsion Testing Machine (100Nm)



HSM40 Torsion Testing Machine (200Nm)

The data acquisition software is supplied for capturing the test parameters and to display graphs for further work. Set of test specimens supplied.

### HSM35 Torsion and Deflection Testing Apparatus

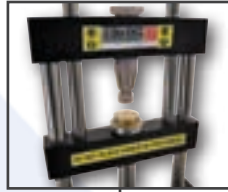
This bench top unit allows a variety of experiments to be undertaken to investigate test specimens under torsional loading and bending loading within their elastic limits.

A set of torsion and bending specimens are supplied. A load hanger and set of calibrated weights create specimen loading.

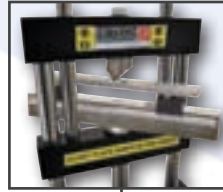


# Universal Material Tester

**HSM58b - Brinell Hardness Test Set**



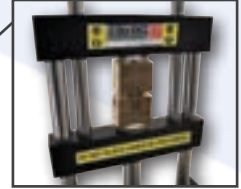
**HSM58c - Bending Device Test Set**



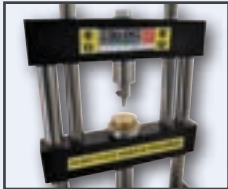
**HSM58P - Device for Deep Drawing**

## HSM58 Universal Material Tester (20kN)

Suitable for students investigating **tensile and compressive** testing on metal and non-metal samples. The experimental capabilities can be further enhanced by the addition of optional extras. The data acquisition system and extensometer are uniquely supplied as standard and allow for computer-based learning through visual projection of characteristic stress-strain curves.



**HSM58e - Symmetrical Shearing Test Set**



**HSM58J - Vickers Hardness Test Set**



**HSM58I - Spring Testing Set**



**HSM58g - Unsymmetrical Shear Test Set**



**HSM58f - Measuring Magnifier for Brinell Impressions**

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

<b>HSM1</b>	Deflection of Beams
<b>HSM3</b>	Eccentrically Loaded Tie
<b>HSM5</b>	Extension of wires
<b>HSM6</b>	Compound wires
<b>HSM7</b>	Extension of Springs
<b>HSM8</b>	Compression of Springs

<b>HSM15</b>	Critical condition of Struts
<b>HSM17</b>	Calibration of Electrical Resistance Strain Gauges
<b>HSM19/D</b>	Rotating Fatigue Machine Digital version
<b>HSM35</b>	Torsion and Deflection Testing
<b>HSM46</b>	Spring Testing Kit
<b>HSM55</b>	Pendulum Impact Tester (300J)



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