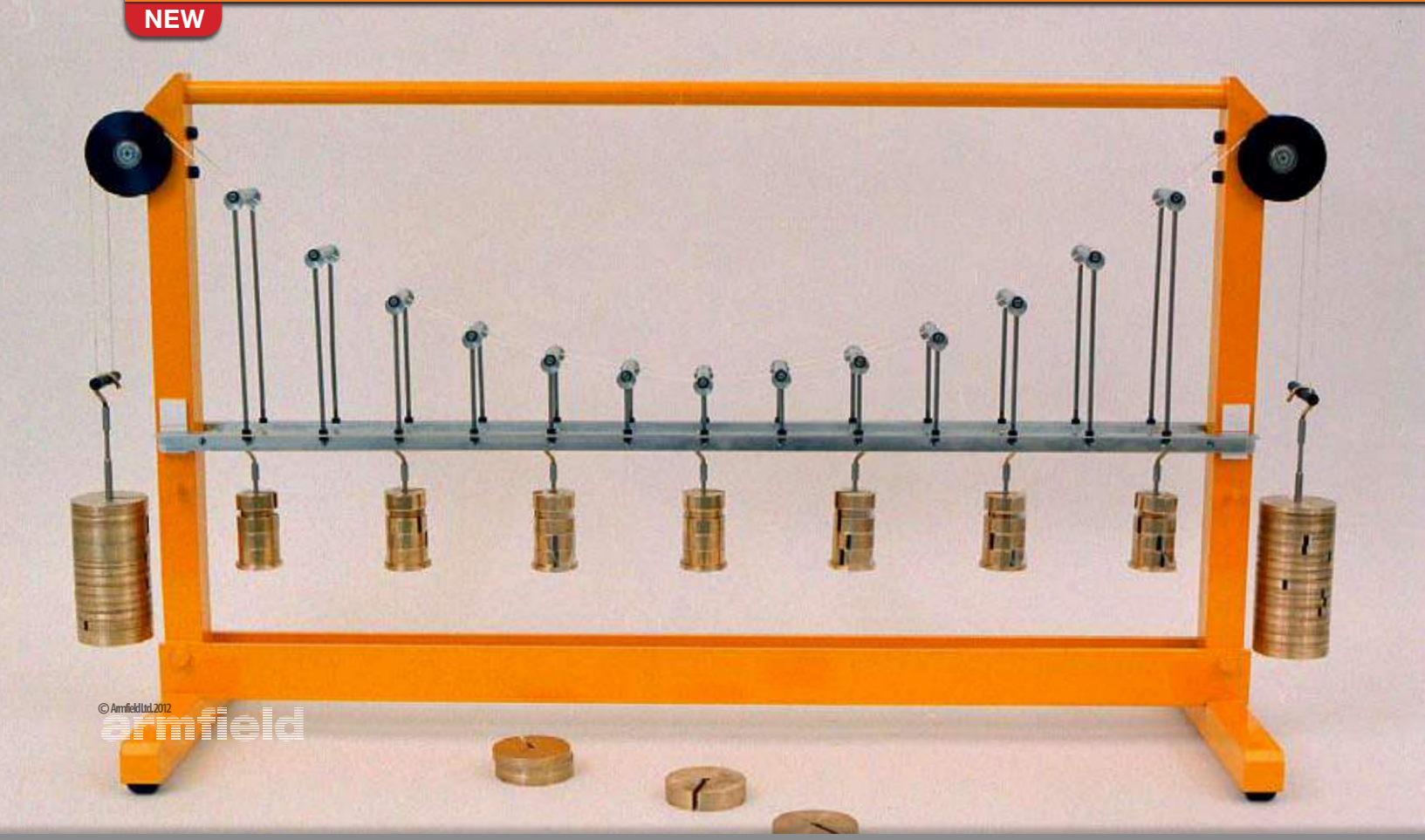
DISCOVER WITH armfield didactec Sanderson

MECHANICAL ENGINEERING LABORATORY APPARATUS

STATICS & VIBRATIONS – SV

STATICS | STRUCTURES | VIBRATION | BALANCING | MATERIALS TESTING

NEW



PART OF THE ARMFIELD DIDACTEC-SANDERSON RANGE OF ENGINEERING TEACHING EQUIPMENT

The Didactec - Sanderson, range of engineering teaching equipment is renowned for excellent quality of build, ease of use and set-up for staff and student.

The Armfield ADS or Armfield Didactec Sanderson range as it is now known has provided the fundamentals for Mechanical and Civil Engineering students the world over.

The products are available over two distinct series, The SV series (this data sheet), and the complementary MAM series.

armfield didactec Sanderson
Mechanical Engineering Laboratory Apparatus

TOPICS COVERED BY THE ADS - SV SERIES

Topics covered by this Statics & Vibrations (SV) data sheet:

- *Statics*
- *Structures*
- *Vibration*
- *Balancing*
- *Materials Testing*

TOPICS COVERED BY THE COMPLEMENTARY ADS - MAM SERIES

Topics covered by the complementary Mechanical & Automotive Mechanisms (MAM) data sheet:

- *Mechanical Mechanisms*
- *Automotive Mechanisms*
- *Theory of Machines*

enviro™ PRODUCTS

BM TRADA CERTIFICATION ISO 9001:2008 | UKAS QUALITY MANAGEMENT 012

<EXTENDED> WARRANTY 2 years 2YR WARRANTY ON ALL ARMFIELD PRODUCTS

PROVISONAL

UNIVERSAL BENCH MOUNTED FRAME SD1:10

DESCRIPTION

The Armfield Didactec Sanderson Universal Bench Mounted Frame provides a very sensible alternative to wall mounting, particularly since many new buildings are predominantly glass, with very flimsy dividing walls.

The frame is designed to accommodate two items of ADS apparatus, allowing adequate space for students to work on each piece of equipment simultaneously. However it is possible to mount three pieces, in the case of the simple transmission system.

By mounting the apparatus on the frame, experiments can be transported between rooms to any convenient location.

OVERALL DIMENSIONS

Height:	*0.7m*
Width:	*1.2m*
Depth:	*0.5m*
Net Weight:	*28 kg*

SHIPPING SPECIFICATION

Volume	*0.62 m^3*
Gross weight	*32 kg*

FRICTION APPARATUS SD1:26

DESCRIPTION

The Sanderson Friction Apparatus is intended for use in either the classroom or laboratory and may be used for simple demonstrations to illustrate the force of friction.

It can also be used by the student to carry out simple experiments to:

1. *Investigate the relationship between the friction force between the surfaces in contact.*
2. *Compare the value of the coefficient of sliding friction between dry surfaces of various materials.*
3. *Compare the value of the coefficient of sliding friction between dry and lubricated surfaces.*
4. *Compare the force of friction between sliding and rolling surfaces.*
5. *Compare the force of friction between "Hard" and "Soft" rolling surfaces.*

The unit may be wall mounted or fitted to the Sanderson Universal Bench Mounting Frame (Ref SD1.10)

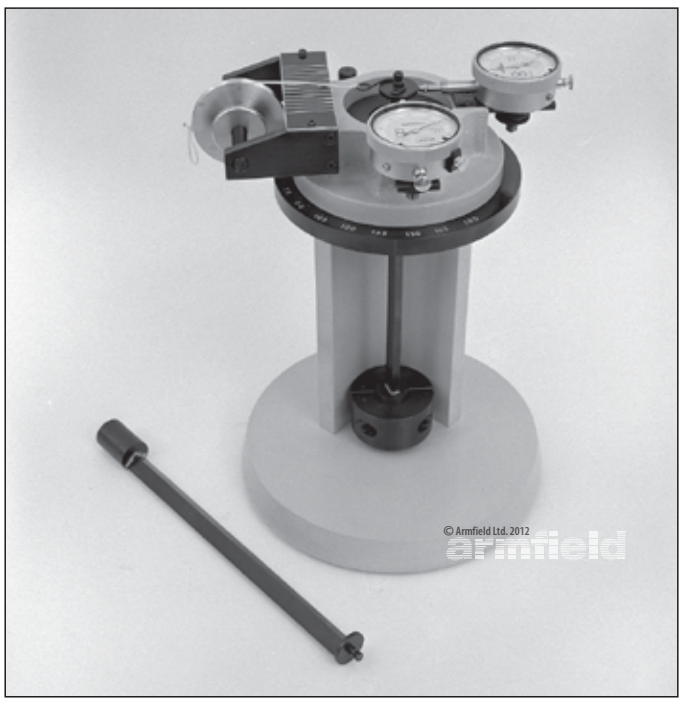
OVERALL DIMENSIONS

Height:	*0.37m*
Width:	*0.30m*
Depth:	*0.24m*
Net Weight:	*14 kg*

SHIPPING SPECIFICATION

Volume	*0.43 m^3*
Gross weight	*18 kg*

UNSYMMETRICAL CANTILEVER APPARATUS SD3:11



DESCRIPTION

The Unsymmetrical Cantilever Apparatus is intended to demonstrate the unsymmetrical bending of beams. Simple experiments may be carried out to determine the deflections Δ_u and Δ_v at the free end of cantilevers of various sections for varying angles of applied load from which the relationship between $\frac{\Delta_u}{W}$ and $\frac{\Delta_v}{W}$ may be determined graphically.

The apparatus consists of a vertical cantilever rigidly clamped at its lower end to the main column which is attached to a rigid base. Beams of varying sections may be used. A loading head, located at the upper end of the column, can rotate freely about the vertical axis of the beam and a locating pin enables the head to be locked at 15° intervals through 180°. A horizontal load may be applied to the free end of the beam by means of a cord attached to the beam and passing over a pulley mounted on the rotating head. The Δ_u and Δ_v deflections of the beam are measured by means of two dial gauges mounted at 90° to each other on the head. To compensate for any lateral deflection of the beam, the line of action of the applied load can be adjusted by lateral adjustment of the load pulley.

The apparatus is portable and is intended for bench mounting, requiring no fixing.

The basic apparatus is supplied with a cantilever specimen of 12 x 12 x 3 equal angle section bright mild steel.

Other specimens are available to special order.

OVERALL DIMENSIONS

Height:	*0.4m*
Width:	*0.3m*
Depth:	*0.3m*
Net Weight:	*14 kg*

SHIPPING SPECIFICATION

Volume	*0.08 m³*
Gross weight	*18 kg*

UNIVERSAL STRUT APPARATUS SD3:12

DESCRIPTION

The Sanderson Universal Strut Apparatus has been developed to enable students to carry out a series of tests to determine the crippling load for struts of varying slenderness ratios and end fixing conditions.

The apparatus has been designed to accommodate struts of suitable lengths within the range 400/800 mm. The struts are rectangular in section, thus ensuring that the deflection occurs in a predetermined plane.

Reversible hardened load blocks are provided so that the struts can be tested under the following conditions:

1. *Both ends pinned.*
2. *Both ends fixed.*
3. *One end pinned, one end fixed.*

The load is applied to the strut by means of a spring balance and a loading beam. The beam pivots on a nut which can be adjusted vertically so that the beam can be maintained in the horizontal position during loading, thus ensuring that a true axial load can be supplied throughout the test.

A light lateral load is applied to the strut to ensure the direction of deflection, the magnitude of which can then be measured by means of a dial indicator.

One set of struts for each end condition is supplied with the apparatus.

EXTRA

A set of load blocks, bushes and specimens are available to allow experiments to be conducted on round specimens.

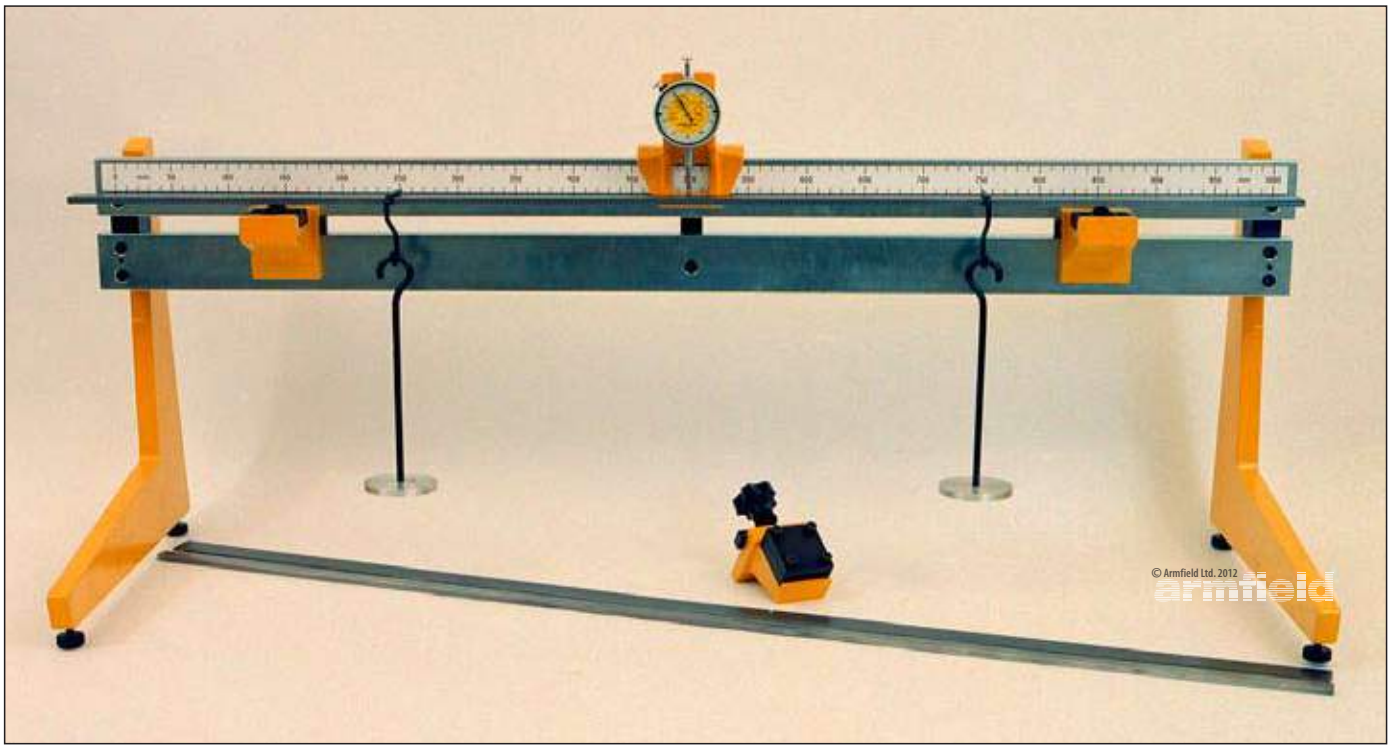
OVERALL DIMENSIONS

Height:	*1.24m*
Width:	*0.88m*
Depth:	*0.58m*
Net Weight:	*56 kg*

SHIPPING SPECIFICATION

Volume	*0.9 m³*
Gross weight	*64 kg*

BEAM DEFLECTION APPARATUS SD3:13



DESCRIPTION

The Sanderson Beam Deflection Apparatus has been designed to enable students to carry out experiments on simply supported and cantilever beams in order to investigate the relationship between the deflections and the applied loads and the effect of variations in length and cross sectional dimensions on the beam deflection.

The Apparatus consists of a rigid main support beam on which the hardened Knife Edge and Cantilever supports for the test beams can be easily positioned. Hardened steel knife edge load hangers and the dial gauge support, which slides freely on the main support beam, can be readily moved to the selected point where the deflection is to be measured. A suitably marked scale is secured to the main support beam so that the test beam supports, the load hangers and the dial gauge may be quickly and accurately located.

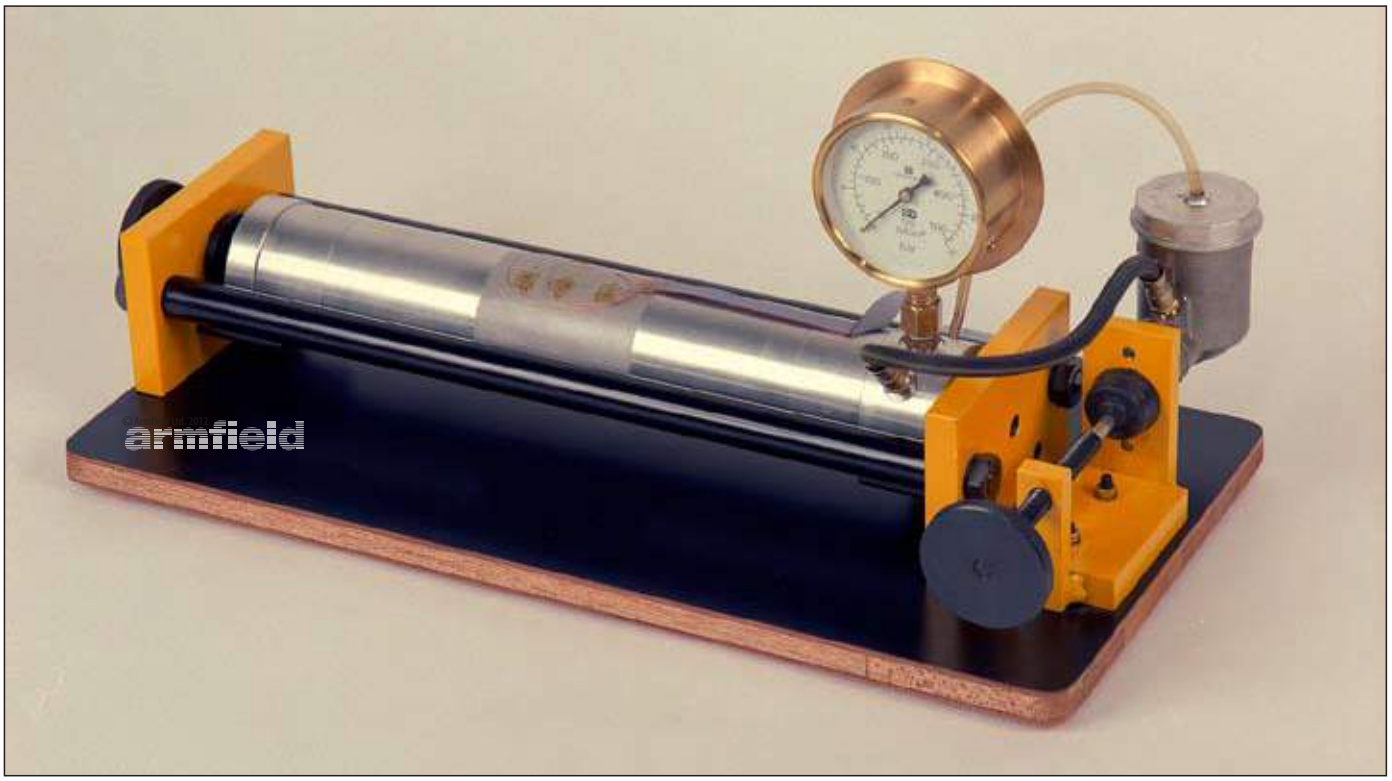
The standard equipment includes three test beams of the same material having suitable cross sectional dimensions.

OVERALL DIMENSIONS

Height:	*0.42m*
Width:	*1.12m*
Depth:	*0.42m*
Net Weight:	*26 kg*

SHIPPING SPECIFICATION

Volume	*0.33 m^3*
Gross weight	*32 kg*



DESCRIPTION

The Sanderson Thin Cylinder Apparatus permits the investigation of stresses and strains in a thin cylinder under internal pressure. The thin walled alloy cylinder, supported by a cradle is mounted on a base board together with the hydraulic hand pump for pressurising the system.

Two stress conditions are available:

1. Open ends – circumferential stress.
2. Closed ends – bi-axial stress.

The cradle is designed to quickly allow the selection of either condition.

Six strain gauges are fitted to the cylinder to permit the measurement of surface strains at various angles. A pressure gauge indicates the cylinder pressure.

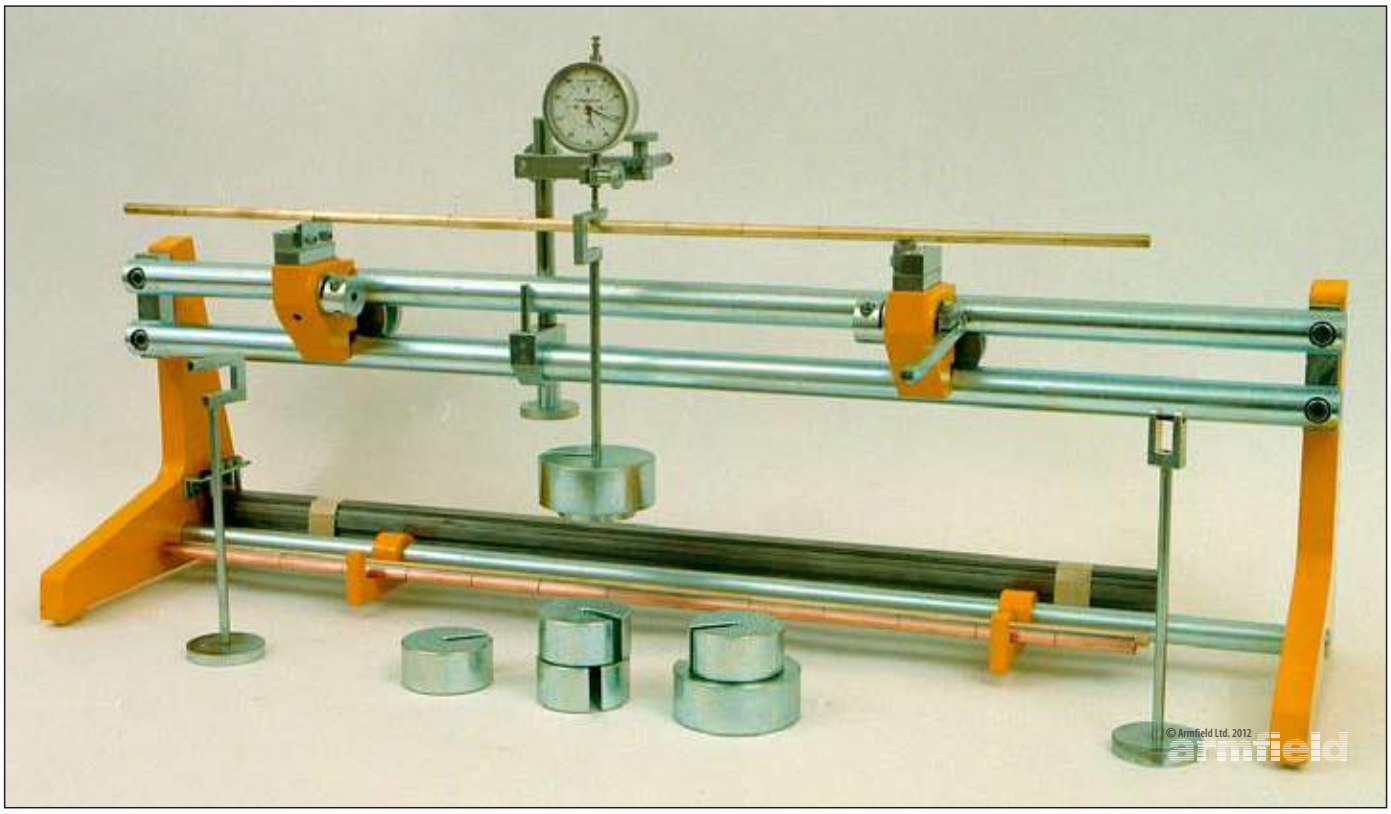
SPECIFICATION

Cylinder material:	*Aluminium Alloy*
Length:	*375mm O/D 76.2mm*
Bore:	*70mm*
Max Test Pressure:	*35 BAR*
Strain gauges:	*Electrical resistance*

SHIPPING SPECIFICATION

Volume	*0.06 m^3*
Gross weight	*6 kg*

TWIST & BEND TESTING MACHINE SD400



DESCRIPTION

The SD400 is a combined twist and bend testing machine for use both in pupil's laboratory exercises and in conjunction with theoretical work on twist and bending. Its size and weight make it easy to carry between the different classrooms.

Twist

In twist tests you can determine and compare the modulus of rigidity for different materials and demonstrate the deformation formula.

Bending

In bending tests you determine with SD400 the modulus of elasticity of different materials and demonstrate, for example, the relation between load, moment of inertia, distance between supports, modulus of elasticity and deflection.

The test pieces for bending tests are of different dimensions, so that you can determine the relation between moment of inertia and dimensions of a material.

Examples of experiments

Investigation of the relationship between load, span, width, height and deflection of a beam.

To ascertain the co-efficient of elasticity for steel, brass, aluminium and wood.

Investigation of the relationship between torsional moment, clamping length and torsional angle of a shaft.

To determine the shear modulus of steel, brass and aluminium.

The equipment includes:

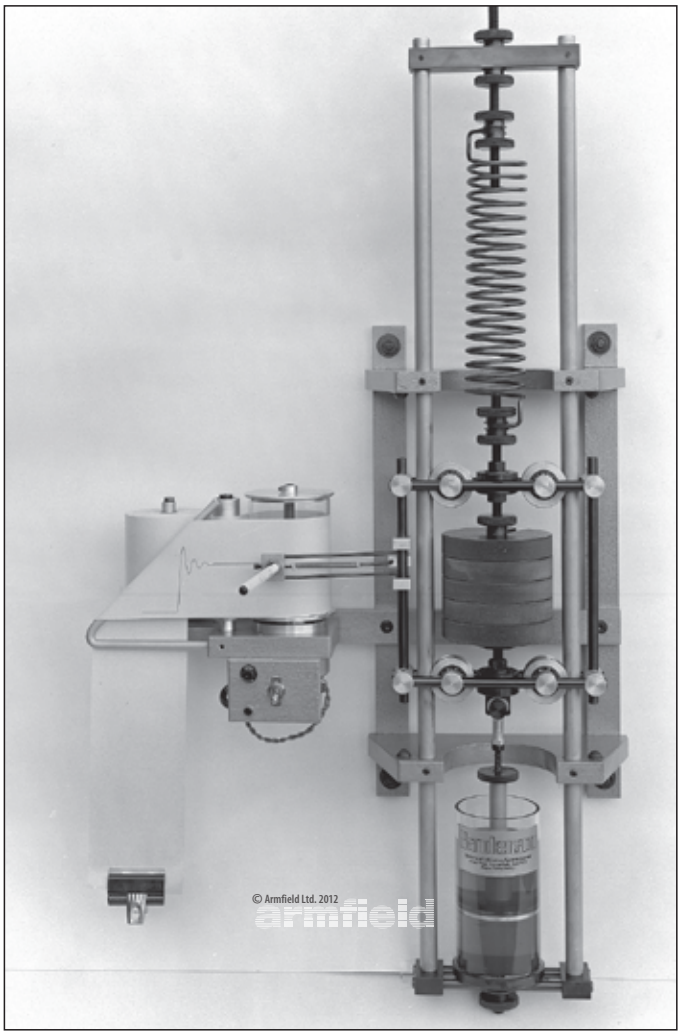
Twist and Bend machine SD400
Two loading devices
Two 1 N masses
Two 0.5 N masses
Test pieces of rectangular cross section
Test pieces 8mm dia. in steel, aluminium brass and wood.

OVERALL DIMENSIONS

Height:	*0.35m*
Width:	*0.80m*
Depth:	*0.23m*
Net Weight:	*13 kg*

SHIPPING SPECIFICATION

Volume	*0.23 m^3*
Gross weight	*17 kg*



DESCRIPTION

The Simple Vibration Apparatus illustrated is intended for use in either the lecture room or the laboratory.

Demonstrations may be carried out to illustrate free and damped vibrations of a simple spring-mass system having one degree of freedom and the response of a second order mechanical system to a step input.

Experiments can be carried out by students in the laboratory to investigate the relationship between the mass of the body, the stiffness of the spring, the periodic time or frequency of oscillation and to observe the effect of viscous damping on the system.

Springs of various stiffness and suitable masses are supplied. The dashpot is adjustable to provide a wide range of damping.

A pen attached to the vibrating frame and a paper strip driven by a synchronous motor provide the means of producing amplitude/time recordings.

The unit may be wall mounted or attached to the Sanderson Bench Mounting Frame (Ref: SD1:10).

REQUIREMENTS

When ordering please state voltage required.

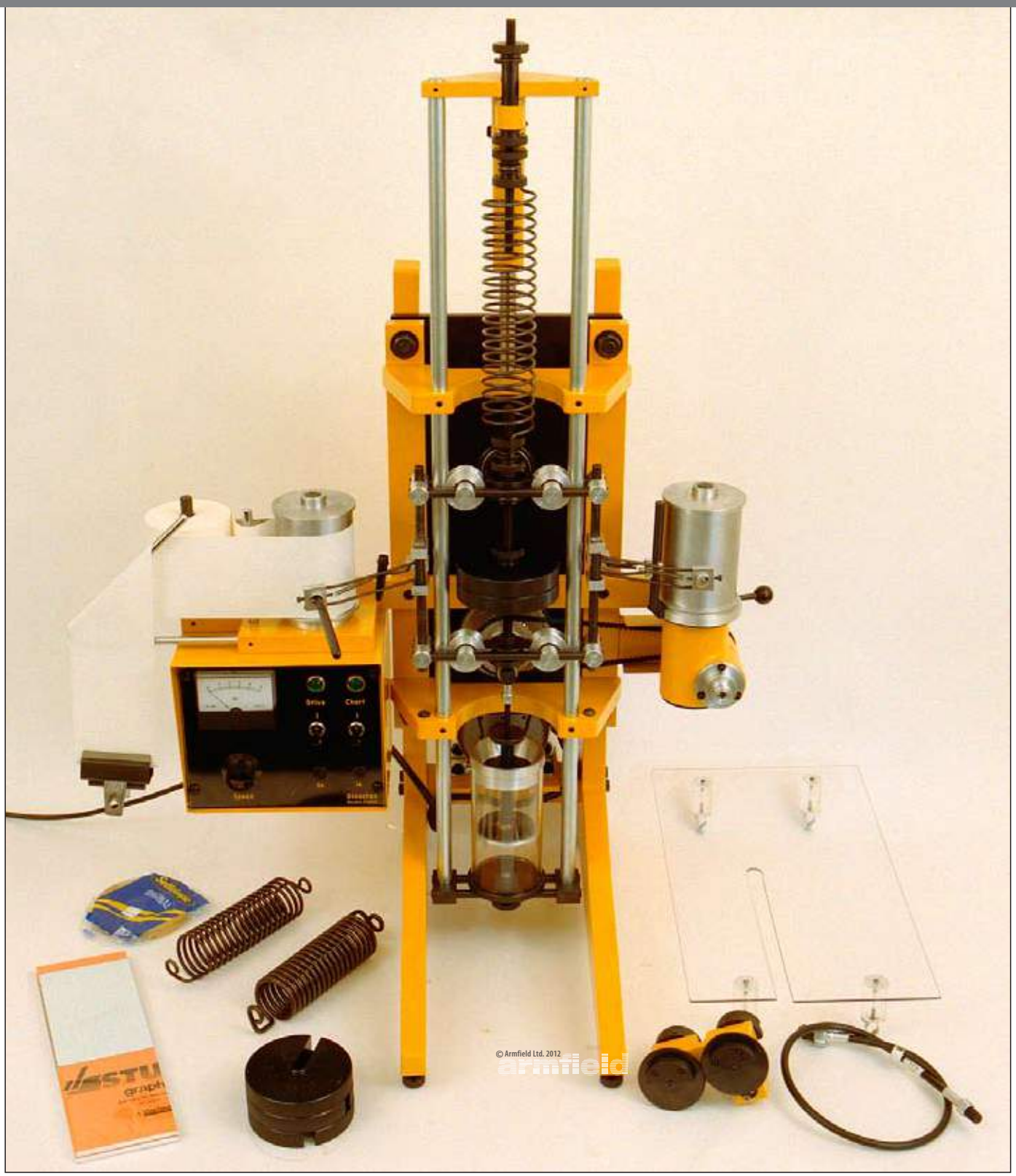
OVERALL DIMENSIONS

Height:	*1.00m*
Width:	*0.60m*
Depth:	*0.35m*
Net Weight:	*28 kg*

SHIPPING SPECIFICATION

Volume	*0.35 m^3*
Gross weight	*34 kg*

FREE & FORCED VIBRATION APPARATUS SD4:13A



DESCRIPTION

The Sanderson Free and Forced Vibration Apparatus has been developed to extend the range of demonstrations and experiments which may be carried out to include the free and forced vibrations of a single degree of freedom with viscous damping.

Simple adjustments can be made to the apparatus and the motion of the mass can be readily observed and recorded on the two pen recorders provided. The use of so called "Black Boxes" has been avoided, a feature welcomed by most teachers.

Adopting the well tried features of the simple Sanderson Vibration Apparatus, the mass carriage is constrained by rollers on vertical guide ways to provide minimum uncontrolled damping. Variable viscous damping is provided by an oil dashpot.

Two methods of exciting forced vibration are adopted; either by oscillating the upper spring mounting with SHM at variable frequency or by applying a rotating out balance force at variable frequency to the vibrating mass.

Two pen recorders are provided, a continuous paper recorder for amplitude and frequency measurements and a rotating drum recorder for amplitude and phase measurements.

REQUIREMENTS

When ordering please state voltage required.

OVERALL DIMENSIONS

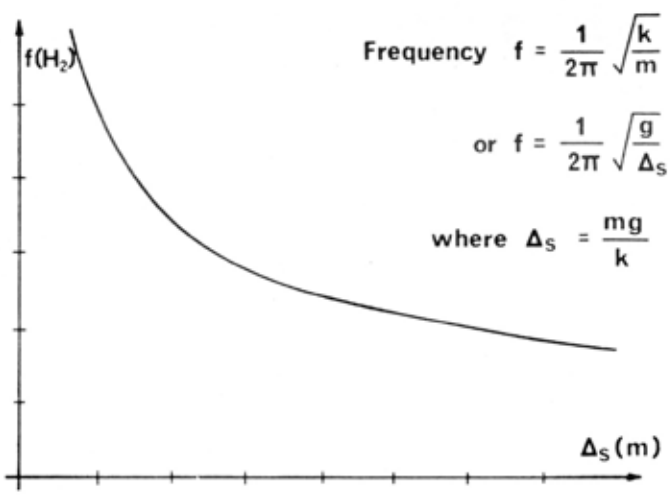
Height:	*1.24m*
Width:	*0.88m*
Depth:	*0.58m*
Net Weight:	*75 kg*

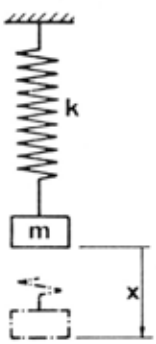
SHIPPING SPECIFICATION

Volume	*0.89 m³*
Gross weight	*85 kg*

Experiment 1

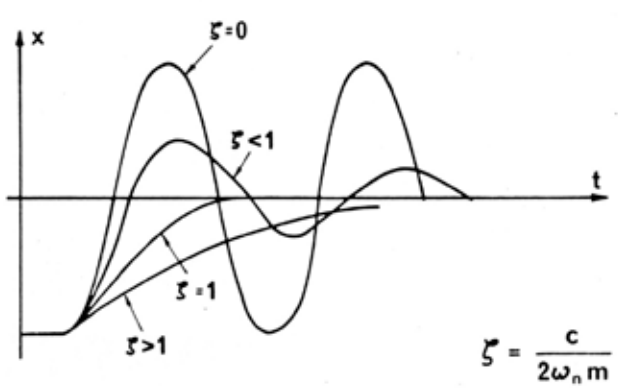
To investigate the relationship between the mass of the body, the stiffness of the spring and the periodic time or frequency of the oscillation of a simple spring-mass system having one degree of freedom.

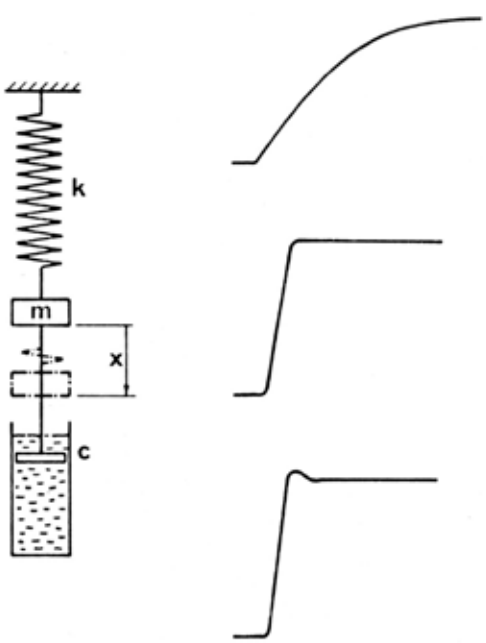




Experiment 2

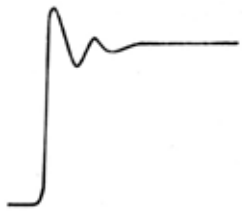
(a) To investigate the effect of viscous damping on the free vibration of a simple spring-mass-damper system.

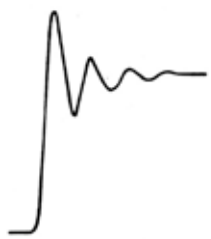


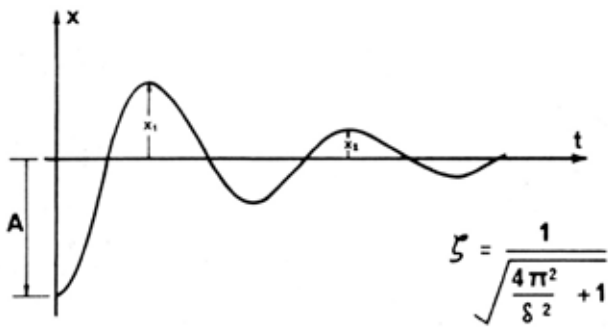


Experiment 2

(b) To determine the damping ratio or factor for a given spring-mass-damper system.







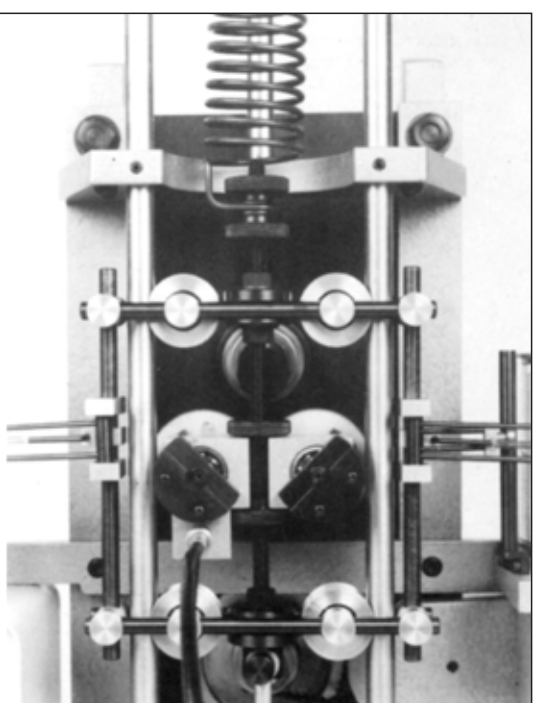
$$\zeta = \frac{1}{\sqrt{\frac{4\pi^2}{\delta^2} + 1}}$$

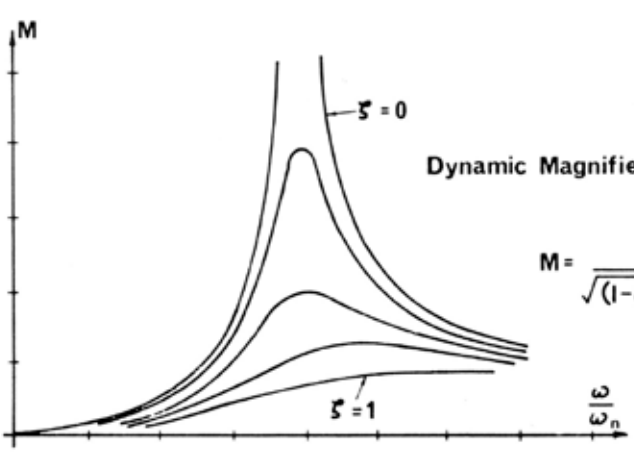
$$\delta = \log_e \frac{x_1}{x_2}$$

Experiment 3

To investigate the relationship between the amplitude of the steady state vibration of the vibrating mass and the forcing frequency for varying damping ratios.

(a) Vibrations induced by applying a periodic disturbing force to the mass. In this experiment the exciter unit is driven from a gearbox via a flexible coupling such that one revolution of the contra rotating discs is equal to one revolution of the phase recorder.



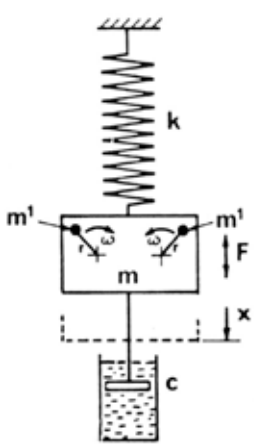


Dynamic Magnifier

$$M = \frac{1}{\sqrt{(1-\alpha^2)^2 + 4\zeta\alpha^2}}$$

$$\zeta = \frac{c}{2\omega_n m}$$

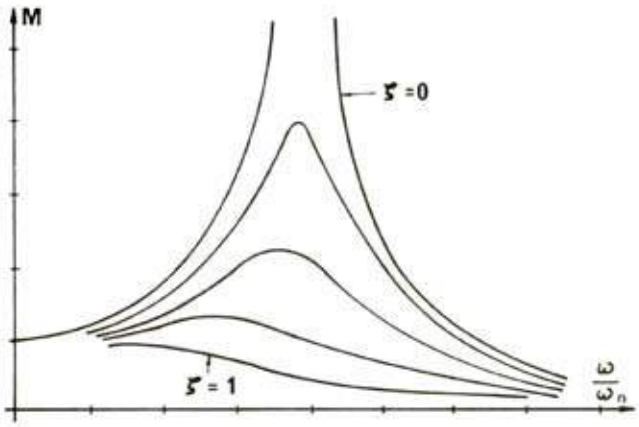
$$\alpha = \frac{\omega}{\omega_n}$$



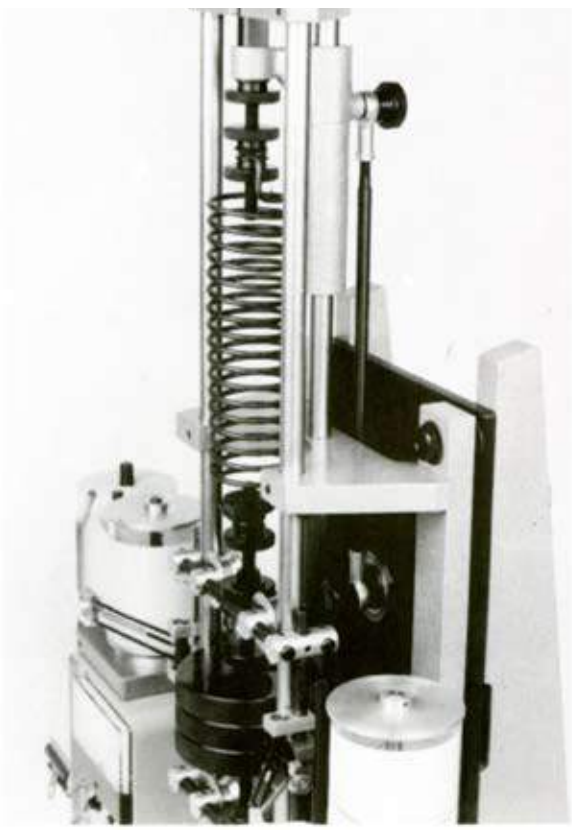
$$x = X \cos(\omega t - \phi)$$

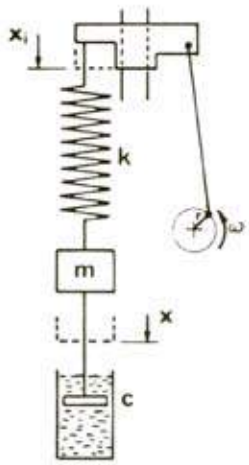
Experiment 3

(b) Vibrations induced by a periodic displacement of the point of support of the spring. In this experiment a connecting rod, driven by an eccentric, imparts a sinusoidal input to the upper mounting of the spring such that one revolution of the eccentric is equal to one revolution of the phase recorder.



Dynamic Magnifier $M = \dfrac{1}{\sqrt{(1-\alpha^2)^2 + 4\zeta\alpha^2}}$





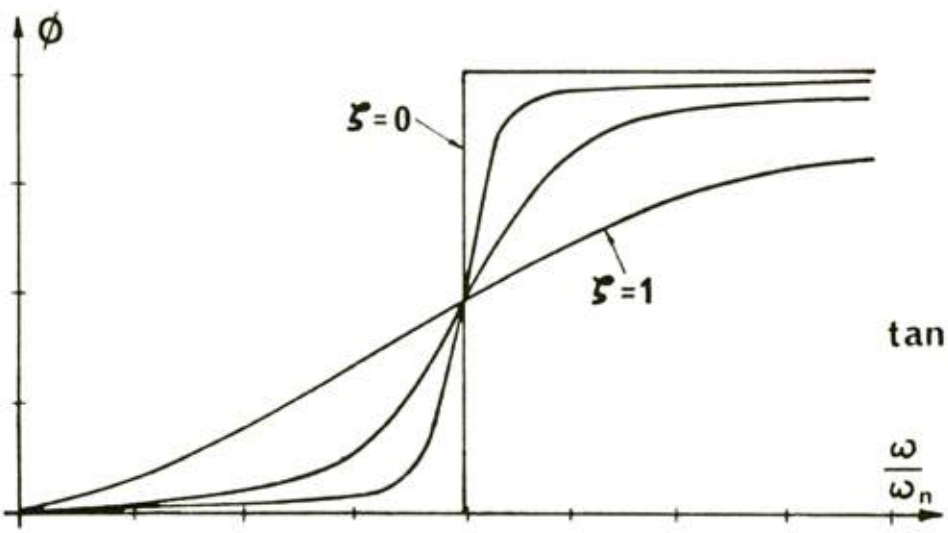
$\zeta = \dfrac{c}{2\omega_n m}$

$\alpha = \dfrac{\omega}{\omega_n}$

$x = X \cos(\omega t - \phi)$

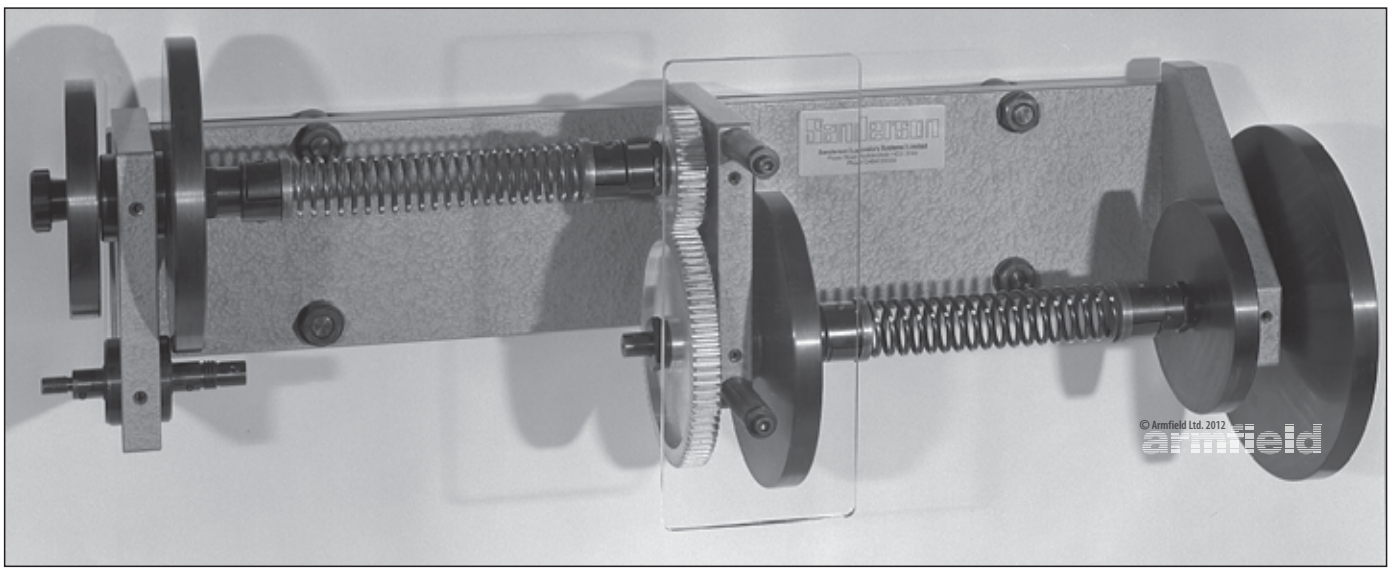
Experiment 4

To investigate the phase relationship between the vibrating mass and the periodic displacement of the spring support for varying damping ratios.



$\tan \phi = \dfrac{2\zeta\alpha}{1-\alpha^2}$

TORSIONAL OSCILLATIONS APPARATUS SD4:14



DESCRIPTION

The Sanderson Torsional oscillations apparatus is intended for use in either the classroom or the laboratory and may be used to illustrate and investigate the torsional oscillations of single rotor, multi-rotor and geared systems.

The apparatus consists basically of a rigid frame carrying bearing cells, helical springs to simulate long flexible shafts and discs of varying mass moment of inertias. Suitable gears of various sizes are also provided.

The natural frequencies are of a low order and may be counted, a line drawn axially on the spring serves to illustrate the elastic line and facilitates the experimental location of the nodes.

The apparatus may be wall mounted or mounted on the Sanderson Universal Bench Mounting Frame (Ref SD1.10).

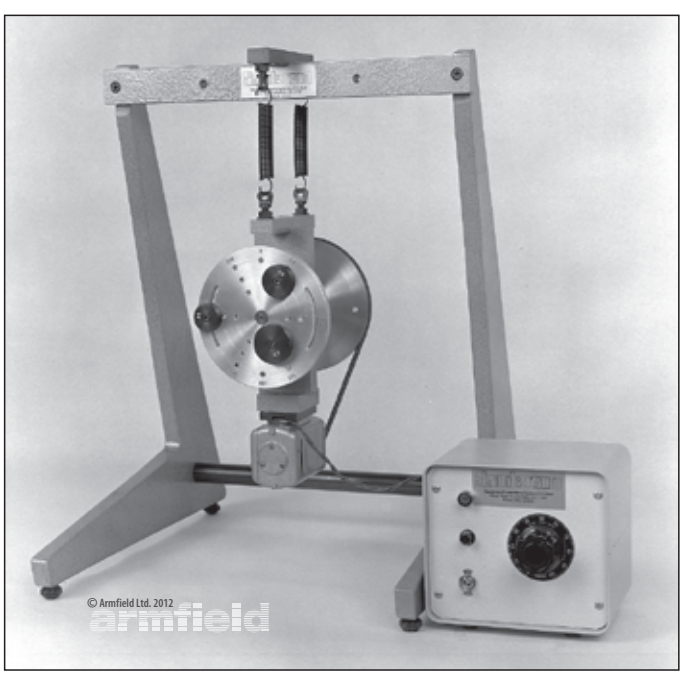
OVERALL DIMENSIONS

Height:	*0.38m*
Width:	*0.79m*
Depth:	*0.37m*
Net Weight:	*28 kg*

SHIPPING SPECIFICATION

Volume	*0.32 m³*
Gross weight	*32 kg*

SIMPLE BALANCING APPARATUS SD5:12



DESCRIPTION

The Sanderson Simple Balancing apparatus has been designed with Craft Studies courses in Mechanical Engineering in mind. It is intended for use in either the classroom or laboratory for simple demonstrations and experiments in the balancing of co-planar rotating systems.

The rotating system is basically a shaft mounted on bearings, supported in a rigid frame and driven by a small electric motor attached to the frame. A disc to which masses may be attached is rigidly secured to the shaft.

The disc is suitably drilled and the holes are positioned so that various conditions of unbalance in a co-planar rotating system can be simulated and the normal methods used to determine the magnitude and position of the counter balance mass verified.

The unit is supported on springs attached to the main frame so that the oscillation set up by any unbalanced force may be observed.

OVERALL DIMENSIONS

Height:	*0.60m*
Width:	*0.47m*
Depth:	*0.44m*
Net Weight:	*22 kg*

SHIPPING SPECIFICATION

Volume	*0.43 m³*
Gross weight	*27 kg*

DESCRIPTION

The DIDACTEC range of Structures Apparatus has been designed to overcome one of the biggest problems now facing teachers and students alike, namely that of having to select the right parts for the experiment, from a vast range of components, which is both time consuming and irritating.

The DIDACTEC concept is for each piece of apparatus to be compact and totally self-contained including dial indicators, masses and hangers where necessary. With this approach it has shown that experiments can be set up quickly and, with recourse to the instruction book, conducted concisely and accurately. This approach is extremely cost effective as will be seen when reference is made to the competitive pricing of the DIDACTEC range.

TORSION OF BARS APPARATUS DT8:00

DESCRIPTION

This simple piece of apparatus has been designed for student laboratory exercises to investigate the elastic torsion characteristics of circular bars. The range of experiments include:

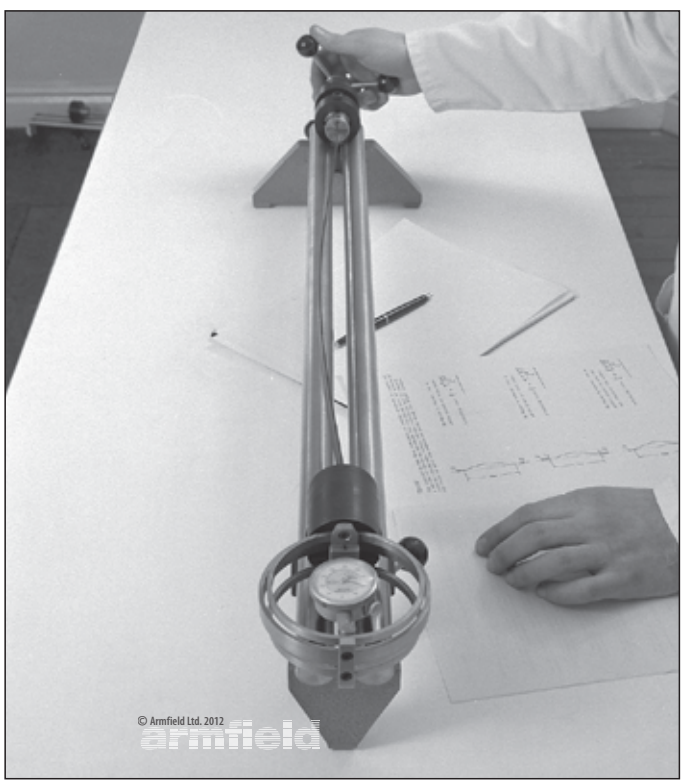
1. The verification of the elastic torsion equation

2. The determination of the Modulus of Rigidity for different materials.

Torque is applied to the specimen bars by means of a spring balance and torque arm and a dial gauge in contact with the arm enables the angle of twist to be measured. A range of specimens in different materials is supplied as standard.

OVERALL DIMENSIONS		SHIPPING SPECIFICATION	
Height:	0.52m	Volume	0.14 m^3
Width:	0.50m	Gross weight	13 kg
Depth:	0.26m		
Net Weight:	9.5 kg		

STRUT BUCKLING APPARATUS DT8:01



DESCRIPTION

This apparatus enables the student to determine experimentally the buckling load for struts of varying slenderness ratios and end fixing conditions.

Varying lengths of struts can be subjected to direct axial loading and the critical load determined accurately.

Struts with rigidly fixed or pin-jointed end conditions may be tested and the effect of these end conditions on the buckling load is demonstrated.

The load is applied by means of a differential screw to provide sensitive adjustment.

A load cell and dial gauge are used to measure and indicate the load being applied to the strut.

A range of specimens is supplied as standard.

OVERALL DIMENSIONS		SHIPPING SPECIFICATION	
Height:	0.19m	Volume	0.85 m^3
Width:	0.91m	Gross weight	15 kg
Depth:	0.19m		
Net Weight:	11 kg		

SUSPENDED BEAM APPARATUS DT8:02

DESCRIPTION

This apparatus is intended to represent a simple application of a suspended beam and may be used to determine experimentally the tension in the cables supporting a beam carrying a series of distributed loads.

A light alloy BEAM is supported on the rods attached at pivot points to cross members threaded on the supporting cables which pass over ball bearing pulleys.

Tension in the supporting cables is determined by attaching suitable masses to the cable stirrups.

Loads may be applied to the beam by attaching masses at a series of loading points and indicators enable the beam to be returned to a position for the 'true shape' of the supporting cables.

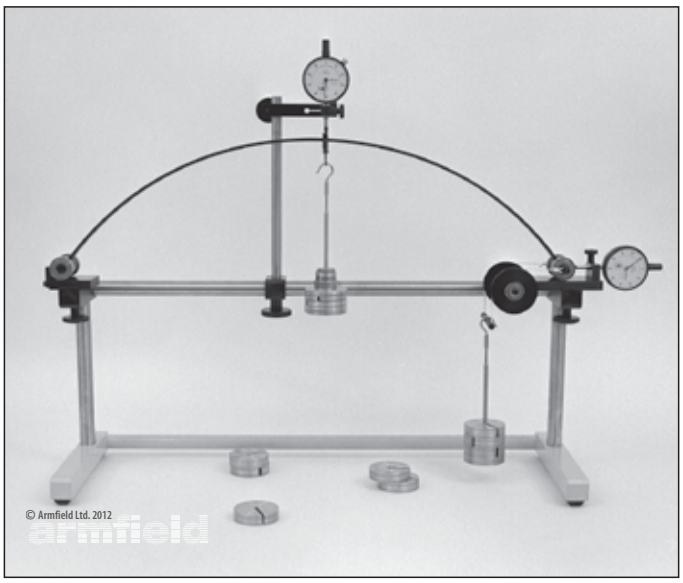
OVERALL DIMENSIONS

Height:	*0.45m*
Width:	*0.85m*
Depth:	*0.26m*
Net Weight:	*8.5 kg*

SHIPPING SPECIFICATION

Volume	*0.2 m^3*
Gross weight	*12 kg*

TWO HINGED ARCH BEAM APPARATUS DT8:03



DESCRIPTION

The apparatus enables the student to determine experimentally the horizontal component of the abutment thrust of a simple two hinged arch beam.

The beam is supported on ball bearing rollers attached to each end of the beam and the horizontal movement of the free end is indicated by a dial gauge so that the beam can be returned to its original unloaded span.

The horizontal thrust force is applied to the free end of the beam by means of masses attached to a cord passing over ball bearing pulleys.

Varying loads may be applied to the beam by means of load hangers and masses and a dial gauge is provided to enable the vertical displacement to be measured.

OVERALL DIMENSIONS		SHIPPING SPECIFICATION	
Height:	*0.54m*	*Volume*	*0.67 m³*
Width:	*0.75m*	*Gross weight*	*14 kg*
Depth:	*0.21m*		
Net Weight:	*9.25 kg*		

PORTAL FRAME APPARATUS DT8:04

DESCRIPTION

A simple piece of apparatus designed for use in conjunction with theoretical studies in the deflections of a simple rectangular portal frame subject to varying applied loads.

It can be used by the student to determine experimentally:-

1. The deflection of the frame when subject to horizontal loading.

2. The deflection of the frame when subject to vertical loading.

The specimen portal frame is attached to a rigid base by simple clamps and loads can be applied by mass hangers and a suitable ranges of masses.

The horizontal and vertical deflections to the frame can be conveniently measured by means of dial gauges.

OVERALL DIMENSIONS		SHIPPING SPECIFICATION	
Height:	*0.50m*	*Volume*	*0.65 m³*
Width:	*0.70m*	*Gross weight*	*15 kg*
Depth:	*0.21m*		
Net Weight:	*10 kg*		

DEFLECTION OF CURVED BARS APPARATUS DT8:05

DESCRIPTION

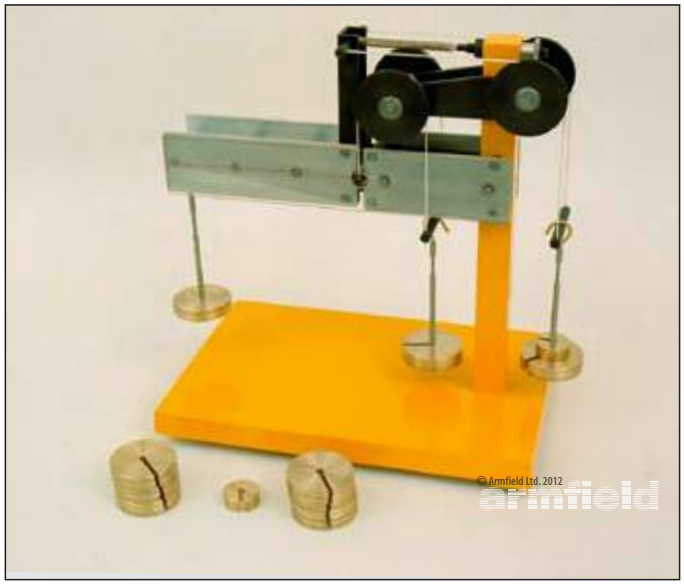
A small compact piece of apparatus designed to enable the student to determine experimentally the horizontal and vertical displacements at the free end of various thin curved bars when subject to single concentrated loads.

The specimen bars are attached to a rigid base by means of a simple clamp block which can be secured in predetermined positions to suit the specimen.

A special load hanger, supported on a knife attached to the free end of the beams, allows the horizontal and vertical displacements to be measured by means of dial gauges.

OVERALL DIMENSIONS		SHIPPING SPECIFICATION	
Height:	0.35m	Volume	0.12 m^3
Width:	0.33m	Gross weight	10 kg
Depth:	0.23m		
Net Weight:	7 kg		

BENDING MOMENT & SHEARING FORCE APPARATUS DT8:06



DESCRIPTION

This apparatus has been designed for use in either the classroom or laboratory and may be used to show that in a beam subject to transverse loads, at any section of the beam:

1. The SHEARING FORCE is the algebraic sum of the transverse components of the forces to one side of the section.

2. The BENDING MOMENT is the algebraic sum of the moments of the forces to one side of the section.

The beam is hinged at a typical transverse section and loads may be applied at varying positions on the beam.

For the purposes of obtaining equilibrium, balancing forces are applied at the hinge point by suitable masses attached to cords passing over ball bearing pulleys.

OVERALL DIMENSIONS		SHIPPING SPECIFICATION	
Height:	0.34m	Volume	0.1 m^3
Width:	0.34m	Gross weight	11 kg
Depth:	0.20m		
Net Weight:	7.5 kg		

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