

PHYSICS 2008

STUDENT EXPERIMENTS

DATA LOGGING

MECHANICS

WAVES

ENERGY AND ENVIRONMENT

THERMODYNAMICS

OPTICS

ELECTRICITY AND MAGNETISM

ATOMIC AND NUCLEAR PHYSICS

LABORATORY EQUIPMENT

3B SCIENTIFIC® PRODUCTS

...going one step further

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Committed to quality

3B Scientific provides you with good quality at fair prices. Our sophisticated quality management complies with the ISO 9001:2000 standards and the Worlddidac Quality Charter and is regularly approved by independent experts.

That's something you can rely on.

New Products

9 Reasons to Buy 3B Scientific® Products:

1 3-year quality guarantee
If, in spite of proper handling, you should discover any material or manufacturing defect within three years of the date of purchase, we will replace the product or correct the defect.

2 Low-price guarantee
With your purchase you obtain the highest quality at the lowest prices. If you can purchase a qualitatively comparable product at a lower price anywhere in the world within 14 days of purchase, you may return the product and we will refund the full purchase price.

3 14-day right of return
If, for any reason, you should not be fully satisfied with a 3B Scientific® product, simply return it in the original packaging and a copy of the invoice within 14 days. You will receive a complete refund.

4 Rapid delivery
We have an extensive range of products on site in our warehouse and can deliver most of the equipment within just a few days.

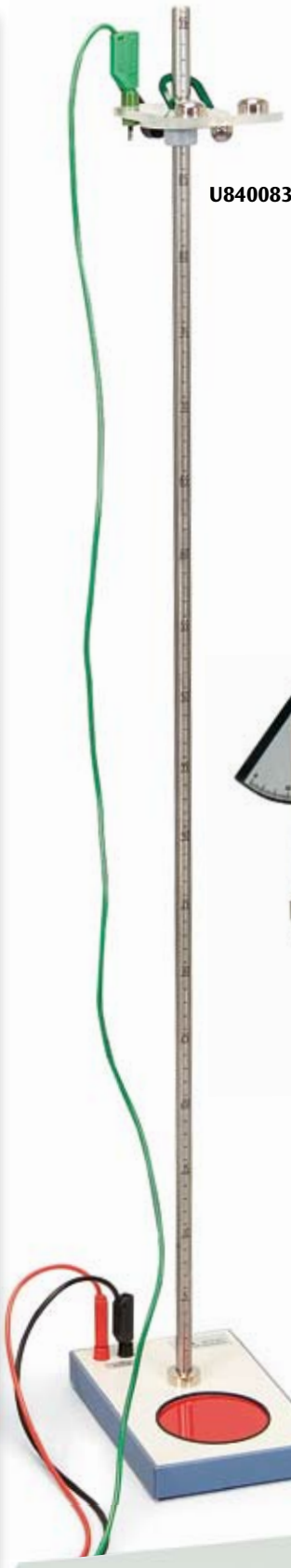
5 Special discounts
When orders entail larger volumes you can benefit from extra savings. Please ask our sales team about special volume discounts.

6 Continuous improvements
In order to be able to offer you the best possible quality, we continue to develop new products and innovate our product processes. For that reason it might be the case that actual products appear slightly different from the ones illustrated here.

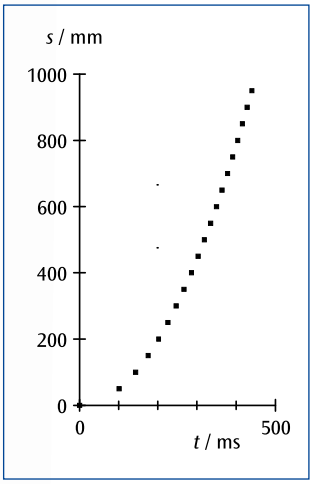
7 Expanding the product spectrum
We are constantly expanding our product range and for that reason look forward to your ideas and comments to help inspire new developments.

8 Operational world-wide
In general, our products can be put into operation anywhere. Please pay close attention to your local mains voltage, i.e. 230 or 115 volts, when connecting up equipment with a mains power supply.

9 Quality management
As of June 2000 we have obtained a quality approval certification for service, products and organisational processes according to DIN EN ISO 9001:2000. This recognised Quality Management System has since lent us official support for our strategic commitment to innovation, product improvement and customer orientation. In addition to this we also continue to fulfil all of the quality standards associated with the introduction of the Worlddidac Quality Charter initiated in September 2004.



U8400830



U8400830
Free-Fall Apparatus

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U8400930

U8400930
Launcher S

Page 46

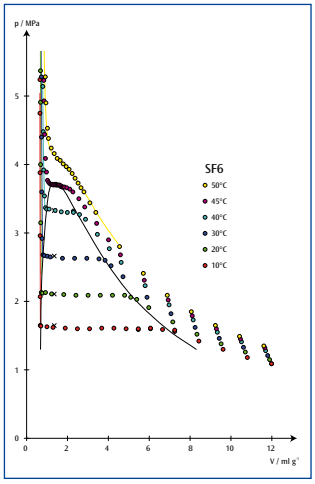
U8533341-230
Digital Counter (230 V, 50/60 Hz)

U8533341-115
Digital Counter (115 V, 50/60 Hz)

Page 198



U8533341



pV diagram for SF_6

U10400

Critical Point Device

Page 98

Unique!

NEW

MERCURY FREE



U10400

NEW

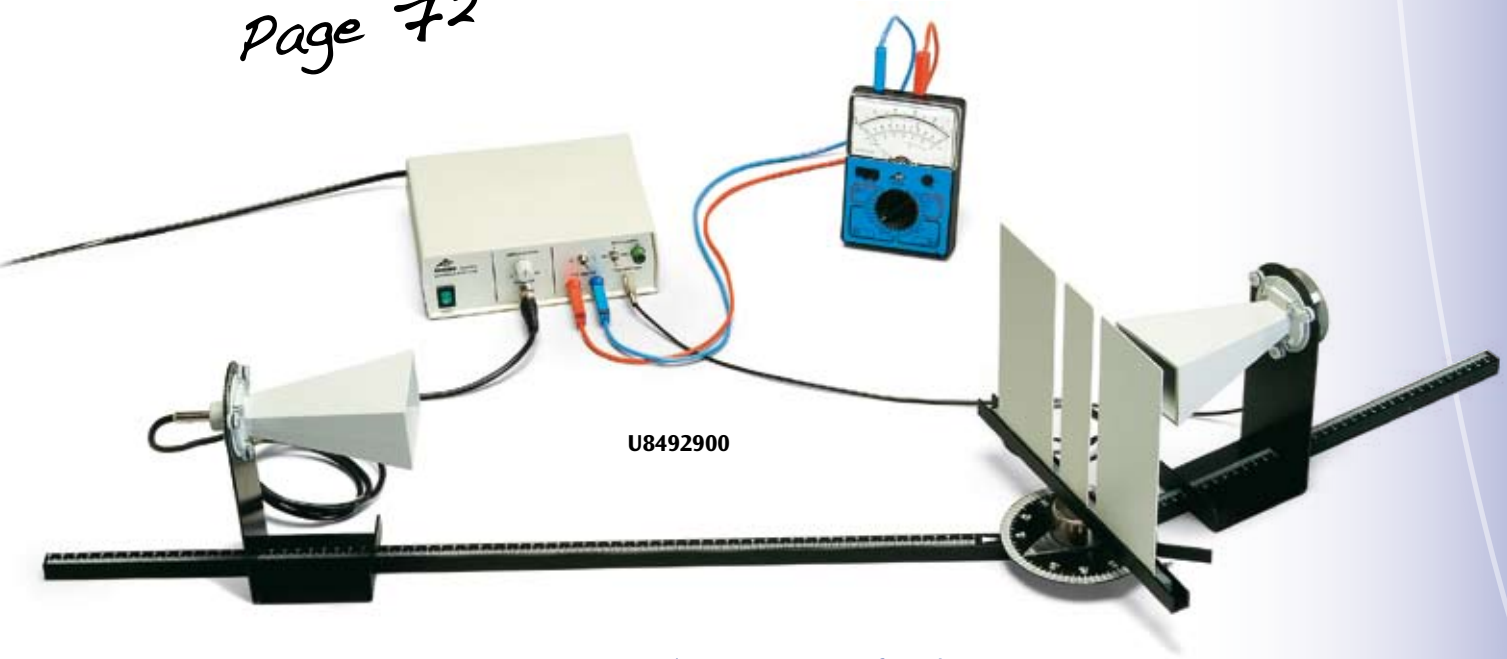
U8492900-230

Microwave Set (230 V, 50/60 Hz)

U8492900-115

Microwave Set (115 V, 50/60 Hz)

Page 72



U8492900

NEW

3B NET*log*™ sensors: from page 25

U11305-230
3B POWER*log* (230 V, 50/60 Hz)

U11305-115
3B POWER*log* (115 V, 50/60 Hz)

Page 25



U11305



U11354
Force Sensor, ±50 N

Page 26



U11364



U11354

U11364
Light Sensor

Page 30

U11393
Skin Resistance Box

Page 31



U11393

U11392
Human Pulse Sensor Box

Page 31

U11392



NEW

U11822

Type K/IR Thermometer

Page 195



U11822

U11804

Noise Level Meter P8005

Page 199



U11804

U33010-230

High-Voltage Power Supply 5 kV (230 V, 50/60 Hz)

U33010-115

High-Voltage Power Supply 5 kV (115 V, 50/60 Hz)

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U33010

U33000-230

DC Power Supply 0 – 500 V (230 V, 50/60 Hz)

U33000-115

DC Power Supply 0 – 500 V (115 V, 50/60 Hz)

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U33020-230

DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)

U33020-115

DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

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U33020

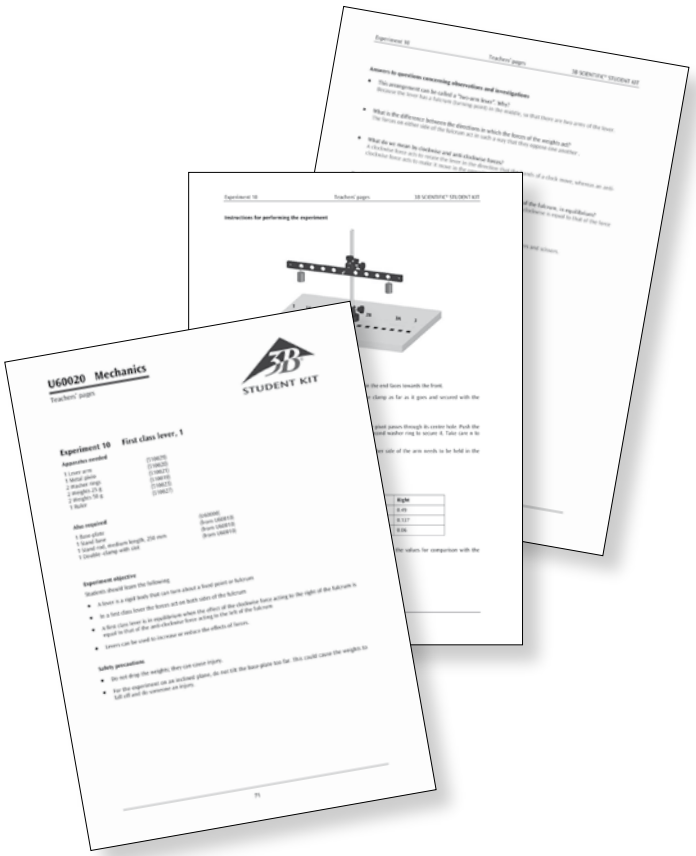


U33000

Student Experiments for Lower Secondary Level

The 3B STUDENT *Kits* allow students in lower secondary level to work independently in setting up and carrying out a comprehensive range of basic experiments on the topics of mechanics, heat and optics. Detailed instructions for the experiments, divided into pages for students and pages for teachers, help the students to perform the experiments and enable the teachers to make the necessary preparations.

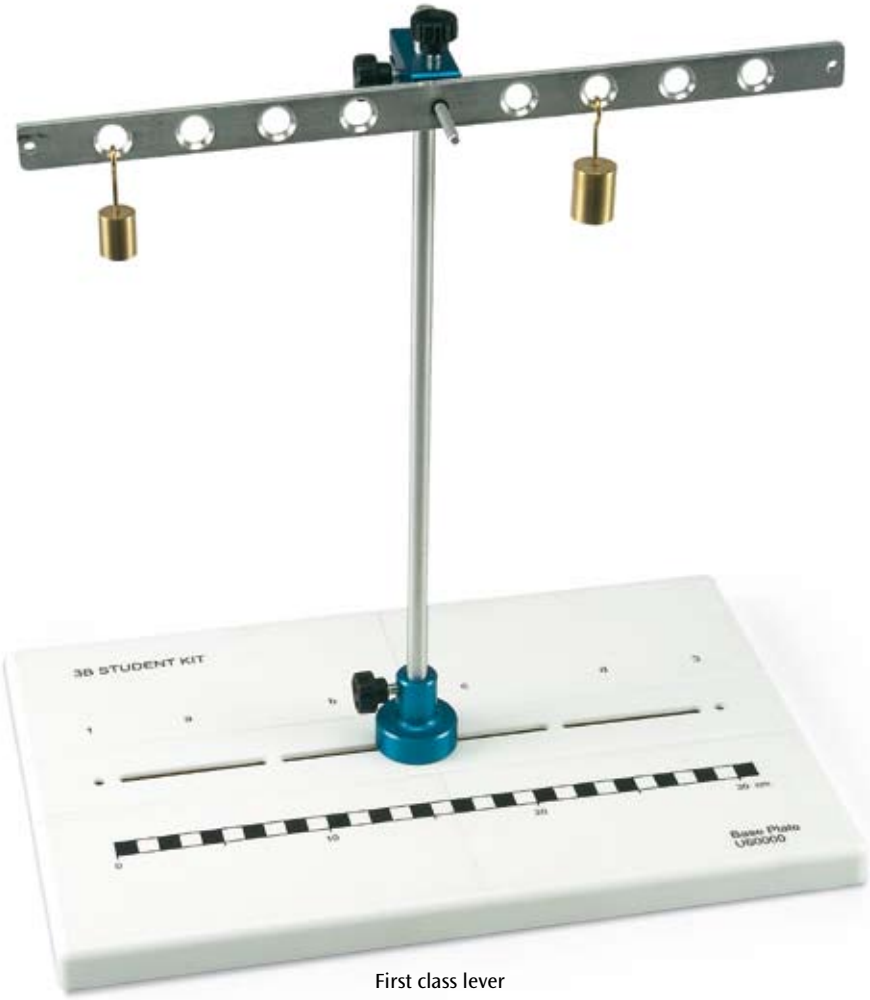
Each experiment set-up, on which students can also work in pairs for example, requires a bench area of approximately 400 x 250 mm². That is sufficient to ensure that the set-up is clear and manageable, stable and free from problems. The robust components are made of anodised aluminium, plastic or glass.



Mechanics:

- **Effects of forces**
- **Action and reaction**
- **Deformation by forces (2 experiments)**
- **Masses and densities of bodies**
- **Friction (2 experiments)**
- **Second/third class levers (2 experiments)**
- **First class lever (2 experiments)**
- **Fixed pulley**
- **Moving pulleys**
- **Combinations of fixed and moving pulleys (block and tackle)**
- **Inclined plane (2 experiments)**
- **Connected vessels**
- **Pressure in liquids**
- **Principle of the U-tube manometer**
- **Pressure due to weight of fluids**
- **Buoyancy in liquids**
- **Floating and sinking**
- **Air as a body**
- **Pressure and volume**
- **Temperature and volume**
- **Effects of atmospheric pressure**

Equipment:
U60020 STUDENT *Kit* – Mechanics
U60010 STUDENT *Kit* – Basic Set



First class lever

Heat:

- Principle of a thermometer
- Heating of solid bodies
- Heating of liquid bodies
- Heating of gases
- Behaviour of bimetallic objects
- Conduction of heat
- Radiation of heat
- Condensation
- Distillation
- Temperature of mixtures

Equipment:
U60040 STUDENT *Kit* – Heat
U60010 STUDENT *Kit* – Basic Set

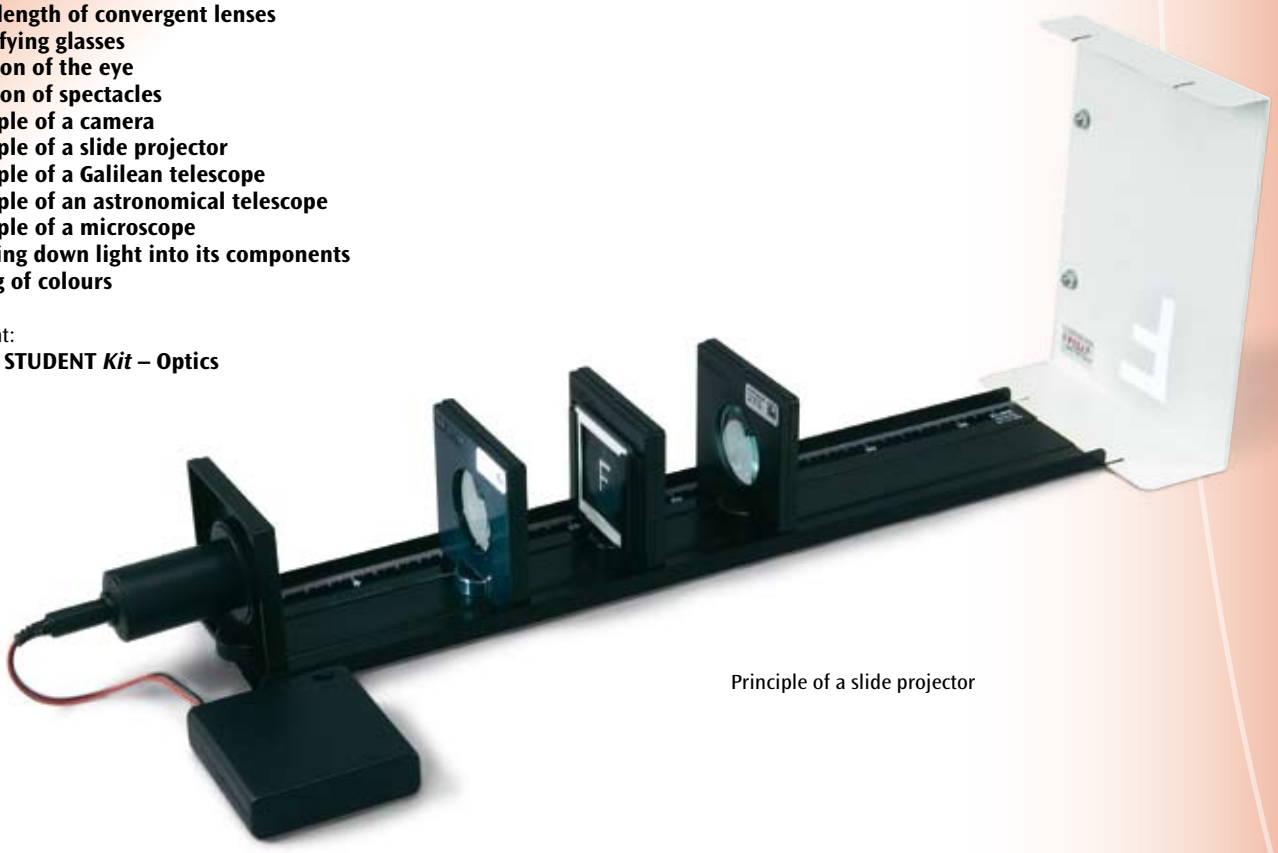


Principle of a thermometer

Optics:

- Propagation of light
- Light and shadows
- Reflection at a plane mirror
- Concave and convex mirrors
- Refraction of light
- Refractive index
- Optical lenses (paths of rays)
- Focal point of convergent lenses
- Focal length of convergent lenses
- Magnifying glasses
- Function of the eye
- Function of spectacles
- Principle of a camera
- Principle of a slide projector
- Principle of a Galilean telescope
- Principle of an astronomical telescope
- Principle of a microscope
- Breaking down light into its components
- Mixing of colours

Equipment:
U60050 STUDENT *Kit* – Optics



Principle of a slide projector

U60010

STUDENT *Kit* – Basic Set

Basic set of apparatus for use with STUDENT *Kits* for mechanics (U60020) and heat (U60040). Consisting of a robust base-plate made of plastic, stands and clamps made of anodised aluminium and other components that are used in both mechanics and heat experiments. In a robust plastic box with foam inserts moulded to the shapes of the items plus a transparent lid.

Contents:

1 Base plate
2 Stand bases
2 Stand rods, 360 mm
1 Stand rod, 250 mm
2 Stand rods, 100 mm
2 Double clamps
2 Double clamps with slot
1 Clip, 8 mm dia.
1 Clip 22 mm dia.
1 Clip 27 mm dia.
1 Beaker, 500 ml
1 Test tube
1 Glass tube, 50 mm
1 Glass tube, 250 mm
1 Silicone tube, 500 mm x 6 mm dia.



U60010

U60020

STUDENT *Kit* – Mechanics

Set of apparatus for carrying out 26 basic student experiments on the mechanics of solids, liquids, and gases. In a robust plastic box with foam inserts moulded to the shapes of the items and a transparent lid. Includes a CD with instructions for the experiments.
The experiments are designed to occupy as little space as possible on the base plate of the STUDENT *Kit* basic set (U60010), while remaining clear and easy to perform.

Contents:

1 Steel leaf spring
1 Lever arm
1 Ruler
1 Pulley
1 Pulley with hook
1 Weight, 100 g
3 Weights, 50 g
2 Weights, 25 g
1 Dynamometer, 2 N
1 Metal pivot
4 Washer rings to fit metal pivot
1 Pulley with cord
1 Trolley
1 Friction pad
1 Coil spring
1 Iron block
1 Aluminium block
1 Wooden block
1 Silicone tube, 500 mm x 3 mm dia.
1 Tubing connector
1 Clip, 8 mm dia.
1 Clip, 14 mm dia.
1 Syringe, 50 ml
1 Syringe, 30 ml
1 Plastic sphere
1 Rubber stopper
(30 mm x 31/25 mm dia.)
1 Funnel, 40 mm dia.
1 U-tube manometer
1 Measuring cylinder
100 g Modelling clay

Additionally required:
U60010 STUDENT *Kit* – Basic Set





U60020

U60040

STUDENT *Kit* – Heat

Set of apparatus for carrying out 10 basic student experiments on heat. In a robust plastic box with foam inserts moulded to the shapes of the items and a transparent lid. Includes a CD with instructions for the experiments. The experiments are designed to occupy as little space as possible on the base plate of the STUDENT *Kit* basic set (U60010), while remaining clear and easy to perform.

Contents:

1 Conical flask, 100 ml
1 Bimetallic strip
4 g Glycerine
1 Concave mirror mounted on stem
1 Aluminium rod 200 mm
1 Thermometer, –10°C – +100°C
1 Glass tube with 90° bend
1 Rubber stopper, 25 mm x 24/19 mm dia.
1 Spirit burner
1 Ceramic mat

Additionally required:
U60010 STUDENT *Kit* – Basic Set



U60040



U60050

STUDENT *Kit* – Optics

Set of apparatus for carrying out 19 basic student experiments in optics. In a robust plastic box with foam inserts moulded to the shapes of the items and a transparent lid. Includes a CD with instructions for the experiments. The experiments are designed to occupy as little space as possible on the base-plate of the STUDENT *Kit* basic set (U60010), while remaining clear and easy to perform.

Contents:

1 Screen
1 Optical lamp
1 Lens, f = 50 mm
2 Lenses, f = 100 mm
1 Lens, f = 300 mm
1 Lens, f = -100 mm
2 Slide-holders
1 Semi-circular shape
1 Lens shape, rectangular
1 Lens shape, concave
1 Lens shape, convex
1 Prism
1 Single-slit aperture
1 Triple-slit aperture
1 Aperture in the shape of an F
1 Mirror with magnetic holder
2 Small candles
1 Opaque object
1 Colour slide

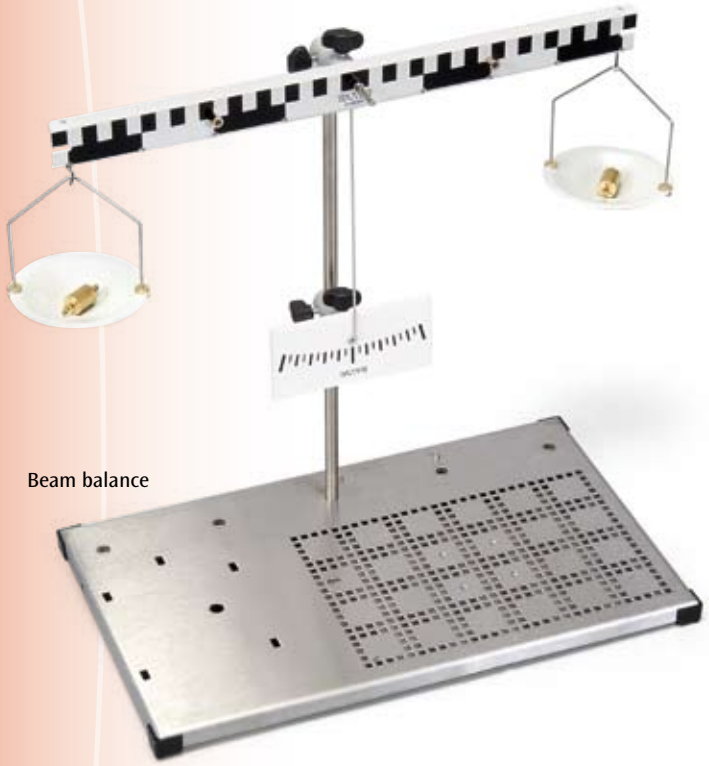
U60050



Student Experiment Kits

With the student experiment kits students can independently carry out numerous experiments on mechanics, heat, optics, electricity and magnetism. Comprehensive experiment instructions provide students with the requisite support. With the base plate determining the layout of an experiment, teachers and training staff can obtain a quick overview of the progress and success of the individual student performing the experiment.

The student experiment kit is a robust and easy to use experiment system. An area of only 400x245 mm approx. is needed for each experiment. Even this small area will guarantee a trouble-free, clearly arranged and stable set-up.



Beam balance

Heat:

- **Calibrating a thermometer**
- **Linear expansion of solid bodies**
- **Volumetric changes in liquids**
- **Volumetric changes in gases**
- **Bimetallic strips**
- **Temperature curve for the heating of water**
- **Temperature curve for heating liquids of various mass**
- **Specific heat capacity of various substances**
- **Mixtures of liquids, mix temperature**
- **Heat conduction**
- **Heat radiation**
- **Reflection of heat radiation**
- **Heat convection in a liquid**
- **Heat convection in air**
- **Heat insulation**
- **Melting and freezing**
- **Temperature curve for melting ice**
- **Latent heat of ice**
- **Boiling and condensing, boiling temperature**
- **Temperature curve of boiling water**
- **Distillation**
- **Evaporation**

Equipment heat:
U8448000 SEK Heat
U8408020 SEK Base Plate



Temperature curve for the heating of water

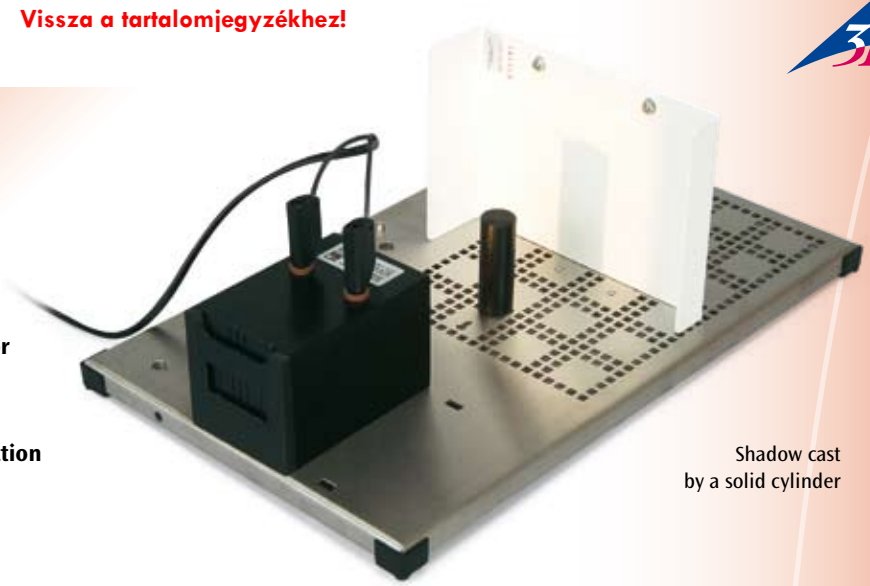
Mechanics:

- **Hooke's law**
- **Calibrating a dynamometer**
- **Deformation of a leaf spring**
- **Addition of forces acting along the same line**
- **Addition of forces acting along different lines**
- **Force down an inclined plane**
- **Normal force on an inclined plane**
- **Inertia**
- **Friction**
- **Coefficients of friction**
- **First class lever**
- **Beam balance**
- **Second and third class levers**
- **Fixed pulleys**
- **Moving pulleys**
- **Forces on a block and tackle**
- **Work with a block and tackle**
- **Multiple pulley**
- **Period of a pendulum (bob suspended from a thread)**
- **Period of a spring oscillator**

Equipment mechanics:
U8408000 SEK Mechanics
U8408020 SEK Base Plate

Optics:

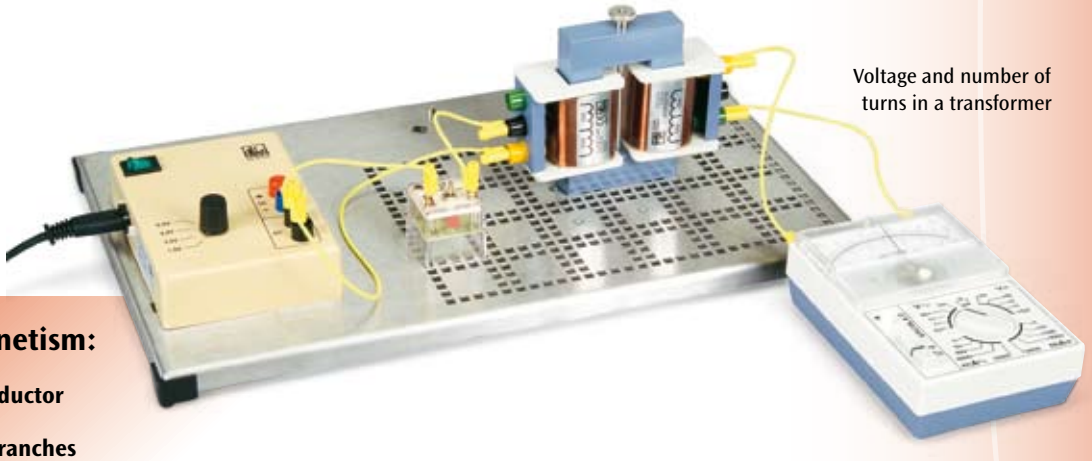
- Propagation of light, light beams and rays
- Opacity
- Shadows
- Umbra and penumbra
- Reflection from a flat mirror
- Focussing of light by a concave mirror
- Reflection and ray paths for a concave mirror
- Reflection and ray paths for a convex mirror
- Images in a flat mirror
- Refraction passing from air to glass
- Law of refraction, calculating index of refraction
- Refraction passing from glass to air
- Limiting angle for total internal reflection
- Light rays through a plane-parallel plate
- Light rays through a prism
- Total internal reflection in a prism
- Focussing of light by a converging lens
- Refraction by a converging lens, focal length
- Light rays through converging lens
- Refraction by a diverging lens
- Light rays through a diverging lens
- Light rays through multiple lenses
- Images with a converging lens
- Lens equation and equation for magnification
- Image aberrations
- Image formation in the eye
- Short-sightedness and its correction
- Long-sightedness and its correction
- Cameras
- Slide projectors



Shadow cast by a solid cylinder

- Microscopes
- Galilean telescopes
- Astronomical telescopes
- Colour dispersion through a prism
- Reunification of spectral colours
- Additive colour mixing

Equipment optics:
U8478000 SEK Optics
U8408020 SEK Base Plate
U8475430-230 Transformer 12 V, 25 VA (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 VA (115 V, 50/60 Hz)



Voltage and number of turns in a transformer

Electricity and Magnetism:

- Conductor and non-conductor
- Simple circuits
- Circuits with multiple branches
- Current in simple circuits
- Current in circuits with multiple branches
- No-load voltage and terminal voltage
- Voltage in a circuit with multiple branches
- Voltage in a simple circuit
- Ohm's law
- Law of resistance
- Temperature dependence of resistance
- Current-voltage graph for an incandescent lamp
- Current-voltage graph of an NTC resistor and a PTC resistor
- Resistance in a simple circuit
- Resistance in a circuit with multiple branches
- Resistance and voltage in a simple circuit
- Resistance and current in a circuit with multiple branches
- Potentiometers with and without load
- Charging characteristic of a capacitor
- Voltage and charge on a capacitor
- Forces produced by a magnet on test specimens
- Splitting a magnet
- Magnetic fields of a horseshoe magnet and a bar magnet
- Magnetic field of a coil
- Forces in the magnetic field of a coil
- Induction produced by relative motion
- Induction produced by modification of magnetic field
- Law of induction
- Ohmic resistance in DC and AC circuits
- Capacitors in DC and AC circuits
- Coil in DC and AC circuits
- Principle of a transformer
- Voltage and number of turns in a transformer
- Current and number of turns in a transformer

Equipment electricity:
U8498000 SEK Electricity and Magnetism
U8408020 SEK Base Plate
U8531170 ESCOLA2 Multimeter
U8498030-230 SEK Power Supply (230 V, 50/60 Hz)
or
U8498030-115 SEK Power Supply (115 V, 50/60 Hz)

Vissza a tartalomjegyzékhez!

Student Experiment Kits

U8408020

SEK Base Plate

(see page 10-11)

Tilt resistant stainless steel base with five special threads for the tilt free insertion of stand rods, threads for mounting a dismantling transformer and expansion slots for the insertion of electrical components.
With rubber feet.
Dimensions: 400x245x15 mm³ approx.



U8448000

U8408000

SEK Mechanics

Set of equipment for carrying out 20 student experiments on the mechanics of solids. In a sturdy plastic box. Includes CD with experiment instructions. Experiments are set up and performed on the SEK base plate (U8408020) so that they are compact but still clear in their layout and objectives.

Contents:

- 2 Stand rods with external and internal thread, 400 mm
- 1 Stand rod with external thread, 400 mm
- 2 Stand rods, 110 mm
- 2 Double clamps
- 1 Balance arm/ruler
- 2 Riders for balance arm
- 2 Hanging trestles for scale pans
- 2 Scale pans
- 1 Scale
- 1 Axle rod for pulleys
- 1 Carriage
- 2 Pulley blocks each with two pulleys and hooks for loads
- 1 Multiple pulley
- 1 Plastic pulley, 40 mm
- 4 Weights with 2 hooks, 25 g
- 1 Slotted weight with 2 hooks, 50 g
- 1 Weight 100 g
- 2 Weights with hook 1g
- 1 Weight with hook 5 g
- 1 Body for friction and inertia experiments
- 1 Stop plate
- 1 Dynamometer 1 N
- 1 Dynamometer 2 N
- 1 Magnetic field
- 1 Glass paper K80, 45x280 mm²
- 1 Leaf spring, 330 mm
- 1 Coil spring with 2 eyelets, approx. 5.25 N/m
- 1 Length of twine, 100 m
- 1 Steel knitting needle, 200 mm

U8448000

SEK Heat

Set of equipment for carrying out 22 student experiments on heat.
In sturdy plastic box. Includes CD with experiment instructions.
Experiments are set up and performed on the SEK base plate (U8408020) so that they are compact but still clear in their layout and objectives.

Contents:

- 1 Metal spirit burner
- 1 Ceramic gauze 100x100 mm²
- 1 Stand rod with external and internal thread, 400 mm
- 1 Ring with clamp
- 1 Tube 500 mm
- 1 Tube 200 mm
- 1 Short metal tube
- 1 Angle scale
- 2 Thermometers, -10 – 110°C, 1 K, red filling
- 1 Calibrating thermometer without scale, -10 – 100°C
- 1 Beaker, 100 ml
- 1 Measuring cylinder, 50 ml
- 1 Test tube, 160 mm
- 1 Test tube with wax
- 1 Conical flask, 100 ml
- 1 Rubber bung with two holes
- 2 Rubber bung with one hole
- 1 Capillary tubes
- 2 Ring washers
- 1 Pointer
- 1 Double clamp
- 1 Aluminium tube
- 1 Iron tube
- 1 Brass tube
- 1 Protective ring 50 mm
- 1 Set of 10 pieces of thermal paper
- 1 Table salt for freezing mixture
- 1 Heating body holder
- 1 Heating body, black
- 1 Heating body, plain
- 1 Set of metal bodies
- 1 Bimetallic strip with 10-mm handle
- 1 Calorimeter, 100 ml
- 1 Stirrer
- 1 Coiled tube (VPE 6)
- 10 Sheets of round filter paper
- 1 Test tube tongs with metal stem for stand mounting
- 1 Blue dye dispenser with wooden tapers
- 4 g Glycerine in bottle
- 3 Weights with hook



U8408000

U8478000

SEK Optics

Set of equipment for carrying out 26 student experiments on ray optics. In sturdy plastic box. Includes CD with experiment instructions. Experiments are set up and performed on the SEK base plate (U8408020) so that they are compact but still clear in their layout and objectives. Components are held in place magnetically so that they do not slip. Accompanying overlay masks with cut-outs specify the positioning of the optical components.

Contents:

1 Optical lamp, 12 V, 20 W
2 Experiment leads, 30 cm, black
1 Inclined table and screen
1 Plastic box
1 Lens, f = +300 mm
1 Lens, f = +100 mm
2 Lens, f = +50 mm
1 Lens, f = -100 mm
2 Candles
1 Plexiglas plate with mount
1 Plexiglas semi-circle
1 Rectangular prism
1 Diaphragm holder, magnetic
1 Single-slit diaphragm
1 Three-slit/5-slit diaphragm
1 Diaphragm in the shape of the letter F
1 Flexible mirror
1 Red filter
1 Blue filter
1 Image object
1 Opaque object for casting shadows
1 Parallel plate/base for prism
1 Converging lens, low-profile model
1 Diverging lens, low-profile model
1 Set of overlay masks



U8478000

U8498000

SEK Electricity

Set of equipment for carrying out 34 student experiments on electricity and magnetism. In sturdy plastic box. Includes CD with experiment instructions. The experiments are set up and performed in a space saving fashion but are still clearly laid out on the SEK base plate (U8408020).

Contents:

1 Set of experiment leads
1 Bar magnet, 65x16x5 mm³ approx.
1 Flat horseshoe magnet, AlNiCo
50 g Iron filings
10 Lengths of steel wire, notched
50 m Nickel-chrome wire, 0.2 mm
50 m Steel wire, 0.2 mm
1 Former for coil resistors
1 Transformer core 20x20 mm²
1 Retaining screw
1 Coil 200 + 400 windings
1 Coil 400 + 400 windings
1 Resistor 1 Ω (plug-in component)
1 Resistor 47 Ω (plug-in component)
1 Resistor 33 Ω -20
1 Potentiometer 100 Ω (plug-in component)
1 PTC resistor 50 Ω (plug-in component)
1 NTC resistor 100 Ω (plug-in component)
1 Electrolytic capacitor 4700 µF (plug-in component)
2 Reversing switches (plug-in component)
2 Plug-in components with 6 connector sockets
2 E10 lamp sockets (plug-in component)
3 Incandescent lamps E10, 7 V

U8498000



SEK Power Supply

(see page 11)

AC/DC power supply for SEK electricity kit (U8498000). Housing with attachment hooks for clamping into the SEK base plate (U8408020). Voltages: 1.5/ 3.0/ 4.5/ 6.0 V AC/DC

U8498030-230

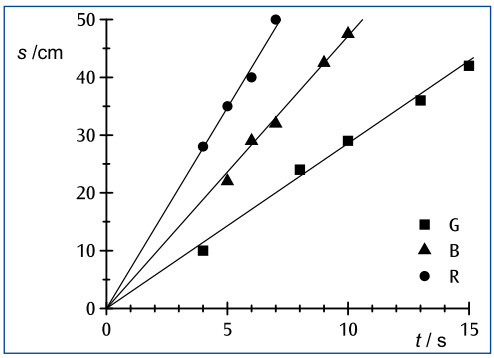
SEK Power Supply (230 V, 50/60 Hz)

U8498030-115

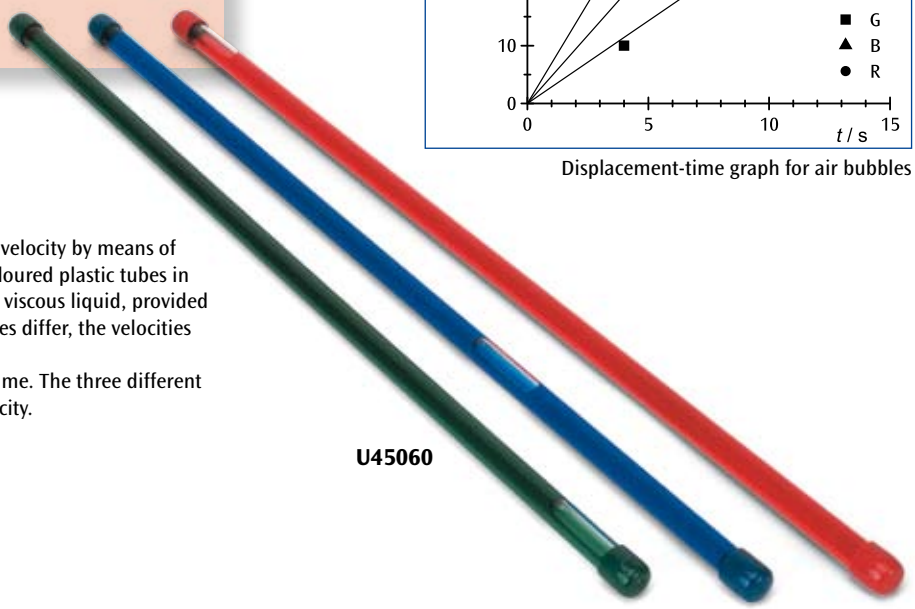
SEK Power Supply (115 V, 50/60 Hz)

Experiment Topics:

- **Displacement-time graphs**
- **Linear gradients**
- **Velocity**



Displacement-time graph for air bubbles



U45060

U45060

Constant Velocity Student Kit

Set of equipment for investigating the concept of velocity by means of student experiments. Consisting of three small coloured plastic tubes in which an air bubble rises at constant velocity in a viscous liquid, provided the tubes are aligned vertically. Since the viscosities differ, the velocities also differ.
The position of the air bubble is plotted against time. The three different resulting straight lines lead to a definition of velocity.

Length: 500 mm approx.
Diameter: 13 mm approx.

Additionally required:
U40801 Mechanical Stop Watch, 15 min
U10073 Pocket Measuring Tape, 2 m

Experiment Topics:

- **Determining mass of evacuated air and density of air**
- **Effect of air pressure on a slightly inflated hot-air balloon and on a suction cap**
- **Lowering of the boiling point of liquids at decreased air pressure**

Effect of air pressure on a slightly inflated balloon



U45052

Vacuum Student Kit

Set of equipment for introducing the fundamentals of vacuum physics by means of student experiments.

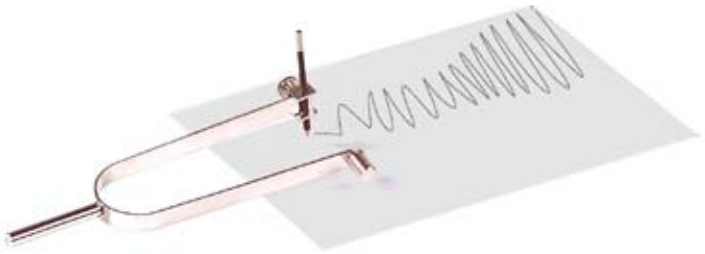
Contents:
1 Experiment plate with washer
1 Vacuum bell jar
2 Beakers
1 Pressure hose with check valve
1 Pressure hose with T-connector and check valve
1 Simple hand pump in storage container
1 Suction cap
2 Balloons
2 Pipettes

Additionally recommended:
U42048-230 Electronic Scales 200 g (230 V, 50/60 Hz)
or
U42048-115 Electronic Scales 200 g (115 V, 50/60 Hz)



U45052

The acoustics kit allows students to carry out numerous experiments on acoustics independently. A wide variety of sound sources are studied to begin with and the concepts of noise, bangs and tones as well as pitch and loudness are investigated. Waves along a rope are used to illustrate harmonic vibrations and overtones. There is also some extensive study of various different musical instruments. Different high-pitched tones are generated by means of a monochord and the ensuing intervals are calculated experimentally. These studies are expanded to other instruments and can easily lead over to a study of musical notes.



Description of vibrations with a tuning fork with plotter pen

BESTseller

Experiment topics:

- Noise, bangs, pure tones
- Vibrating air columns
- Whistles and pipes
- Vibrating bars, plates and bells
- Infra-sound
- Ultra-sound
- Tuning fork with plotter pen
- Travelling waves along a rope
- Velocity of propagation of sound
- Waves in water
- Echo
- Moving sources of sound (Doppler effect)
- Plate vibrations (Chladni figures)
- Vibrations of a bell
- Standing waves on a rope, overtones
- Sounds of musical instruments
- Timbre of the human voice
- Measurement of wavelength (Kundt figures)
- Resonance
- Helmholtz ball resonators
- Sound analysis
- Loudness
- Pitch of string instruments
- Pitch of wind instruments
- Reed pipe
- C-major scale and its intervals
- Triads, harmonies

U8440012

Acoustics Kit

Complete set of equipment for carrying out more than 30 student experiments on acoustics. In plastic tray with foam inlay.
Includes CD with experiment instruction.

Dimensions: 530x375x155 mm³ approx.
Weight: 4.5 kg approx.

Contents:

1 Monochord, with ruler and musical scale
1 Steel string
1 Perlon string
1 Spring balance on support
1 Reed pipe with 8 valves
1 Tuning fork with plotter pen, 21 Hz
1 Tuning fork, 440 Hz
1 Light-metal tuning fork, 440 Hz
1 Pipe
1 Variable-length closed air column
1 Tuned open air column
1 Chladni disc with handle
1 Galton whistle
1 Kundt pipe with retaining clip
5 g Lycopodium powder in sprinkling cellar
1 Metallophone with beater
1 Rope for demonstrating waves
1 Helmholtz resonator, 70 mm dia.
1 Helmholtz resonator, 52 mm dia.
1 Helmholtz resonator, 40 mm dia.
1 Helmholtz resonator, 32 mm dia.
1 Screw clamp
1 Wood block



U8440012

Optics Using a Light Box

The light box kit allows students to carry out numerous experiments independently to obtain an introduction to the fundamentals of geometrical optics and colour mixing directly on a bench.

Colours and Shadows:

- Coloured light and coloured objects
- Mixture of colours
- Casting shadows
- Coloured shadows

Reflection:

- Reflection from a plane mirror
- Reflected images, image reversal
- Multiple reflections from a mirror
- Reflection from a concave mirror (focal point and spherical aberration)
- Reflection from a parabolic mirror
- Reflection from a convex mirror

Refraction:

- Determining refractive index with a semi-circular object
- Determining refractive index with a parallel block
- Angle of minimum deflection for a prism
- Total internal reflection in a semi-circular object
- Total internal reflection in a prism
- Focal point of a converging lens
- Focal point of a diverging lens
- Spherical aberration



U30011

U30011

Light Box

Set of equipment for optical experiments to be carried out on a bench, consisting of a light box in a sturdy plastic housing and numerous optical components. Complete set in sturdy wooden storage case.
The light box has four light outlets: the two side outlets have two hinged mirrors for experiments on colour mixing and shadows. All openings are equipped with mounts for optical components in 50x50 mm² slide frames. Parallel, convergent and divergent light can be generated by adjusting a converging lens attached in front of the lamp. There are two double-sided slit diaphragms available so that four different beam configurations can be created.

Lamp:	12 V, 36 W
Connections:	4-mm socket
Light box:	175x100x65 mm³ approx.
Storage case:	250x240x100 mm³ approx.

Contents:

1 Light box
8 Colour charts
1 Plane mirror (glass)
1 Concave mirror (metal)
1 Convex mirror (metal)
1 Bi-convex lens, large (transparent acrylic)
1 Bi-convex lens, small (transparent acrylic)
1 Bi-concave lens (transparent acrylic)
1 Parallel plate (transparent acrylic)
1 Semi-circular object (transparent acrylic)
1 60° prism (transparent acrylic)
1 Asymmetrical 90° prism (transparent acrylic)
1 Symmetrical 90° prism (transparent acrylic)
2 Slit diaphragms
8 Colour filters (in slide frame)
1 Pair of connector leads with 4-mm plugs

Additionally required:
U13900-230 Transformer 12 V, 60 W (230 V, 50/60 Hz)
or
U13900-115 Transformer 12 V, 60 W (115 V, 50/60 Hz)

U30039

Spare Lamp for Light Box (not illustrated.)
Spare lamp for light box, 12 V, 36 W.

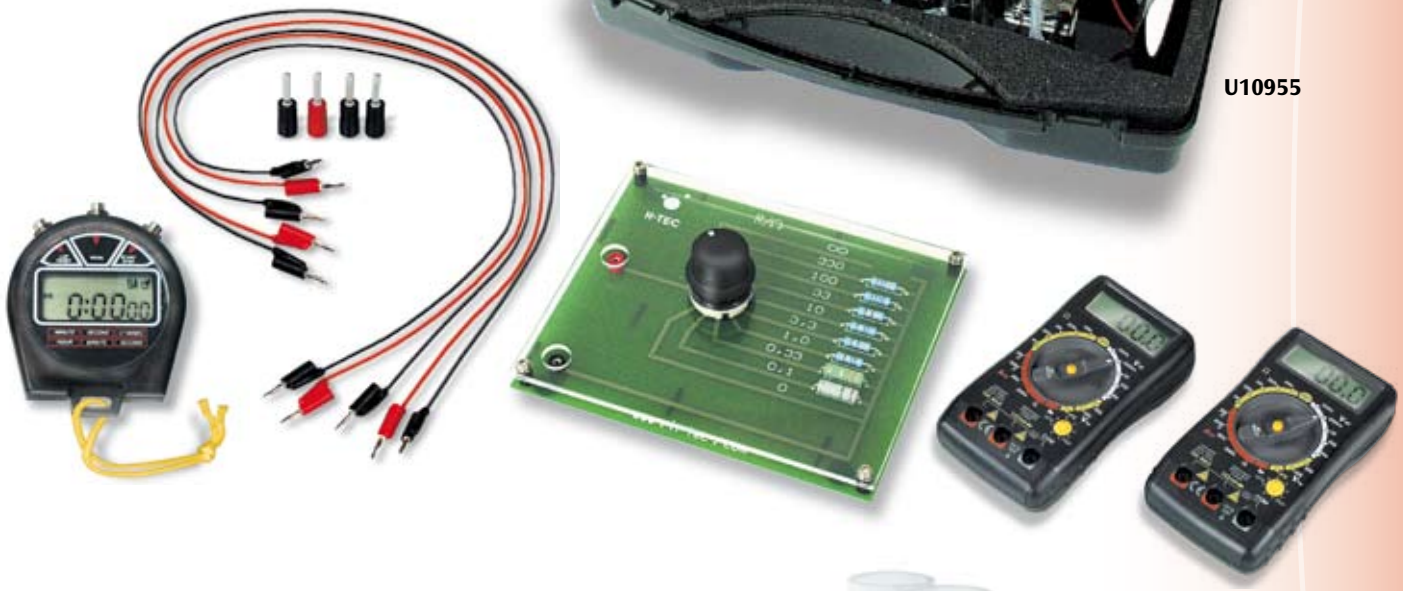
The experiment case for fuel cells allows students to gradually investigate the world of fuel cells and solar-hydrogen technology in many illustrative and quantitative experiments.

Experiment Topics:

- Current-voltage curve of a solar cell.
- Power curve and efficiency of a solar cell.
- Current-voltage curve of a PEM electrolyser
- Energy efficiency and Faraday efficiency of a PEM electrolyser
- Current-voltage curve of a PEM fuel cell
- Power curve of a PEM fuel cell
- Current-voltage curve of a direct methanol fuel cell



U10955



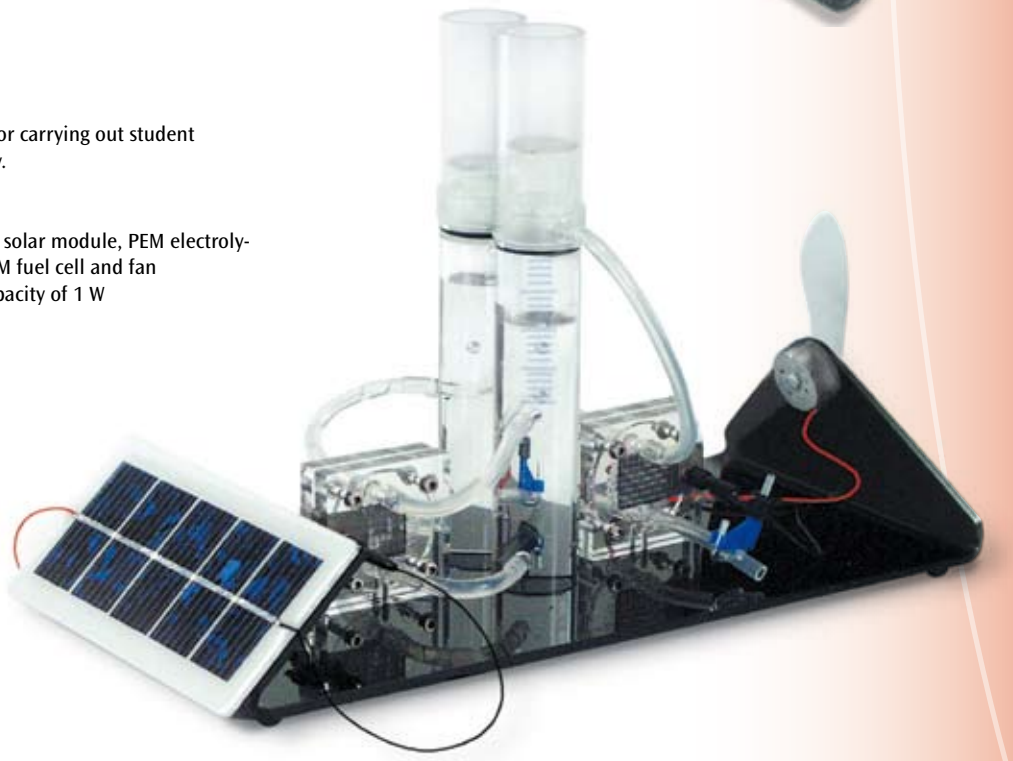
U10955

Fuel Cell Experiment Case

Solar-hydrogen cell system and accessories for carrying out student experiments. In storage case with foam inlay.

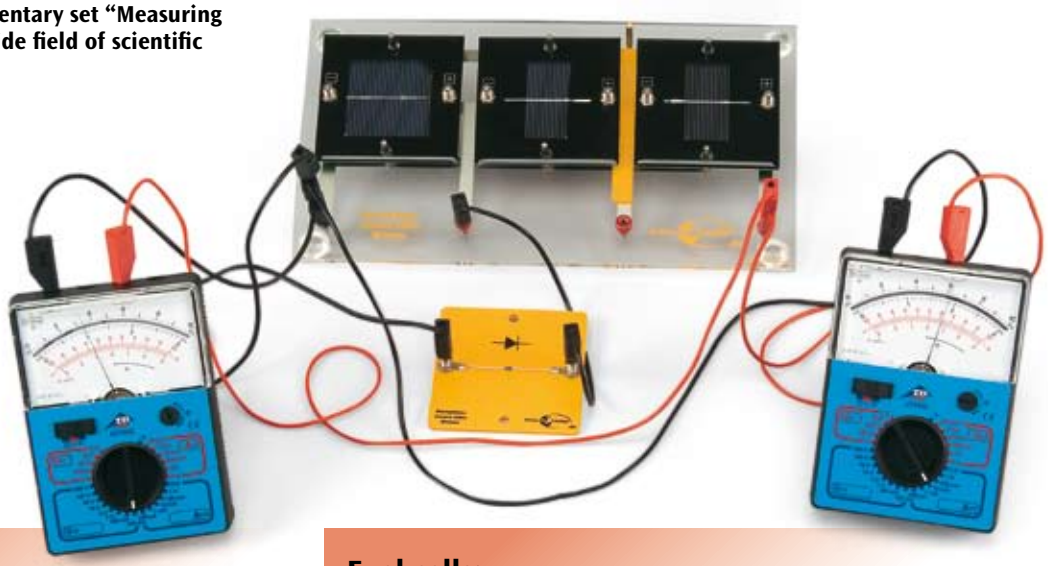
Contents:

1 Solar-hydrogen cell system consisting of solar module, PEM electrolyser, hydrogen and oxygen reservoirs, PEM fuel cell and fan
1 Resistor decade with maximum load capacity of 1 W
2 Digital multimeters
3 Connector leads, 50 cm, red
3 Connector leads, 50 cm, black
1 Stop watch
250 ml Distilled water
1 Storage case



The set of photovoltaic equipment can be used for numerous qualitative and quantitative student experiments on the subject of photovoltaics for secondary school teaching. In addition, there are two supplementary sets available.

The fuel cell expansion set is a supplementary system for experiments on the subject of hydrogen technology that also allows for self-tuition. The supplementary set "Measuring without instruments" opens up a wide field of scientific experiments at pre-secondary level.



Shading of series-connected solar cells

Photovoltaics:

- Series and parallel connection of solar cells
- Output of solar cell depending on the surface
- Output of solar cell depending on the angle of incidence of light
- Output of solar cell depending on the brightness of the illumination
- Efficiency of energy conversion
- Internal resistance of solar cells
- Diode nature of solar cells
- Current-voltage curve and bulk factor of solar cells
- Output of solar cells depending on temperature
- Shading of solar cells
- Output of solar cells depending on frequency of incident light

Equipment:
U10970 Photovoltaics Equipment Set
U17450 Analog Multimeter (2x)
U13800 Set of 15 Experiment Leads, 75 cm

Fuel cells:

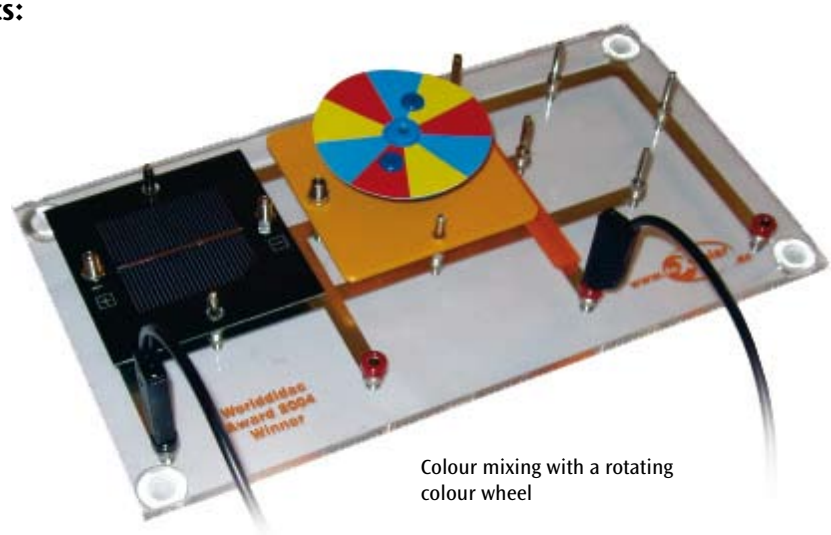
- Operation of fuel cells
- Electrode reaction
- Current-voltage curve of electrolyser
- Current-voltage curve of fuel cell
- Current-voltage curve of a fuel cell stack
- Current-voltage curve depending on type of ions and electrolyte concentration
- Current-voltage curve depending on temperature
- Solar-energy/hydrogen circuit
- Efficiency of fuel cells
- Efficiency of solar-hydrogen devices

Equipment:
U10970 Photovoltaics Equipment Set
U10971 Fuel Cell Supplementary Set
U17450 Analog Multimeter (2x)
U13800 Set of 15 Experiment Leads, 75 cm
U33300-230 Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (230 V, 50/60 Hz)
or
U33300-115 Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (115 V, 50/60 Hz)
Disposable chemicals

Simple experiments on electricity and optics:

- Electrical loads
- Series and parallel connection of incandescent lamps
- Direction of rotation and velocity of an electric motor
- Brightness
- Diffuse radiation
- Albedo radiation
- Rotating discs
- Colour mixing
- Colour illusions

Equipment:
U10970 Photovoltaics Equipment Set
U10972 Supplementary Set "Measuring without Instruments"
2 Experiment Leads from U13800



Colour mixing with a rotating colour wheel

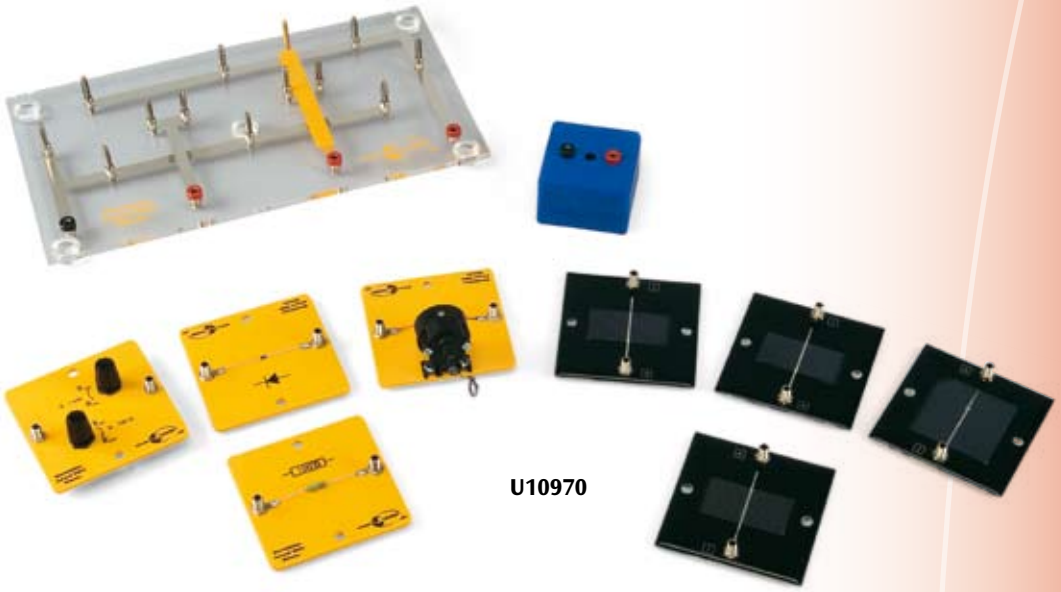
U10970

Photovoltaics Equipment Set

Set of equipment on the topic of photovoltaics for one student workplace.
Includes storage container with inlays and circuit diagram overlay.

Contents:

1 Basic unit
1 Circuit diagram
3 Solar cells 50x25 mm²
1 Solar cell 50x50 mm²
1 Lighting module
1 Diode module
1 Motor module
1 Potentiometer module
1 Resistor module
4 Plastic covers and colour filters



U10970



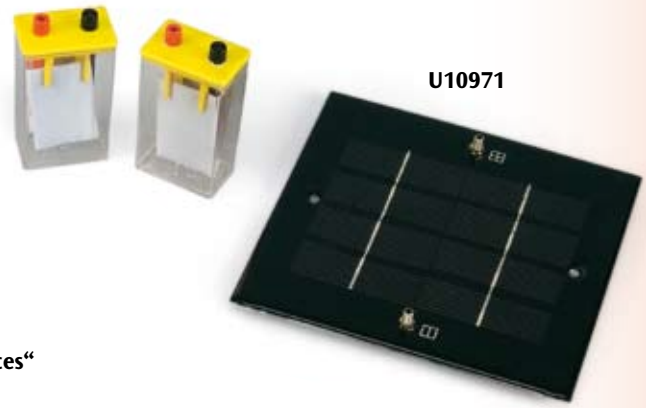
U10971

Fuel Cell Supplementary Set

Supplement to the photovoltaic equipment set (U10970) for student experiments on fuel cells and solar-energy/hydrogen technology. The components can be safeguarded in the storage container for U10970.

Contents:

1 Solar module for fuel cell
2 Fuel cells



U10971

U10972

Supplementary Set „Measurement without Measuring Devices“

Supplement to the photovoltaic equipment set (U10970) for student experiments at pre-secondary level.

Contents:

1 Plug-in horn
1 Plug-in incandescent lamp
1 Plug-in motor
1 Set of 5 rotary discs including holder

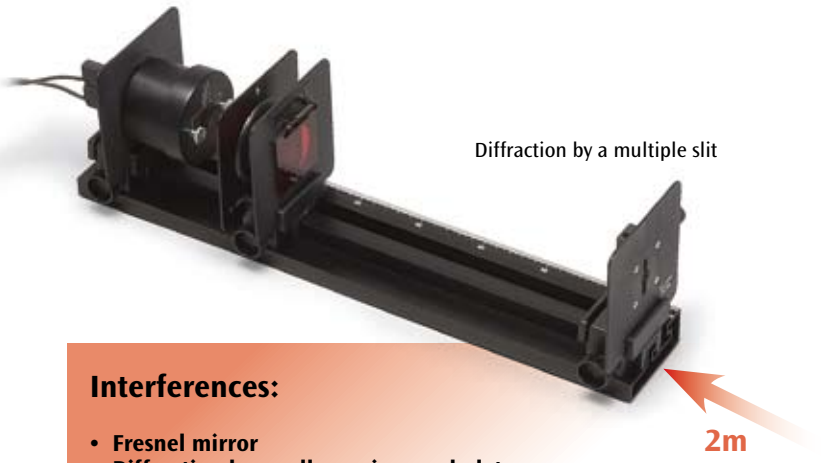


U10972

Kröncke Optical System for Student Exercises

The Kröncke optical system provides robust reliability that has been tried and tested for decades and offers all the precision needed for student exercises and practical courses in numerous experiments on ray and wave optics. The experiments are carried out in traditional fashion using the white light of an incandescent lamp, the filament of which can be projected through an adjustable slit to observe interference in particular.

All optical components are mounted in diaphragms with no stems and can easily be adjusted vertically and with precision into the optical light path when mounted on optical riders. Optical riders can freely move on the U-profile rail of an optical bench and can be attached with a minimum of effort.



Diffraction by a multiple slit

Ray optics:

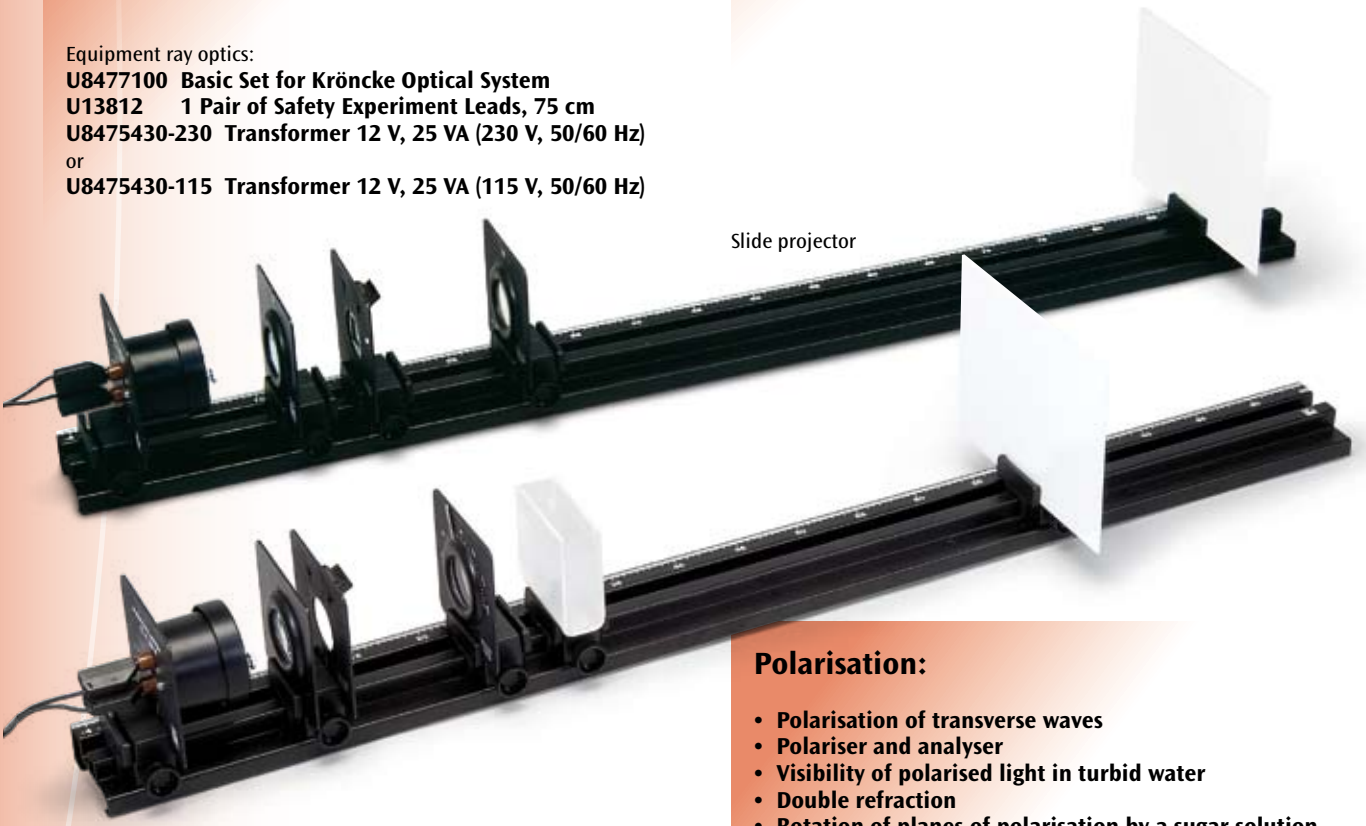
- Pinhole camera
- Imaging with converging lenses
- Image aberrations
- Images in the eye (eye model)
- Correction of vision
- Magnifying glasses
- Microscopes
- Astronomical telescopes
- Terrestrial telescopes
- Slide projectors

Equipment ray optics:
U8477100 Basic Set for Kröncke Optical System
U13812 1 Pair of Safety Experiment Leads, 75 cm
U8475430-230 Transformer 12 V, 25 VA (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 VA (115 V, 50/60 Hz)

Interferences:

- Fresnel mirror
- Diffraction by small openings and plates
- Diffraction by an air gap
- Diffraction by the wire
- Diffraction by multiple slits
- Diffraction by the grating
- Optical resolution
- Determining the wavelength of light

Equipment interference:
U8477100 Basic Set for Kröncke Optics
U8477105 Supplementary Set for Interference
U13812 Pair of Safety Experiment Leads, 75 cm
U8475430-230 Transformer 12 V, 25 VA (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 VA (115 V, 50/60 Hz)



Slide projector

Visibility of polarised light in turbid water

Polarisation:

- Polarisation of transverse waves
- Polariser and analyser
- Visibility of polarised light in turbid water
- Double refraction
- Rotation of planes of polarisation by a sugar solution

Equipment polarisation:
U8477100 Basic Set for Kröncke Optical System
U8477110 Supplementary Set for Polarisation
U13812 Pair of Safety Experiment Leads, 75 cm
U8475430-230 Transformer 12 V, 25 VA (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 VA (115 V, 50/60 Hz)



U8477105

U8477105

Supplementary Set for Interference

Supplementary set to the Kröncke optics basic set (U8477100) for carrying out student experiments on the interference of light waves.

Contents:

1 Optical bench, 500 mm
1 Adjustable slit
1 Diaphragm with 9 circular discs
1 Diaphragm with 9 circular holes
1 Diaphragm with 3 individual slits and 1 double slit
1 Diaphragm with 4 multiple slits and grating
1 Diaphragm with 3 ruled gratings
1 Micrometer screw
1 Fresnel mirror



U8477100

Basic Set for Kröncke Optical System

Contents:

1 Optical lamp
1 Optical bench, 1000 mm
6 Optical slides
2 Clamps
2 Converging lenses, f = 50 mm
2 Converging lenses, f = 100 mm
2 Converging lenses, f = 150 mm
1 Converging lens, f = 300 mm
1 Converging lens, f = 500 mm
1 Diverging lens, f=-100 mm
1 Diverging lens, f=-500 mm
1 Diaphragm with 1 slit
1 Diaphragm with 3 slits
1 Photograph in slide frame
1 Transparent screen
1 White screen
1 Set of 4 colour filters
1 Ruler, 15 mm
1 Set of holes arranged to form the number „1“
1 Pinhole aperture, 6 mm



U8477100

U8477110

Supplementary Set for Polarisation

Supplementary set to the Kröncke optics basic set (U8477100) for carrying out student experiments on the polarisation of light waves.

Contents:

1 Pair of polarising filters
1 Pinhole aperture, 10 mm
1 Rectangular cuvette



U8477110

3B NET*log*™: Our network capable system for acquisition and processing of data in science lessons.

The design of student experiments presents a challenge. The experiments must not require complicated and expensive measuring instruments and they must not be too time consuming, but they must still yield meaningful results that can be easily displayed in graphical form.

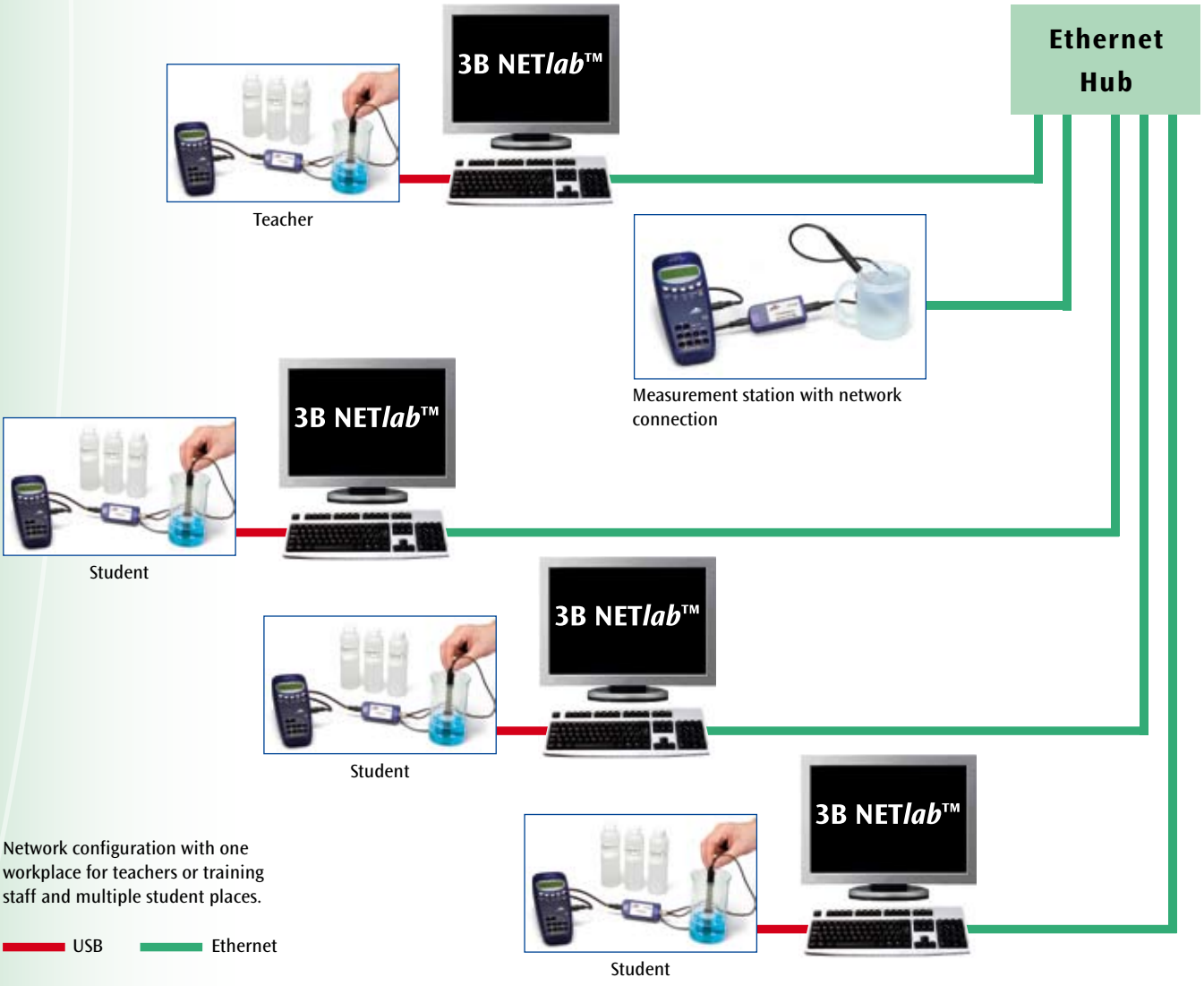
The computer linked measuring instrument 3B NET*log*™ offers a wealth of possibilities for meeting these requirements in a wide variety of student experiments. By equipping it with the appropriate sensor for a task, it can be used to measure many different physical quantities. It is also possible to make measurements involving rapid processes, such as the vibration of a tuning fork, with a high sampling rate and resolution, or to automate the recording of measurements involving slow processes over a long period of time. It is not even necessary for the instrument to be connected to the computer during such measurements. 3B NET*log*™ has analog signal input connections for voltage, current, or external sensors. There is also provision for digital inputs and both analogue and digital outputs are available.

By combining 3B NET*log*™ with the computer program 3B NET*lab*™, it is possible to utilize all the extended functions of the instrument. These include an oscilloscope mode and a generator for producing any desired periodic signal form.

3B NET*log*™ can either be connected to a computer via USB or linked directly to a network via an optional network port of its own. Thus, for example, experiments that cannot be moved, or for which only simple equipment is available, can be still accessible to every computer in the network.

For displaying and processing the data, 3B NET*lab*™ provides a tool that is powerful, but nevertheless easy to understand. Instructions in the form of web pages, which can be opened in Microsoft's Internet Explorer, describe experiments that lead students into many different areas of physics. 3B NET*lab*™ features are embedded into these web pages directly at the places where they are needed. That makes navigation just as straightforward as surfing the Internet. Any student wishing to experiment alone, without instructions, has free access to all the measuring and data processing functions of the 3B NET*log*™ measuring lab tool.

The full power of 3B NET*lab*™ becomes apparent when it is connected to a network. From their computers, teachers can examine students' data records even while they are being made or processed. Conversely, teachers can carry out experiments themselves and students can access the experimental data from individual computers and perform their own analyses.



Network configuration with one workplace for teachers or training staff and multiple student places.

3B NET*log*™

3B NET*log*™ can be used as an interface for data acquisition linked to a computer, or as a hand held instrument with a data-logger for measurements of current and voltage or in combination with various sensors. It incorporates sensor connectors with automatic identification of sensors. It can be connected to a computer via USB or connected directly to a network via an optional Ethernet port of its own. Includes USB cable and installation CD with data transfer program and plug in power supply.

Voltage inputs:
- Channels: 2 Differential amplifiers (A and B)
- Measuring ranges: 0 – ±200 mV, 0 – ±2 V, 0 – ±20 V
- Connectors: Two twin 4 mm safety sockets

Current input:
- Channel: Parallel to A
- Measuring ranges: 0 – ±200 mA, 0 – ±2 A
- Connector: One twin 4 mm safety socket

Analogue sensor inputs:
- Channels: 2 (A and B)
- Connectors: Two 8-pin miniDIN sockets
- Sensor identification and calibration: Automatic
- Triggering: Quasi-continuous
- Sampling rate: 50 kilosamples/s
- Resolution: 12 bit

Voltage outputs:
- Channels: 2 (A' and B'), with common ground connection
- Voltage amplitude: 0 – ±5 V
- Connectors: Two twin 4 mm safety sockets

Analogue sensor outputs:
- Channels: 2 (A' und B')
- Connectors: Two 8 pin miniDIN sockets
- Sampling rate: 10 kilosamples/s
- Resolution: 12 bit

Digital Inputs:
- Channels: 4 (A, B, C, D)
- A: TTL
- B: TTL, high-speed sampling rate, 100 kilosamples/s
- C, D: High-speed optical coupler (galvanically isolated)
- Connector: One 8 pin miniDIN socket

Digital outputs:
- Channels: 6 (A', B', C', D', E', F')
- Signal: TTL
- Connector: One 8 pin miniDIN socket

Additional data:
- Computer connection: USB port
- Internal data storage: 128 k
- Monitor display: Large display (64 x 122) for data on all channels

P ower supply: 4.5 V DC/300 mA or 3 batteries LR6 AA alternatively 3 NiCd or 3 NiMH rechargeable batteries

U11300-230
3B NET*log*™ (230 V, 50/60 Hz)

U11300-115
3B NET*log*™ (115 V, 50/60 Hz)

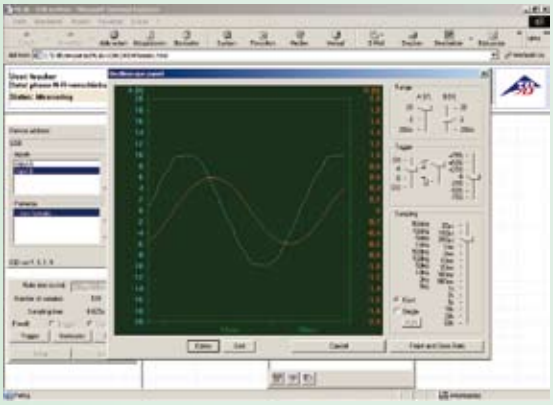
U11300ip-230
3B NET*log*™ with Ethernet Port (230 V, 50/60 Hz)

U11300ip-115
3B NET*log*™ with Ethernet Port (115 V, 50/60 Hz)

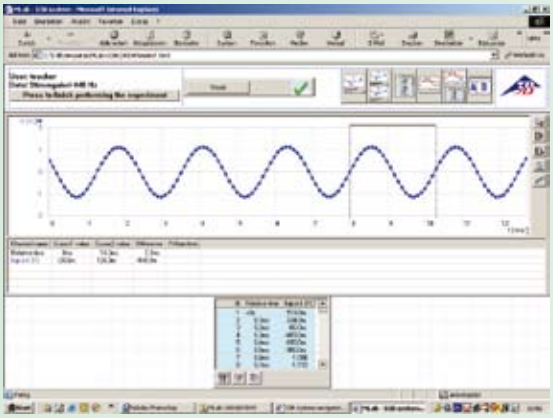


3B NET*lab*™:

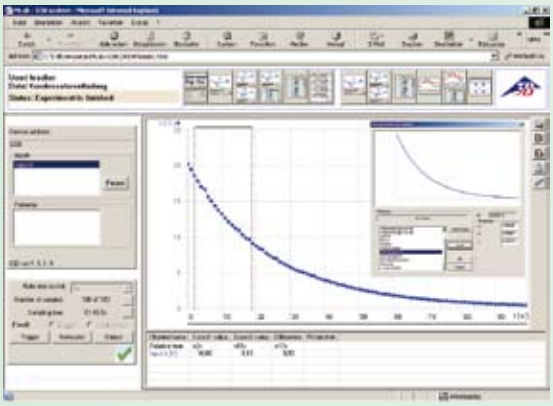
- **Comprehensive range of data processing functions, including tangents, integration, curve matching, all kinds of formula calculations and interpolation.**
- **Data acquisition with date and time of each measurement.**
- **Recording and processing several series of measurements.**
- **Presentation of data in the form of graphs or tables, analogue or digital multimeter functions.**
- **Easy configuration of sensor and experiments on the basis of predefined experiment files.**
- **Text windows for comments about the experiment.**
- **Support for analogue and digital sensors.**
- **Automatic identification of sensors.**



Oscilloscope: Voltage phase shift in RL series resonant circuit



Sound amplitude of a tuning fork as a function of time



Discharge curve of a capacitor



U11310

3B NET*lab*™

3B NET*lab*™ is a data acquisition and data processing program for the 3B NET*log*™ interface that can also be operated in a network. As it is based on ActiveX technology, all the available functions can be integrated into web pages that can be displayed and used with the Microsoft Internet Explorer browser.

The main function of 3B NET*lab*™ is computer aided experimentation for science education. For that purpose, a large number of experiment instructions are available in the form of web pages. Users can navigate through these in the same way as they would browse the Internet and all the operations can be controlled with the help of facilities incorporated into the web pages at appropriate points.

Experiment Instructions for carrying out experiments can also be written by teachers using standard HTML tools and the programming environment made available for the purpose. All kinds of Internet tools and technologies, such as multimedia sequences, animations, films, etc. can be incorporated into the experiment files.

A software measuring lab is available for solo experimentation that utilizes all the functions of the functions of 3B NETlog™ interface device. A wide range of graphical tools is available for processing experimental data.

Thanks to its networking capability, 3B NET*lab*™ is ideally suited for use in schools. It enables teachers to check on the status and results of student's experiments from their own desk. Conversely, an experiment that is being carried out by the teacher can be followed by students on their own monitor screens.

Licensing:

3B NET*lab*™ contains a specified location license for the normal use of the computer program throughout a school or educational establishment, including the preparation of school or student work at home.

System requirements:

Windows
Microsoft Internet Explorer 6 or higher
Intel Pentium III / AMD Athlon 600 MHz or higher
128 MB RAM
100 MB free hard-disk space
Monitor with a resolution of 1024x768 pixels or higher
USB port

3B POWER*log*
Programmable voltage and current source with power output for connection to the two analog outputs of the 3B NET*log*™ unit (U11300). Includes plug in power supply and two connector leads with 8 pin miniDIN plugs.

Output power:	6 W
Current:	0 – ±1 A
Voltage:	0 – ±10 V
Bandwidth:	0 – 50 kHz



U11305

U11305-230

3B POWER*log* (230 V, 50/60 Hz)

U11305-115

3B POWER*log* (115 V, 50/60 Hz)

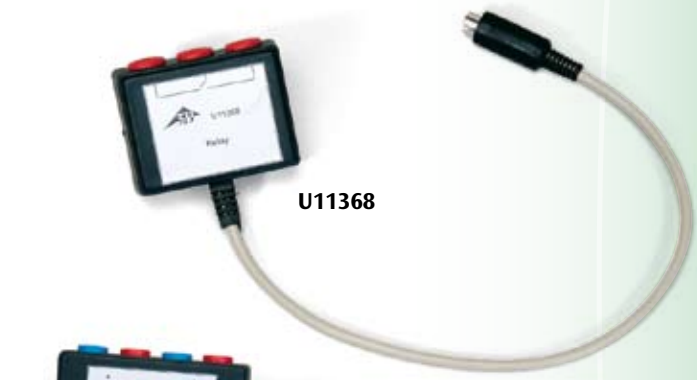
Additionally required:
U11310 3B NET*lab*™
U11300-230 3B NET*log*™ (230 V, 50/60 Hz)
or
U11300-115 3B NET*log*™ (115 V, 50/60 Hz)
or
U11300ip-230 3B NET*log*™ with Ethernet Port (230 V, 50/60 Hz)
or
U11300ip-115 3B NET*log*™ with Ethernet Port (115 V, 50/60 Hz)



U11368

Relay
Power relay with a set of change over contacts for initiating measurements using 3B NET*lab*™ software. The relay is controlled by the digital output of the 3B NET*log*™ unit (U11300) and it features both normally open and normally closed contacts.
Safe potential separation between coil and contact set in accordance with VDE 0160. The contacts are made of a high performance silver alloy.
Includes connector lead with 8 pin miniDIN plugs.

Max. switched voltage:	250 V AC / 220 V DC
Max. switched current:	6 A AC / 0.12 A DC
Max. switched power:	1500 VA
Min. switched power:	1 mW
Connectors:	4 mm safety sockets



U11376

Additionally required:
U11310 3B NET*lab*™
U11300-230 3B NET*log*™ (230 V, 50/60 Hz)
or
U11300-115 3B NET*log*™ (115 V, 50/60 Hz)
or
U11300ip-230 3B NET*log*™ with Ethernet Port (230 V, 50/60 Hz)
or
U11300ip-115 3B NET*log*™ with Ethernet Port (115 V, 50/60 Hz)



U11377

U11376

Digital Output Box
Output box for connecting the digital outputs A, B, C and D of the 3B NET*log*™ unit (U11300) to four pairs of 4 mm safety sockets. Includes connector lead with 8 pin miniDIN plugs.

Output signal:	TTL level
Connectors:	4 mm safety sockets

U11377

Digital Input Box
Input box for connecting the digital inputs A, B, C and D of the 3B NET*log*™ unit (U11300) to four miniDIN8 sockets. Includes connector lead with 8 pin miniDIN plugs.

Input and output signal:	TTL level
Connectors:	8 pin miniDIN sockets



U11361

U11365

U11354

Force Sensor, ±50 N

Force sensor for the measurement of unidimensional forces, with tare function. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement ranges:	0 – ±5 N, 0 – ±50 N
Accuracy:	±1%
Sensor type:	Metal strip strain gauges



U11354

U11361

Ultrasonic Motion Sensor

Sensor for the measurement of unidimensional motion, e.g. on an air cushion track or in free fall. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0.15 m to about 11 m
Resolution:	2 mm
Accuracy:	±1%
Sensor type:	Electrostatic 50 kHz converter
Sampling frequency:	10 Hz

U11365

Photo Gate

Infrared photo gate for triggering the 3B NET*log*™ unit (U11300) or a digital counter (U8533341). For time measurements in experiments on free fall, motion on a track or pendulum oscillations and for counting pulses. With operational indicator light. Includes stand rod with screw thread and connector lead with 8 pin miniDIN plugs.

Barrier spacing:	75 mm
Rise time:	< 500 ns
Spatial resolution:	< 1 mm
Time resolution:	0.1 ms

U11363

Acceleration Sensor, ±5*g*

Sensor for the measurement of unidimensional acceleration, e.g. of a rider on an air cushion track, of a coil spring pendulum or of a lift. Can be used in conjunction with 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±50 m/s²
Resolution:	0.03 m/s²
Accuracy:	±1%
Sensor cable:	2 m
Sensor type:	Capacitive acceleration sensor

U11362

Acceleration Sensor, ±25*g*

Sensor for the measurement of unidimensional collisions and all kinds of high acceleration motion. Can be used in conjunction with 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±250 m/s²
Resolution:	0.2 m/s²
Accuracy:	±1%
Sensor cable:	2 m
Sensor type:	Capacitive acceleration sensor



U11363

U11362

U8533380

Laser Reflection Sensor

Sensor for triggering the 3B NET*log*™ unit (U11300) or a digital counter (U8533341) in time measurements on moving objects. Suitable for opto electronic scanning of light and dark markings on moving objects or in conjunction with a reflecting foil to form a wide spaced obstruction sensor. The intensity of the laser beam is adjusted automatically according to the distance of the object. Includes reflecting foil, stand rod with screw thread and connector lead with 8 pin miniDIN plugs.

Maximum range:	2.5 m
Laser power:	< 1 mW
Laser protection class:	II



U8533380

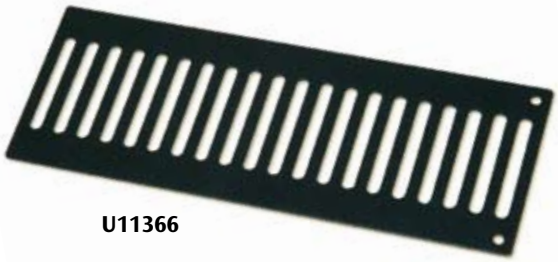
U11366

Picket Fence

Aluminium strip with 21 openings for determining gravitational acceleration g from time intervals recorded for a light beam passing through the individual openings of the strip as it falls freely past the beam. Anodised sheet aluminium with two holes for suspension of additional weights to demonstrate that the acceleration is independent of the mass.

Distance between rungs: 10 mm

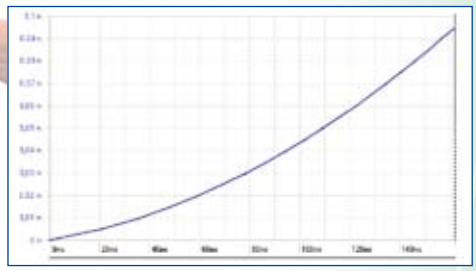
Dimensions: 205x75 mm² approx.



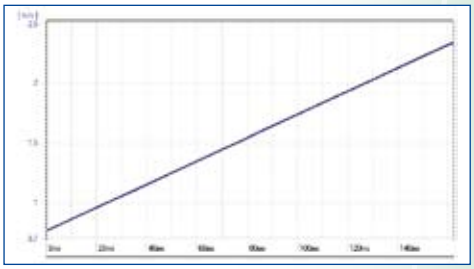
U11366



Measurement of free fall using a picket fence



Distance travelled as a function of time



Acceleration due to gravity as a function of time

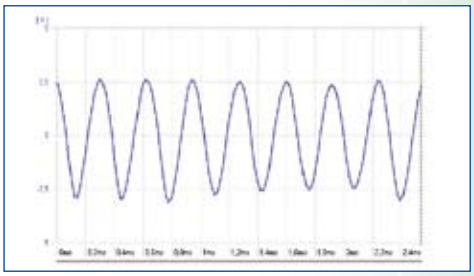
U11367

Microphone

Sensor for the measurement of the relative acoustic pressure or for plotting sound wave patterns, e.g. of voices or musical instruments. With built in electret microphone. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Frequency range: 50 Hz – 20 kHz

Microphone cable: 2 m



Sound amplitude of a tuning fork as a function of time



U11367



Measuring the sound waves of a tuning fork

U11320

Absolute Pressure Sensor, 2500 hPa

Sensor for the measurement of absolute pressure, e.g. in experiments on the Boyle-Mariotte law. Can also be used for measuring the production of O_2 during photosynthesis and for experiments on transpiration in closed systems. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes plastic syringe, silicone tube, and connector lead with 8 pin miniDIN plugs.

Measurement range: 0 – 2500 hPa

Accuracy: ±1%

Resolution: 1 hPa

Sensor type: Semiconductor sensor

Hose nipple: 4 mm dia.

Plastic syringe: 20 ml

Silicone tube: 1 m



U11320



Measurement of absolute pressure as a function of volume



U11321

U11321

Relative Pressure Sensor, ±100 hPa

Sensor for the measurement of relative pressure, e.g. the hydrostatic pressure in a column of water or the pressure difference in a Wilke-type Stirling engine (U8440480). Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes silicone tube and connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±100 hPa
Accuracy:	± 1%
Sensor type:	Semiconductor
Hose nipple:	4 mm dia.
Silicone tube:	1 m

U11323

Relative Pressure Sensor, ±1000 hPa

Sensor for the measurement of relative pressure, e.g. the pressure difference in the transparent Stirling motor (U10050). Can be used in conjunction with 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes silicone tube and connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±1000 hPa
Accuracy:	± 1%
Sensor type:	Semiconductor
Hose nipple:	4 mm dia.
Silicone tube:	1 m



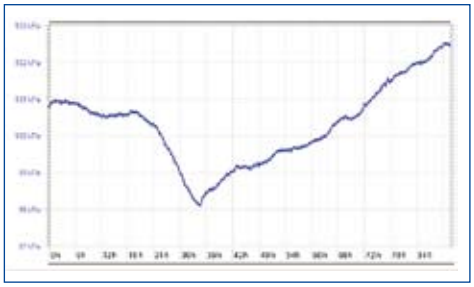
U11323



U11315



U11325



Changes in atmospheric pressure over three days

U11315

High Current Sensor, 10 A

Sensor for the measurement of high electric currents in DC and AC circuits using a shunt resistor. Capable of withstanding loads up to 20 A for short periods. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – ±10 A
Max. current loading:	±20 A for 15 s
Accuracy:	<1%
Sensor type:	Shunt resistor, 5 mΩ 2 W

U11325

Barometer

Sensor for the measurement of atmospheric pressure. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes silicone tube and connector lead with 8-pin miniDIN plugs.

Measurement range:	700 hPa – 1200 hPa
Resolution:	0.1 hPa
Accuracy:	1.5% of the maximum value of the measuring range
Sensor type:	Semiconductor sensor



U11336

U11336

Humidity Sensor

Sensor for the measurement of relative humidity (RH). Suitable for weather studies and for monitoring conditions in a greenhouse or terrarium. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	0 – 95% (non condensing)
Sensor type:	Capacitive sensor
Accuracy:	3% of RH plus 1% in the range from 0% – 95% 5% of RH plus 1% in the range from 0% – 5%
Resolution:	0.1%
Response time:	15 s



U11375

U11375

Electrometer Box

Impedance converter with high input resistance for the measurement of very small charges and currents. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Input resistance:	$\geq 10^{11}$ Ω
Measurement error:	≤ 1.5%
Connectors:	4 mm sockets



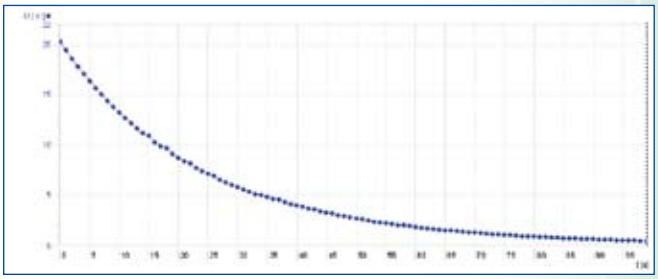
U11380

Basic Experiment Board

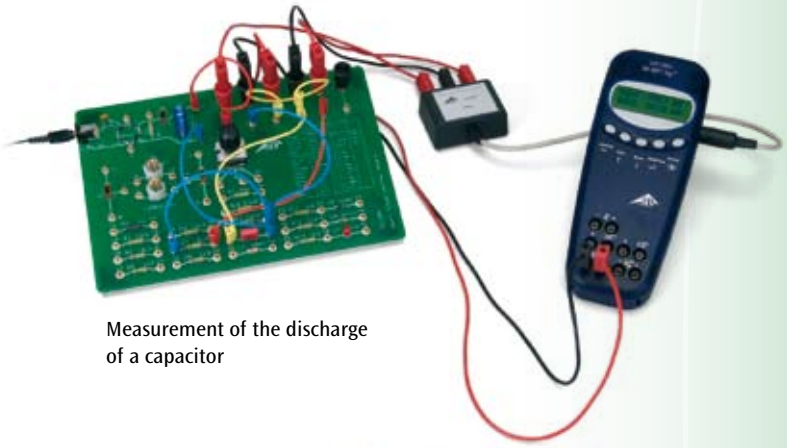
Experiment board with basic circuits for electricity and electronics: circuit components, Ohm's law, Kirchhoff's laws, rheostat and potentiometer circuits, two way switching, charging and discharging curves of a capacitor, inductive effects in DC and AC circuits. Simple semiconductor circuits for determining diode characteristics, rectifier circuits, filter factors.
The board contains:

13 0.5 W resistors ranging from 100 Ω – 100 kΩ
1 Potentiometer, 1 kΩ
3 Filament lamps, 12 V
2 Slide switches
5 Capacitors (2 x 1 µF, 1 x 100 µF [bipolar], 1 x 1000 µF)
5 1 A rectifier diodes
1 Zener diode
1 Red light emitting diode
1 Neon fluorescent light
1 Transformer, 12 V

The components can be interconnected via 2 mm sockets using jumpers and experiment leads.
Six 2 mm/4 mm safety socket adapters are provided for connecting 4 mm experiment leads.
Includes 10 jumpers and 10 leads (5 red and 5 blue) with 2 mm plugs, 20 cm long, plus 8 V AC/500 mA mains power supply.
Dimensions: approx. 233x160 mm²



Discharge curve of a capacitor



Measurement of the discharge of a capacitor

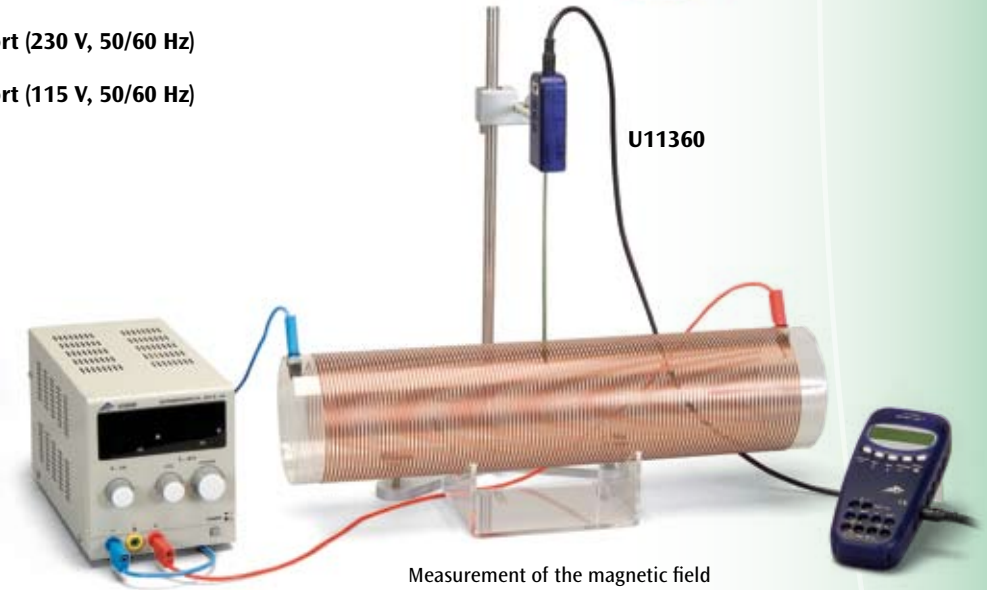
U11380-230

Basic Experiment Board (230 V, 50/60 Hz)

U11380-115

Basic Experiment Board (115 V, 50/60 Hz)

Additionally recommended:
U11310 3B NET*lab*™
U11300-230 3B NET*log*™ (230 V, 50/60 Hz)
or
U11300-115 3B NET*log*™ (115 V, 50/60 Hz)
or
U11300ip-230 3B NET*log*™ with Ethernet Port (230 V, 50/60 Hz)
or
U11300ip-115 3B NET*log*™ with Ethernet Port (115 V, 50/60 Hz)



U11360

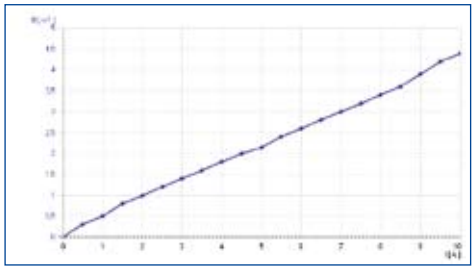
U11360

Magnetic Field Sensor

Sensor for the measurement of magnetic flux density in the tangential direction. Can be used in conjunction with 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer.
Includes connector lead with 8 pin miniDIN plugs.

Measurement ranges:	0 – ±2 mT, 0 – ±20 mT, 0 – ±100 mT
Resolution:	0.01 mT, 0.1 mT, 1 mT
Accuracy:	±1.5%
Sensor type:	Linearised Hall sensor

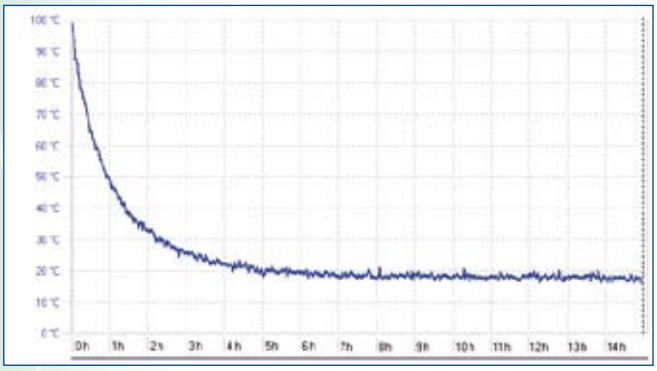
Measurement of the magnetic field around a current carrying coil



Magnetic field as a function of current



U11360



Fall in temperature as a function of time



U11330



Demonstration of Newton's law of cooling

U11330

Temperature Sensor, Pt100

Temperature sensor for the measurement of temperatures in organic liquids, solutions of salts, acids, and bases. The stem and tip of the temperature sensor are of stainless steel. Can be used in conjunction with 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	-50°C – 150°C
Resolution:	0.1° C
Accuracy:	0.1% of measured value plus 0.25°C
Sensor cable:	1 m, with silicone insulation
Sensor type:	Pt100 thermocouple



U11331

U11331

Temperature Sensor, TC – K

Temperature sensor for the measurement of extremely low and extremely high temperatures, for example in liquid nitrogen or liquid oxygen, or inside a flame. With room temperature compensation. The immersible NiCr-Ni sensors (U11854 und U11855) can also be connected to the sensor box. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	-270°C to 1370°C
Accuracy:	0.2% plus 3°C (-270°C – 0°C) 0.1% plus 2°C (0°C – 1370°C)
Resolution:	1°C
Sensor type:	NiCr-Ni (type K)
Sensor length:	60 cm approx.



U11391

U11391

Geiger-Müller Box

Connection box for operation of a Geiger-Müller counter tube to measure ionising radiation. The high voltage supply for the counter tube is generated inside the box. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Counter tube voltage:	500 V via 1 MΩresistor
Connector:	BNC socket



U11364

U11364

Light Sensor

Light sensor for the measurement of luminous intensity. Can be used in conjunction with a 3B NET*log*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement ranges:	0 – 600 lux, 0 – 6000 lux, 0 – 150,000 lux
Resolution:	0.8 lux, 8 lux, 200 lux

U11335

Conductivity Sensor

Sensor for measuring the specific electrical conductivity of liquid media, the total concentration of dissolved substances and the diffusion of ions through membranes, and for showing the difference in conductivity between ionic and molecular compounds and between strong and weak acids. The accessories supplied include a calibrating solution. Can be used in conjunction with a 3B NET*lab*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement ranges:	0 – 200 µS, 0 – 2 mS, 0 – 20 mS
Resolution:	1 µS, 10 µS, 100 µS
Sensor type:	measurement electrode using four wire technology, with graphite cells and integrated Pt100 temperature sensor
Accuracy:	5% without calibration, 0.5% with calibration
Sensor cable:	1.5 m



U11335

U11392

Human Pulse Sensor Box

Sensor for measuring frequency of the human pulse at an earlobe or fingertip using an infrared signal transmitter clip. Automatic adjustment of signal level. Designed to conform to the latest safety requirements. Can be used in conjunction with a 3B NET*lab*™ unit (U11300) for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	Pulse rates from 40 – 160 beats/min
Safety category:	Safety class II, classification BF



U11392

NEW

U11393

Skin Resistance Box

Sensor for measuring the resistance of a person's skin as influenced by external factors (stress, "lie detection"). Designed to conform to the latest safety requirements. Can be used in conjunction with a 3B NET*lab*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Input resistance:	>100 kΩ
Safety category:	Safety class II, classification BF



U11393

U11350

pH Sensor

Sensor for the measurement of pH values and redox potentials in aqueous solutions. Can be used in conjunction with a 3B NET*lab*™ unit (U11300) for manual measurements or for processing measurement data when connected to a computer. Includes connector lead with 8 pin miniDIN plugs.

Measurement range:	pH 0 – 14
Sensor type:	Ag-AgCl combination electrode, gel filled, not refillable
Accuracy:	pH 0.05 in range from 20°C – 25°C
Resolution:	pH 0.01
Response time:	≤ 1 s to reach 95% of final value

Additionally recommended:
U11351 Buffer Solution



U11350

U11351

Buffer Solution

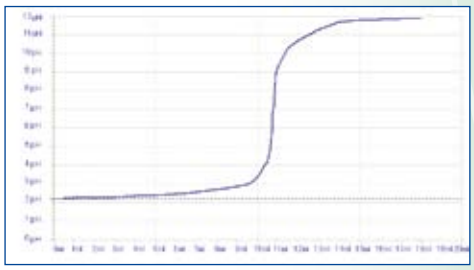
Set of buffer solutions in three flasks with pH values of 4.00, 7.00 and 9.00.

Volume: 250 ml each

Titration of acetic acid solution with sodium hydroxide solution



U11351



Determination of the pH value of an aqueous solution

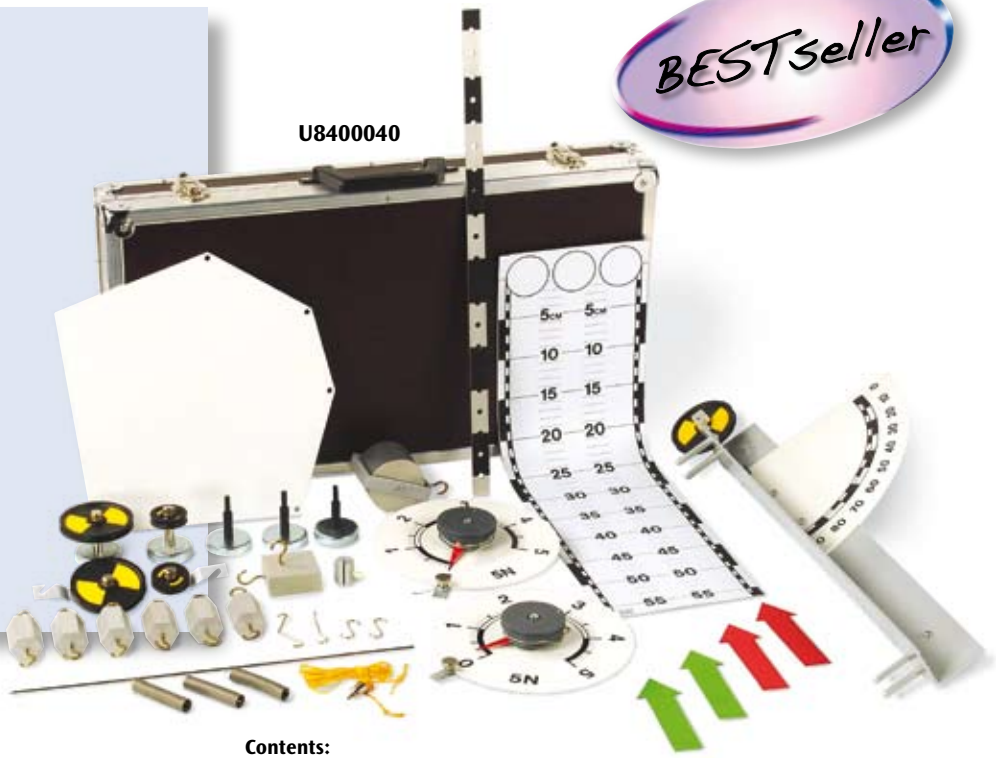
Mechanics on a Whiteboard

Experiment topics:

- Inclined plane
- Lever laws
- Torques and forces
- Forces acting on a lever arm
- Force as a vector
- Pendulum motion
- Physical pendulum
- Fixed and movable pulleys
- Block and tackle
- Hooke's law
- Coupled resonance
- Centre of gravity
- Friction

BESTseller

U8400040



U8400040

Mechanics Kit for Whiteboard

The mechanics kit for whiteboard demonstrations includes more than 25 large, coloured and easily distinguished components stored in a case with foam inlay. More than 30 experiments can be set up in rapid time.

- Large components ensure that experiments can be viewed from a distance.
- Secure attachment is guaranteed by high-grade AlNiCo magnets.
- Quick and easy configuration of experiments.
- Measuring units, vector diagrams and explanations can be provided right next to the experimental configuration on the blackboard.

Additionally required:

U10030 Whiteboard, 600 x 900 mm²

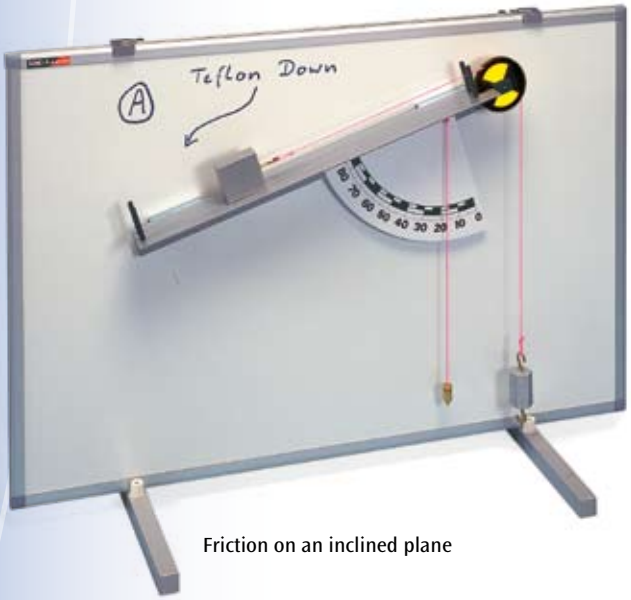
or

U10031 Whiteboard, 900 x 1200 mm²

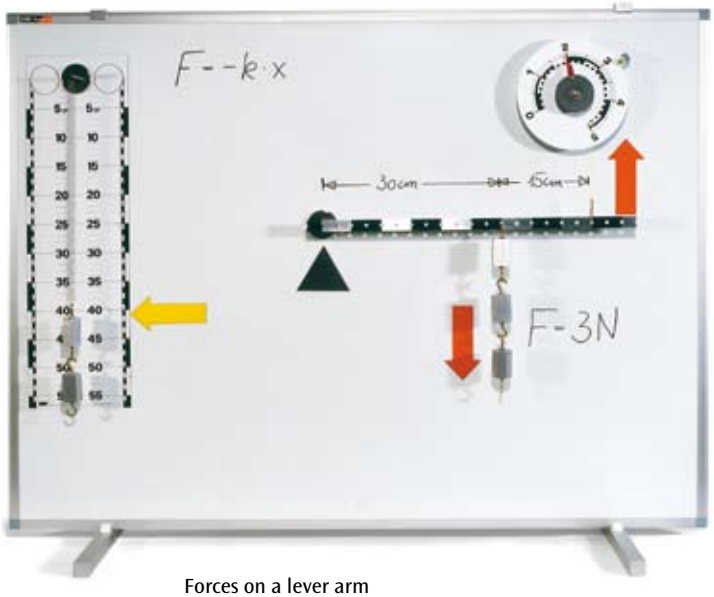
Contents:

1 Inclined plane with pulley and angle scale
1 Rolling mass, 500 g
1 Lever with 20 holes, 545 mm long
1 Pointer for lever, 400 mm long
1 Slotted counterweight with knurled screw, approx. 20 g
1 Pulley, double, 70 mm dia., 40 mm dia.
1 Pulley, 70 mm dia.
1 Pulley, 40 mm dia.
2 Round scale dynamometers, 5 N
3 Magnetic tabs with 8 mm axis
3 Springs with hook, k = 6.2 N/m
1 Dual scale on a magnetic foil, 600x180 mm²
4 Arrows and one equilateral triangle on a magnetic foil
6 Weights with 2 hooks, 100 g each
1 Friction block
1 Set of nylon cords
1 Centre-of-gravity plate
1 Plumb
1 Storage case
1 Manual

Note: A magnet attachment board or whiteboard (U10030 or U10031) is required.



Friction on an inclined plane

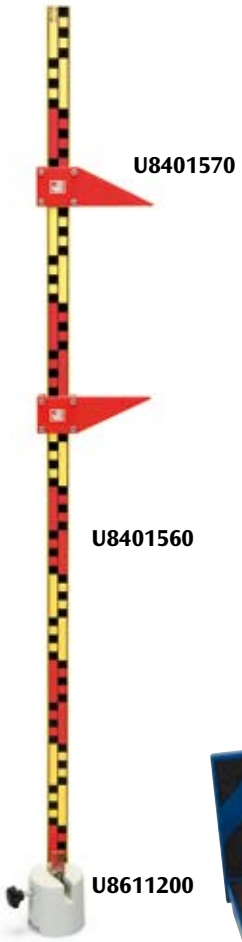


Forces on a lever arm

U8401560

Vertical Ruler, 1 m

Ruler with fastening pin (d = 12 mm) so th at it can be set up vertically in a stand base. Scale as per U8401550.



U8401570

U8401560

U8611200

U8401570

Set of Riders for Rulers

The set of riders consists of two red plastic pointers to match rulers U8401550 and U8401560 that can be used as movable cursors.

Dimensions: 120x40x20 mm^3



U15035

U15035

Vernier Model

For demonstrating Vernier readings on length measuring devices and protractors.

Length: 600 mm
Vernier length: 260 mm
Height: 190 mm

U10073

Pocket Measuring Tape, 2 m

Made of spring band steel, with locking button and rewinding spring.

Length: 2 m / 79 inch
Scales: cm, mm / 1/32 inch



U10073

U8401550

U8401550

Ruler, 1 m

Wooden ruler with mm scale on one side and two-coloured cm scale on the reverse.

Cross section: 25x8 mm^2

U10072

Digital Callipers, 150 mm

For measuring internal and external dimensions and depth. Tempered stainless steel, LCD display. Including locking screw, adjustment from cm to inch, zero-calibration in any position, with plastic pouch.

Measuring range: 150 mm / 6 inch
Graduation: 0,01 mm / 1/128 inch
Display: 5-digit LCD, 6 mm



U10071

U10072





U10070

U10070

External Micrometer

Precision micrometer with thimble and locking system. Measuring surfaces coated with hardened metal, polished with fine lapping. Tempered measuring spindle with polished thread, chromed micrometer arc with insulation, scale drum and sleeve in matt-chrome finish. In plastic pouch.

Measuring range: 0 – 25 mm
Graduation: 0,01 mm

U10071

Callipers, 150 mm

Precision callipers for measuring internal and external dimensions and depth. Tempered stainless steel, precision polished measuring surfaces, gauge with matt-chrome finish. In imitation leather pouch.

Measuring range: 150 mm / 6 inch
Graduation: 1/20 mm / 1/128 inch

U15030

Precision Sphereometer

For measuring plate thicknesses, depressions and radii of curvature of spherical surfaces, for example, lenses.

The device consists of a tripod with three steel tips which form an equilateral triangle. A micrometer screw with a measuring tip is recessed in the middle. Attached to the micrometer screw is a disc with circular divisions from 0 to 500 and a vertical scale with millimeter divisions from -10 to 15 mm at the tripod.

Measuring ranges: 0 – 25 mm and -10 – 15 mm
Screw pitch: 0,5 mm
Measuring accuracy: 0,001 mm
Support spacing: 50 mm

Additionally recommended:
U21885 Plane Mirror



U15030

Watch Glasses from U14200 and U14201

U11901

Mechanical Cumulative Stopwatch

Cumulative stopwatch with start, stop and reset buttons in shock-resistant plastic casing. Dual dial for minutes and seconds. With pendant cord.

Measuring range:	15 min
Scale accuracy:	1/10 s
Diameter:	55 mm

U11902

Digital Stopwatch

Stopwatch with 7-digit LCD display in robust plastic casing with start/stop and split/reset buttons for starting and stopping, cumulative, lap-time and dual-time measurement. Includes pendant cord.

Measuring range:	9 h, 59 min, 59 s, 99/100 s
Accuracy:	1/100 s
Battery:	watch battery 1.55 V, Type 389
Dimensions:	approx. 65x65x18 mm³



U11901



U11902



U16100

Timer

Stopwatch for counting up or down with acoustic alarm. Magnetic holder for attachment to metal surfaces and fold-away support legs.

Display:	4-stellige LCD, 18 mm
Timer range:	99 min 59 s
Ticking rate:	1 s
Dimensions:	ca. 60x60x20 mm³

U11900

Table-Top Stop-Clock

Large quartz-controlled stop-clock with start stop and reset buttons, cumulative time and lap-time settings (clock resets to zero and starts timing again immediately). 2 hands, dial with dual scale for minutes/ seconds and hundredths of a minute.

Measuring range:	60 min / 60 s
Graduations:	1 s / 1/100 min
Dial:	110 mm dia.
Dimensions:	approx. 175x130x95 mm³



U16100



U11900

Mechanical Stopwatches

Stopwatch in stainless steel casing with dual dial for minutes and seconds. In pouch with pendant cord.

Art. Nr.	Measuring range	Reading accuracy	Diameter
U40800	30 min	0.2 sec	45 mm
U40801	15 min	0.1 sec	45 mm



U40800



U40801

Digital Counter

We recommend the use of the digital counter (U8533341-230 or U8533341-115) along with one or two photo gates (U11365) for reliable measurement of the time a carriage on a track takes to cover a distance or when it obscures the light sensors. Also suitable for measuring oscillation periods of a swinging pendulum or similarly the times when it obscures the sensors.

U8533341-230

Digital Counter (230 V, 50/60 Hz)

or

U8533341-115

Digital Counter (115 V, 50/60 Hz)

U11365

Photo Gate



For measuring times when, e.g. a swinging pendulum obscures a sensor

Dynamometer, Colour Coded

Colour coded dynamometer for measuring weights or masses as well as forces. Scaled in newtons or grams and kilograms with zero-point calibration.

Art. Nr.	Colour	Measuring range
U40810	Blue	250 g / 2.5 N
U40811	Green	500 g / 5 N
U40812	Brown	1000 g / 10 N
U40813	Red	2000 g / 20 N
U40814	White	3000 g / 30 N
U40815	Yellow	5000 g / 50 N

U40810 - U40815





Dynamometer, Transparent

Dynamometer with easily read scale printed on a transparent plastic sleeve. Suitable for projection using a projector. With protection against over extension of the spring.

Precision: ±3% of total measuring range
Length: 185 mm
Scale length: 60 mm

Art. Nr.	Measuring range	Scale divisions
U11010	1 N	0.02 N
U11011	2 N	0.04 N
U11012	5 N	0.1 N
U11013	10 N	0.2 N

U11010 - U11013



Precision Dynamometer

Colour coded precision dynamometer in a transparent plastic casing with easy-to-read scale, protection against over extension of the spring and zero-point calibration capability.

Precision: < 1% of total measuring range
Scale division: 1% of total measuring range
Dimensions: 280 mm x 16 mm dia.

Art. Nr.	Colour	Range
U20030	Silver	0.1 N
U20031	Beige	0.2 N
U20032	Yellow	1 N
U20033	Red	2 N
U20034	Blue	5 N
U20035	Green	10 N
U20036	Violet	20 N
U20038	Brown	100 N

U20030 - U20038

U11020 - U11022



Dynamometer for Measuring Tension and Compression

Dynamometer for measuring tension and compression with easily read scale printed on a transparent plastic sleeve. Suitable for projection using a projector. With protection against over extension of the spring. Including compression rod for measuring compression plus pivoting holder for the rod.

Precision: ±3% of total measuring range
Length: 185 mm
Scale length: 60 mm

Art. Nr.	Measuring range	Scale division
U11020	1 N	0.02 N
U11021	2 N	0.04 N
U11022	5 N	0.1 N

Dynamometer with Round Dial

Spring dynamometer for experiment demonstrations. Grooved pulley on ball bearings and cord with hook. Large, easily read round dial. Zero-point calibration via knurled screw. With magnet for attachment to a whiteboard.

Diameter: 175 mm

Art. Nr.	Measuring range	Scale division
U8402440	1 N	0.02 N
U8402450	2 N	0.1 N
U8402460	5 N	0.1 N



U8402440 - U8402460

Sets of Slotted Weights on Weight Holder

Slotted brass weights and holder.

Art.-Nr.	Designation	Weights (incl. holder)	Holder dia.	
U30030	Set of slotted weights, 20-100 g	2 x 5 g, 1 x 10 g, 4 x 20 g	22 mm	
U30031	Set of slotted weights, 10 x 10 g	10 x 10 g	18 mm	
U30033	Set of slotted weights, 5 x 50 g	5 x 50 g	32 mm	
U30032	Set of slotted weights, 5 x 100 g	5 x 100 g	38 mm	

Set of 10 Weights
Brass weights with hooks on both sides so that they can be suspended from one another.

U8404710
Set of 10 Weights, 10 g

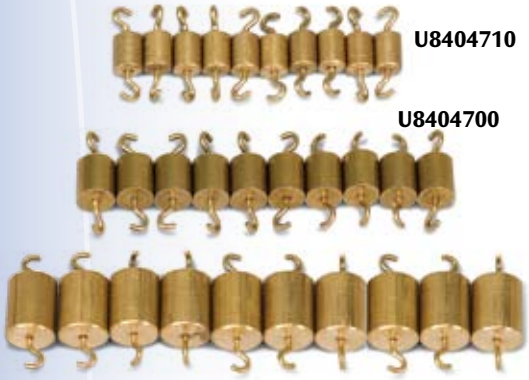
U8404700
Set of 10 Weights, 20 g

U8404720
Set of 10 Weights, 50 g

Set of slotted weights on holder, red and grey

Coloured slotted weights with holder for use in experiment demonstrations.

Art.-Nr.	Designation	Weights (incl. holder)	Holder dia.
U8404760	Set of slotted weights, 10 x 10 g, red and grey	10 x 10 g	25 mm
U8404770	Set of slotted weights, 10 x 50 g, red and grey	10 x 50 g	25 mm
U8404780	Set of slotted weights, 5 x 100 g, red and grey	5 x 100 g	25 mm





Slotted weights from U8404760, U8404770 and U8404780



U30016
Set of Weights 10 g to 1000 g
9-piece set of brass weights in storage box, each with hooks on both sides.
1 x 10 g, 2 x 20 g, 1 x 50 g, 1 x 100 g, 2 x 200 g, 1 x 500 g, 1 x 1000 g

U30014
Set of Weights, 1 g to 1000 g
13-piece set of brass weights in storage block.
1 x 1 g, 2 x 2 g, 1 x 5 g, 1 x 10 g, 2 x 20 g, 1 x 50 g, 1 x 100 g, 2 x 200 g, 1 x 500 g, 1 x 1000 g

U30012
Set of Weights 1 g to 50 g
8-piece set of brass weights, delivered in storage box.
1 x 1 g, 2 x 2 g, 1 x 5 g, 2 x 10 g, 1 x 20 g, 1 x 50 g

U8671420
Set of Weights 100 g to 2000 g
7-piece set of weights with hooks.
1 x 100 g, 2 x 200 g, 1 x 500 g, 2 x 1000 g, 1 x 2000 g

U30013
Set of Weights 1 g to 500 g
12-piece set of brass weights on convenient storage rack.
1 x 1 g, 2 x 2 g, 1 x 5 g, 1 x 10 g, 2 x 20 g, 1 x 50g, 1 x 100 g, 2 x 200 g, 1 x 500 g

U30017
Weight Holder, 50 g
Weight holder for weight set U30013.













U15015

Plumb with Line

Brass body with a line.

Height:	100 mm
Diameter:	20 mm
Weight:	220 g
Line length:	1600 mm



U15015





U15032

U15015



U15033

U10074

Universal Spirit Level, 250 mm

Spirit level made of shock resistant plastic for measuring angles to horizontal, vertical and inclined planes and for joinery. With two plexiglass level gauges, resistant to breakage and leakage. Horizontal gauge built-in and accurately calibrated. Gauge for measuring inclination can be rotated and fixed in place. Scale markings for 45°, 60° and 120°, mm scale on measuring surface, protractor scale for inclination gauge.

Scales:	250 mm/1 mm, -90° – +90°/2°
Dimensions:	250x54x15 mm^3

U15033

Stability Apparatus

For demonstrating the stability of an object as a function of the position of its centre of gravity above the supporting surface. The position of the centre of gravity can be adjusted by tilting the device. The position of the centre of gravity over the base of the stand is indicated by a built-in plumb bob.

Dimensions:	180x150x290 mm^3

U15014

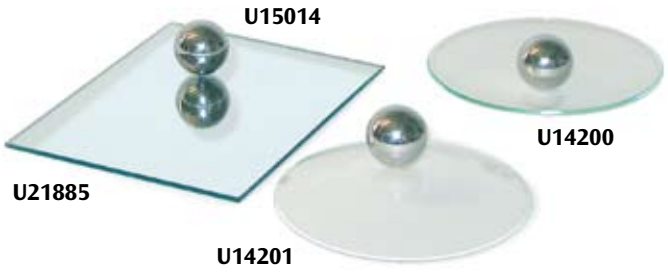
Set of 6 Steel Balls

Ball bearings made of hardened and polished steel. Can be used with watch glasses to demonstrate various states of equilibrium.

Diameter:	30 mm each
Weight:	130 g each

Additionally recommended:

U14200 Set of 10 Watch Glass Dishes, 80 mm
U14201 Set of 10 Watch Glass Dishes, 125 mm
U21885 Plane Mirror



U15014

U14200

U21885

U14201

U15032

Centre-of-Gravity Plate

Plastic plate with 6 boreholes for introducing the concept of centre of gravity and determining centroids.

Additionally required:

U15015 Plumb with Line



U15028

U15027

U8405820

U11026

U8401010

U11025

U8405840

U11027

Helical Springs

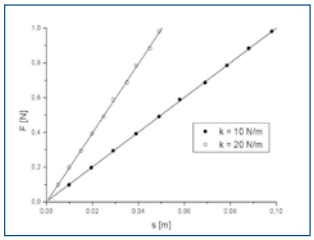
For experiments on expansion and oscillation, with two suspension eyelets.

Art. Nr.	Spring constant	Maximum loading capacity	Length	Diameter
U8405840	1.5 N/m	0.75 N	120 mm	20 mm
U8405820	2.5 N/m	0.75 N	120 mm	16 mm
U15027	3 N/m	1.5 N	80 mm	32 mm
U8401010	5 N/m	2 N	60 mm	20 mm
U11025	6 N/m	2.5 N	115 mm	6 mm
U11026	20 N/m	6.5 N	110 mm	9 mm
U15028	20 N/m	8.0 N	180 mm	9 mm
U11027	100 N/m	13.5 N	95 mm	10 mm

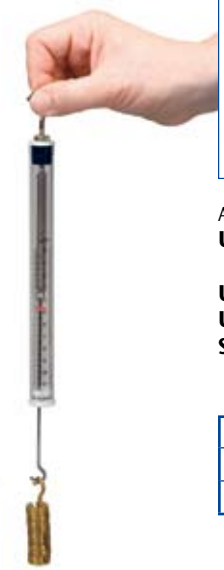
U20037

Dynamometers for Demonstrating Hooke's Law

Two colour coded dynamometers in transparent plastic sleeve with easy-to-read cm/mm scale for demonstrating Hooke's law and calculating the spring constant. Protection against over extension of the spring and zero-point calibration.
Spring constants: 10 N/m and 20 N/m
Length of scale: 115 mm
Dimensions: 280 mm x 16 mm Ø



Additionally required:
U30030 Set of Slotted Weights 10 g



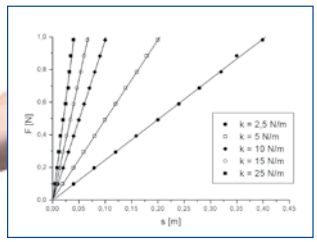


U20037

U40816

Set of Helical Springs for Hooke's Law

5 helical springs with a hook and an attached pointer for determining spring constants



Additionally required:
U8404760 Set of Slotted Weights 10 x 10 g, Red and Grey
U8401560 Vertical Ruler
U8401570 Set of Riders for Rulers
Stand Equipment



U40816

Spring constant	2.5 N/m	5 N/m	10 N/m	15 N/m	25 N/m
Length	122 mm	145 mm	150 mm	147 mm	142 mm
Diameter	15 mm	15 mm	19 mm	20 mm	20 mm

U52004

Force Table

Equipment for quantitative investigation of the combination and resolution of forces, consisting of a circular workplate on a stable base with dual protractor scale. Weights from set of three weight holders with slotted weights U30019 (included), are suspended from 3 cords strung over pulleys with ball bearings.
Dimensions: approx. 300 mm x 390 mm Ø
Weight: approx. 3,1 kg

Additionally recommended:
U52011 Extra Pulley

U8405100

Friction Measuring Apparatus

Demonstration apparatus with movable friction surface for measuring static and dynamic friction between two surfaces as a function of area, force between the surfaces or the combination of materials. For easy measurement of dynamic friction, the movable surface is moved at constant speed under a static body connected to a dynamometer. The friction track can be inclined along its length in order to vary the force between the two surfaces.
Dimensions: approx. 600x140x150 mm³
Weight: 3 kg

Contents:
Basic apparatus with movable friction surface, 2 N dynamometer, three different static bodies, three rails for holding static bodies, three 100 g weights.

U8405100



U52011

Extra Pulley

Additional pulley for use with the apparatus for resolution of forces U52004 with clamp, cord and holder with set of slotted weights.
2 x 5 g, 2 x 10 g, 2 x 20 g and 3 x 50 g.



U52011

U52004

U15026

Wooden Blocks for Friction Experiments

Two wooden blocks with plastic coated surfaces and hook for attaching a dynamometer.
Dimensions: approx. 120x60x60 mm³ and 120x60x30 mm³

Additionally recommended:
U11020 Dynamometer, 1 N
U11021 Dynamometer, 2 N
U11022 Dynamometer, 10 N
U30014 Set of Weights, 1 g to 1000 g



U15026

U30019

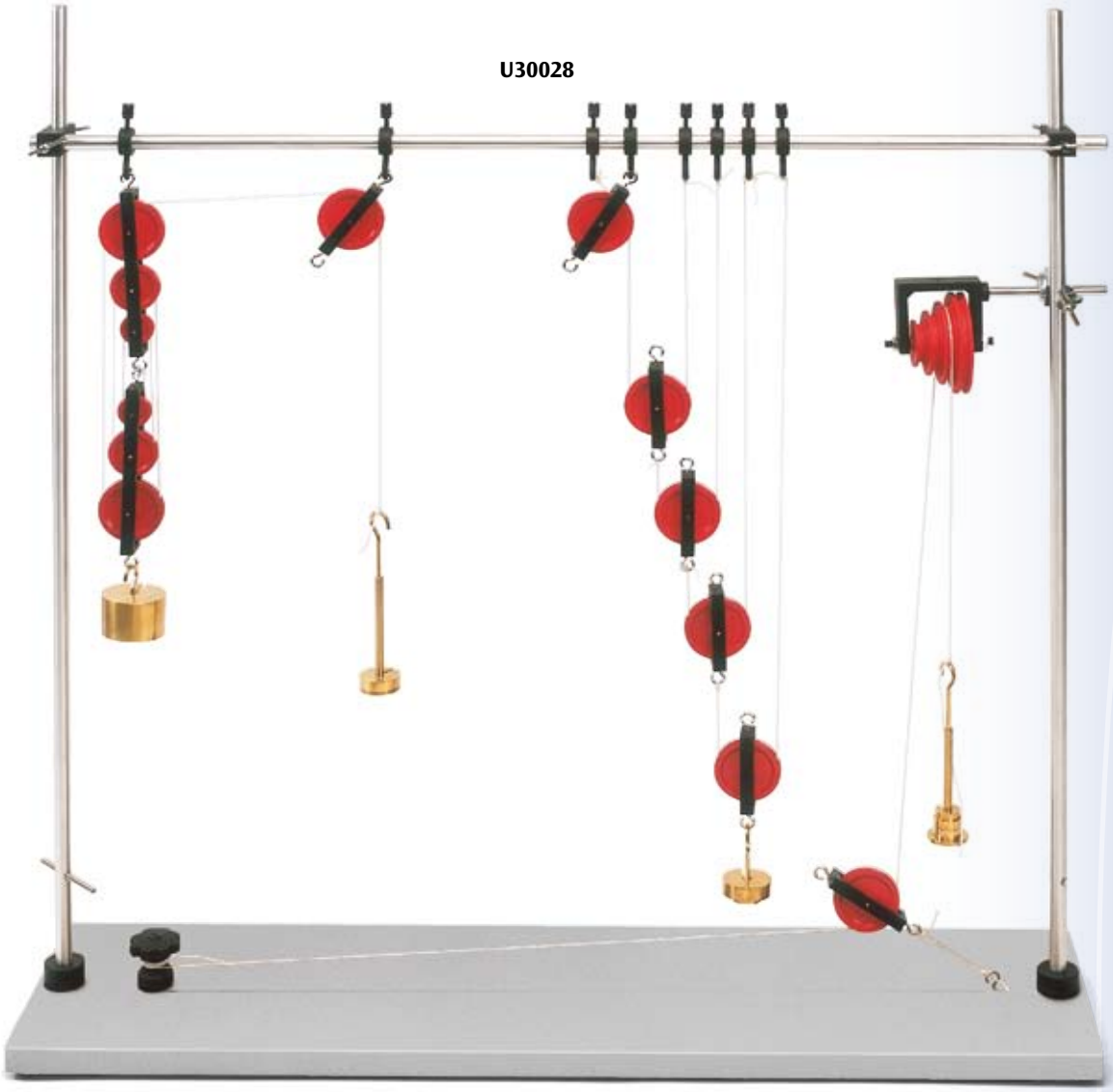
Set of Three Weight Holders with Slotted Weights

Slotted brass weights on holder comprising 3 sets with 2x 5 g, 2x 10 g, 2x 20 g, 3x 50 g.



U30019

U30028





U30028

Pulleys and Block and Tackle Experiment Set

For demonstrating how forces can be altered in direction and distributed over an area by simple machines (fixed and movable pulleys, block and tackle) and introducing the concepts of mechanical work, power and energy.

Complete set of equipment consisting of a stable base plate, retort stand rods, pulley blocks, block and tackle, a set of pulleys of various diameters on an axle, weight holders, slotted weights and a reel of cord. All the experiments can be set up quickly and easily since the closed plastic frame around the pulleys prevents the cord from slipping.

Base plate:	810x200 mm^2
Pulleys:	50 mm dia.
Stand rods:	810 mm x 12,5 mm dia.
Slotted weights:	2 x 10 g, 2 x 20 g, 2 x 50 g, 4 x 100 g, 4 x 200 g, 1 x 500 g
Holders:	1 x 10 g, 1 x 20 g, 5 x 50 g

Contents:

1 Base plate
3 Stand rods
2 Plastic clamps
1 Universal sleeve
8 Hooks
7 Pulley blocks with 1 pulley
2 Pulley blocks with 4 pulleys
2 Tandem pulley block with 3 pulleys
1 Wheel on axle
15 Slotted weights
7 Weight holders
1 Reel of cord

Additionally recommended:

U10073 Measuring Tape, 2 m
U11012 Dynamometer 5 N
U40801 Mechanical Stopwatch, 15 min

U8724980

Cord for Experiments

Red and white plaited hemp string on a bobbin. For a variety of uses, e.g. setting up block and tackle using pulleys U30020 to U30027 or making a pendulum with bobs U30035.

Length:	100 m
Diameter:	1 mm
Maximum tension:	50 N

U8724980



U30029

Wheel on Axle

For investigating moments of inertia and torque. Set of aluminum pulleys with four pulleys of different diameter mounted on cone bearings with cord grooves.

Pulley diameters: 20 mm, 40 mm, 80 mm, 120 mm



U30029



U30025

U30025

Pulley with Table Clamp

Pulley for altering the direction of forces. Plastic pulley with ball bearings and cord groove plus securing clamp. Also has a bore so that it can be attached to a retort stand of up to 12.5 mm diameter

Pulley: 50 mm dia.

Span of bracket: up to 35 mm span

Pulleys and Block and Tackle

For experiments with fixed and movable pulleys. Non-deformable, low-friction pulleys with cord grooves and hooks at the ends of both axles for suspending from fixed supports or other pulleys. The enclosed design of the plastic frame prevents the cord from slipping off the pulley.



U30020

U30021



U30027

U30026

Art.-Nr.	Designation	Pulleys	Diameter	Material
U30020	Pulley block	1	50 mm	synthetics
U30021	Pulley block	2	50 mm	synthetics
U30026	Tandem pulley	2	37/50 mm	aluminium
U30027	Tandem pulley	3	25/37/50 mm	aluminium

U30015

Inclined Plane

Equipment for investigating forces acting on a body on an inclined plane, and determining the holding friction as a function of the angle of inclination. Metal base and inclined plane. The plane is hinged with scales for angle, length and height. Angle of inclination can be adjusted between 0 and 45°. Includes adjustable pulley, roller, weight pan and cord.

Length of inclined plane: 600 mm

Length of base: 450 mm

Scales: divided into cm or degrees

Additionally recommended:

U11013 Dynamometer, 10 N

U30014 Set of Weights 1 g to 1000 g



U30015



U52001

Lever

Complete set of equipment for demonstrating laws of leverage and for experiments on equilibrium. Consists of a retort stand to which is attached a lever mounted on ball bearings with three rows of holes for adjusting the axis of rotation or for suspending weights, red and white block scale with pointer for accurate display of equilibrium state. Can also be used to model balance scales.

Includes set of weights 10 x 50 g.

Length of lever: 1 m

Mass of lever: 0.458 kg

Number of holes: 21

Separation of holes: 50 mm

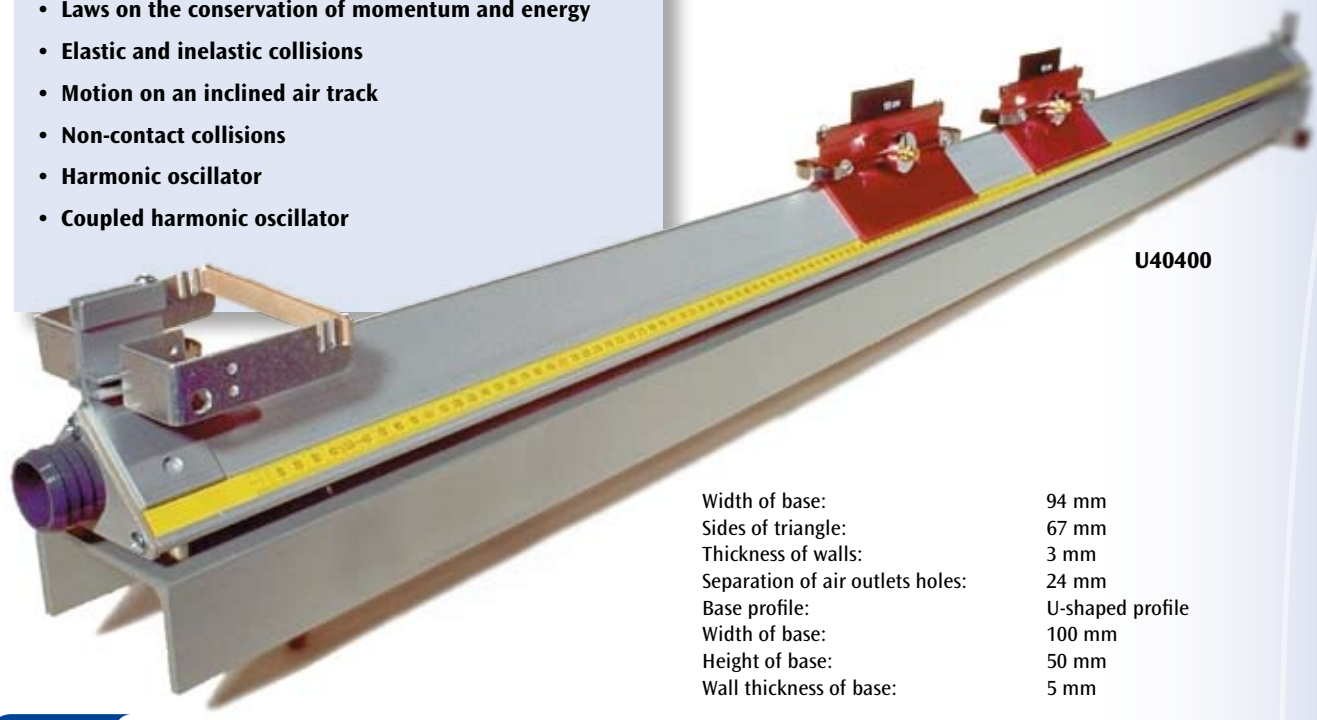


U52001

Experiment topics:

- **Regular movements and movements with uniform acceleration**
- **Newton's equations of motion**
- **Laws on the conservation of momentum and energy**
- **Elastic and inelastic collisions**
- **Motion on an inclined air track**
- **Non-contact collisions**
- **Harmonic oscillator**
- **Coupled harmonic oscillator**

Material:	Anodised aluminium
Total length:	2.07 m
Working length:	1.90 m
Maximum deviation from straight line over complete length:	0.04 mm
Track profile:	Equilateral triangle



U40400

Width of base:	94 mm
Sides of triangle:	67 mm
Thickness of walls:	3 mm
Separation of air outlets holes:	24 mm
Base profile:	U-shaped profile
Width of base:	100 mm
Height of base:	50 mm
Wall thickness of base:	5 mm

U40400

Air Track on U-shaped Base Profile, 1.9 m

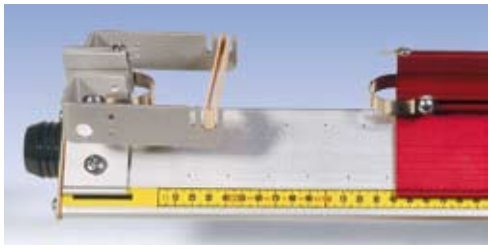
Track with triangular profile and riders for investigating frictionless linear motion. The air is blown in from the front and escapes through small air outlets arranged in 2 rows along the track. This allows for practically frictionless movement of the riders on the triangular track with no tilting. A millimetre rule is set into a groove on one side. Mounted on a robust U-shaped base resting on three feet that can be adjusted to ensure horizontal alignment.

Contents:

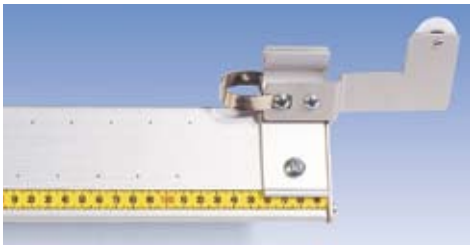
1 Air track on U-shaped base profile resting on three feet
2 Gliders 300 g (red) with additional 50 g weights, spring buffers for elastic collisions and velcro strip for inelastic collisions
3 Helical springs, 50 mm, 1.7 N/m
2 Velocity flags, 10 cm
2 Magnets for contactless impact
1 Manual for the air track

Note:

Air tracks of differing lengths are available on request.



Left-hand end of track with air inlet nozzles and launch mechanism for riders



Right-hand end of track with buffers and pulley

Additionally required:
U15425-230 Air Flow Generator (230 V, 50/60 Hz)
or
U15425-115 Air Flow Generator (115 V, 50/60 Hz)

Air Flow Generator

Fan allowing continuous adjustment of air flow. Includes a hose.

Hose length:	approx. 1.5 m
Power consumption:	max. 1100 W
Dimensions:	300x180x170 mm³
Weight:	4.4 kg

U15425-230

Air Flow Generator (230 V, 50/60 Hz)

U15425-115

Air Flow Generator (115 V, 50/60 Hz)



U15425

U40405

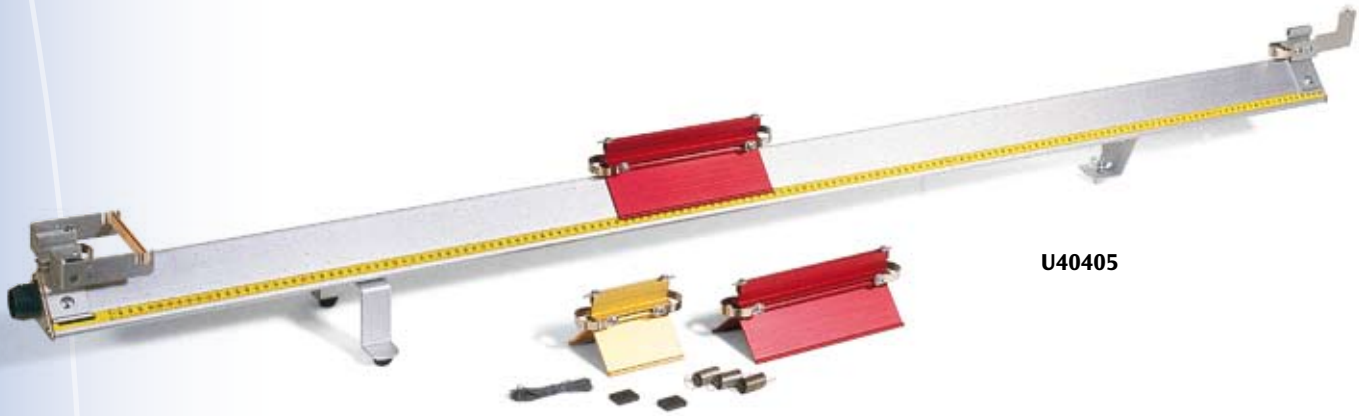
Air Track, 1.6 m

Track with triangular profile and riders for investigating frictionless linear motion. As U40400 with three feet that can be adjusted to ensure horizontal alignment.

Total length: 1.67 m
Operating range: 1.50 m

Contents:

1 Air track with a three-point base and adjustment screw
1 Glider 150 g (gold) with spring buffers
2 Glider 300 g (red) with spring buffers
3 Helical springs, 25 mm, 3.3 N/m
2 Magnets for contactless collisions
1 English operating manual for the air track



U40405

Accessories:

Art. Nr.	Designation	Uses
U40420	Glider 150 g (gold)	
U40421	Glider 300 g (red)	
U40422	Glider 450 g (blue)	
U40423	Air Cushion Deflector	Frictionless deflection of accelerated masses
U40424	Set of 20 Bumper Springs	Investigation of elastic collisions
U40425	Set of 20 Soft Bumper Springs	Investigation of the collision process
U40426	Set of 4 Velocity Flags	Trip flags made of aluminium in widths 5 cm, 10 cm, 20 cm and 30 cm
U40427	Set of Magnets	Investigation of collisions with no actual contact
U40431	Inelastic-Collision Accessories	2 Pairs of spring buffers with velcro surface for investigating inelastic collisions
U40511	Set of 4 Riser Blocks	Aluminium base block in heights 3 mm, 6 mm, 13 mm and 26 mm



U40445



U15014

U40445

Coupled Harmonic Oscillator

Equipment set consisting of 5 150 g riders, 6 coupling springs and 5 damping magnets for modelling molecular oscillations using air tracks U40400 or U40405

Length of springs: 75 mm
Magnets: Ceramic magnets

U15014

Set of 6 Steel Balls

Ball bearings made of hardened and polished steel. Can be used with a guide rail for experiments on elastic collisions. Rail not included.

Diameter: 30 mm each
Weight: 110 g each





Plotting Movements in a Plane Using Powder Tracing

A plotting electrode slides over a plane counter electrode that is insulated and covered in powdered sulphur. An AC voltage across the two electrodes results in the sulphur powder being attracted or repelled depending on the polarity of the plotting electrode. A trace thus appears in the powder with ridges that are formed at constant intervals of time. The distance between the ridges reflects the speed of the plotting electrode.



U8405630

U8405630

Pair of Elastic Balls with Plotting Electrode

Pair of balls with identical mass and sliding plotter electrode for experiments on elastic collisions that can be demonstrated by means of powder tracing. Made of red plastic with metal ball chain.

Diameter:	70 mm each
Weight:	300 g each

Also required:
U8400870 Equipment Set for Powder Tracing



U8405640

U8405640

Pendulum with Plotting Electrode

Cylindrical pendulum bob with sliding plotter electrode for experiments to confirm Kepler's law governing areas covered by a body subject to a central force that can be demonstrated by means of powder tracing.
Steel, with metal ball chain.

Dimensions:	60 mm x 40 mm Ø
Weight:	500 g

Also required:
U8400870 Equipment Set for Powder Tracing





U8400870

U8400870

Equipment Set for Powder Tracing

Set consisting of an insulated plate with 4-mm connector socket, a pulse generator and a transformer with two 4-mm plugs for its secondary winding, 35 g of powdered sulphur and a flat brush.

Transformer:	Safety isolating transformer, short-circuit proof
Output voltage:	115 V – 230 V, safe to touch
Protective resistance:	1 MΩ
Plate dimensions:	390x270 mm²

Experiment topics:

- Newton's equations of motion
- Conservation of momentum and energy
- Elastic and inelastic collisions between equal and different masses
- Harmonic motion and coupled harmonic motion
- Trajectories
- Magnetic repulsion

Air-Cushion Table

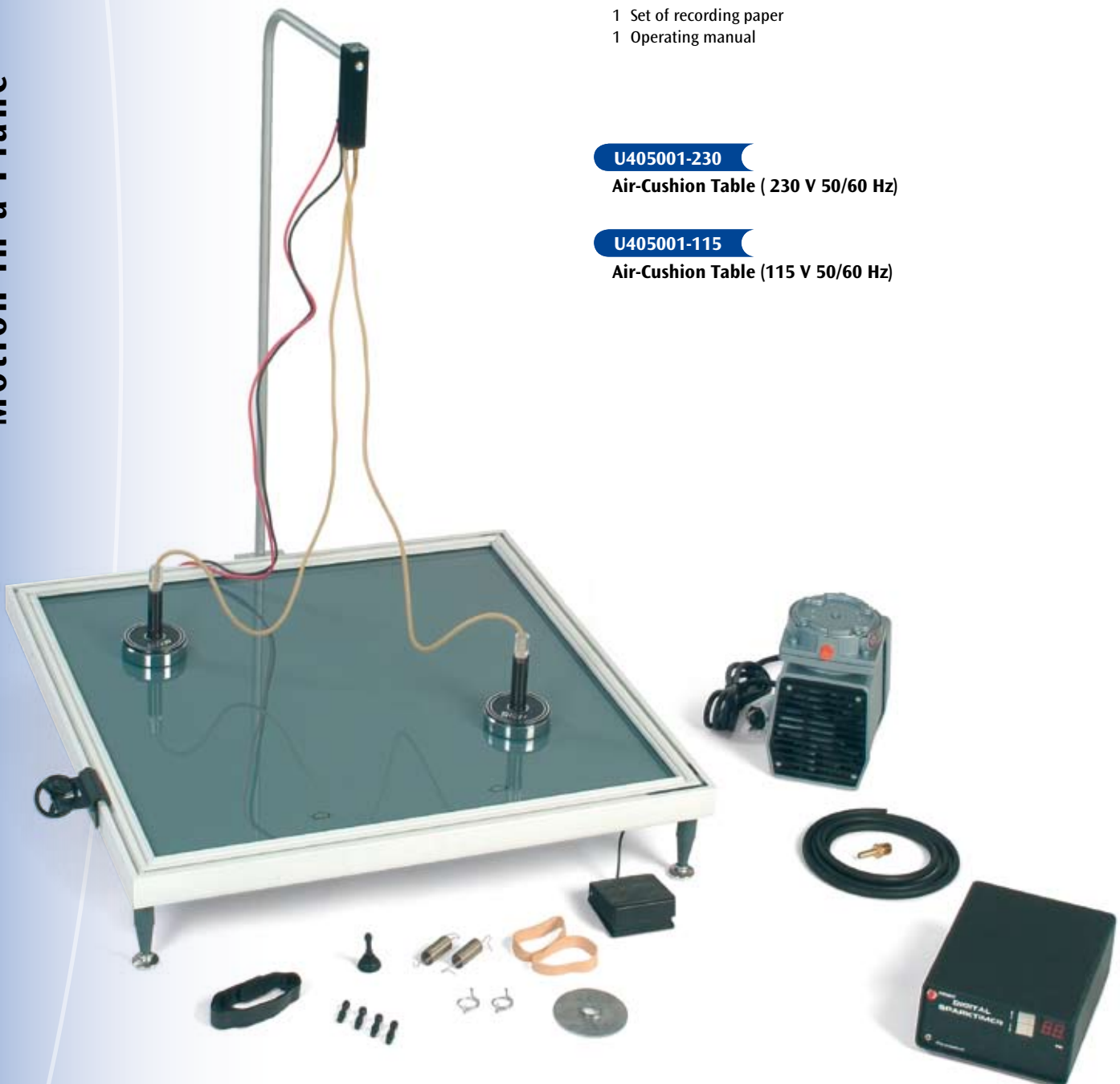
The air-cushion table possesses a flat glass surface serving as a base for recording paper and carbon paper. Compressed air is supplied to the pucks via light hoses. The air emerges from the bottom of the pucks, making them hover over the recording paper. The motion of the pucks is traced by means of spark recording. The air hoses contain thin metal chains via which a connection to the spark generator is established. The sparks jump over from a contact in the center of the puck, leaving marks on the recording paper.
As the pucks weigh 550 grams, their motion is not affected by the hoses or the attached spark wire.

Contents:

1 Experiment table with a glass surface, 580x580 mm²
1 Spark generator with a footswitch
1 Compressor with a hose
2 Steel pucks, 75 mm dia., 550 g
2 Puck collars with velcro fastener
2 Springs
1 Auxiliary puck weight, 150 g
1 Edge pulley, 45 mm dia.
1 Centre rod with sucker
1 Set of recording paper
1 Operating manual

U405001-230
Air-Cushion Table (230 V 50/60 Hz)

U405001-115
Air-Cushion Table (115 V 50/60 Hz)





U40513 U40514



U40515

U40513

Acrylic Puck

Acrylic puck for air-cushion table, for use as a second very light puck to demonstrate collisions between unequal masses.
A steel puck is hardly deflected at all on collision with an acrylic puck.

Diameter: 75 mm
Weight: 90 g

U40514

Aluminum Puck

Aluminum puck for air-cushion table, for use as a second very light puck to demonstrate collisions between unequal masses.

Diameter: 75 mm
Weight: 210 g

U40515

Pair of Magnetic Pucks

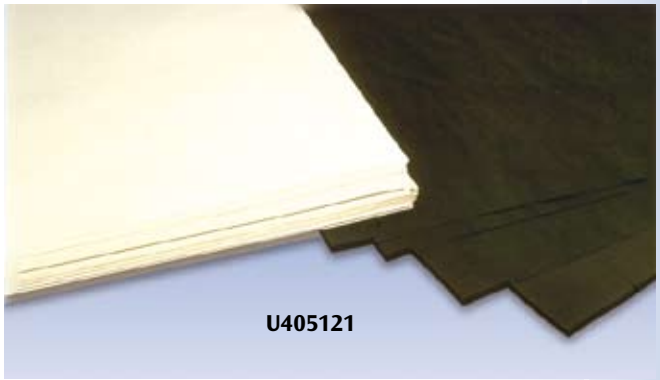
A pair of pucks with extremely powerful magnets positioned such that the pucks repel each other. Intended for performing contactless collisions on the air-cushion table.

U405121

Set of Plotter Paper

100 sheets of printer paper and 1 sheet of special carbon paper for making pen plots in conjunction with an air-cushion table.

Dimensions: 560x560 mm²



U405121

U40510

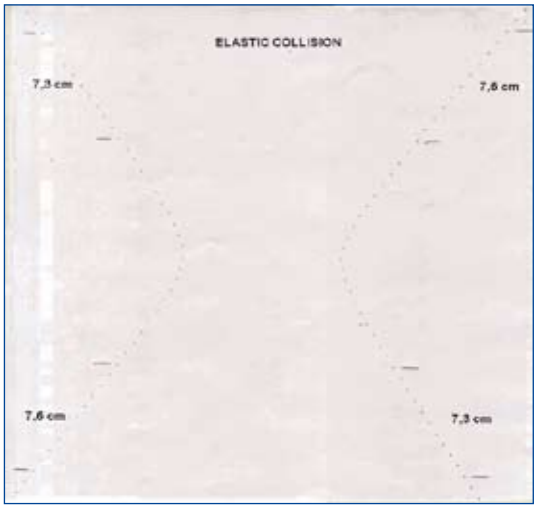
Paper Guide

Long acrylic rod with an internal spring which can be clamped between the inner edges of the air-cushion table. Intended to guide pucks for the purpose of recording harmonic oscillations.

Length: 590 mm

U40510





Elastic collision



Measuring acceleration due to gravity



U8400930

NEW

U8400930

Launcher S

Experimental apparatus for studying vertical and horizontal trajectories as well as trajectories starting at intermediate angles. Also demonstrates the independence of the horizontal and vertical components of motion (for projectiles). Including stand rod and bench clamp

Provides for three different launch velocities. Angle of launch can be adjusted to any arbitrary angle and read off from a protractor scale with a plumb line. The projectile ball is held in place by a magnet until the moment of launch so that the height of the trajectory is independent of the launch angle. When a projectile is launched, a second ball can be released simultaneously from the other side of the launcher that then descends in free fall. The latter should strike the floor at the same time as the projectile if the launch angle is horizontal.

Launch angle:	0° – 90°
Maximum range:	3 m
Projectile diameter:	16 mm
Projectile weight:	22 g
Diameter :	280 x 90 x 90 mm³ approx.
Total weight:	1.5 kg approx.

Experiment topics:

- **Vertical, angled and horizontal launch**
- **Recording of the trajectory with an angled launch**
- **Determination of range and height from the projection angle**
- **Determination of launch speed from the range and height**
- **Determination of launch speed using a ballistic pendulum**
- **Elastic and inelastic collisions**

U10360

Projectile Launcher

Experimental equipment for the quantitative investigation of projectile laws: vertical horizontal and angled launch, recording of flight trajectories depending on launch angle and projectile range. Three different reproducible launch speeds, continuously adjustable launch angles, constant height of trajectory at various angles since the launch point is coincident with pivot point of the cannon. Projectile is launched with almost no spin. With threaded holes on the bottom for attaching a photocell light barrier. The encapsulated design and the use of spherical plastic projectiles ensure that experiments are safe.

The launcher is attached to a table via clamp U10361 or can be used in conjunction with ballistic pendulum U10362.

Horizontal projectile range (Launch angle 45°):	1.1 m, 2.3 m and 4.5 m
Launch angle:	0° – 90°
Reproducibility at 45°:	standard deviation less than1%
Standard deviation of launch ranges:	< 1%
Diameter of projectiles:	25 mm
Mass of projectiles:	7 g
Dimensions:	205x65x60 mm³ approx.
Mass:	480 g approx.

Contents:

1 Launcher
3 Plastic projectile balls
1 Ramrod
1 Wing nut M8x20

Additionally required:

U10361 Clamp for Projectile Launcher
or
U10362 Ballistic Pendulum
Protective Goggles

BESTseller

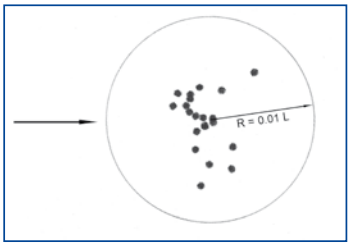
U10360



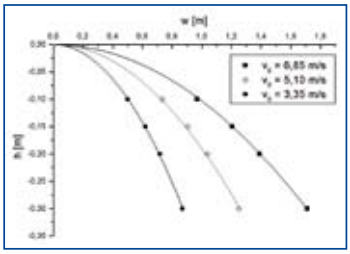
U10361



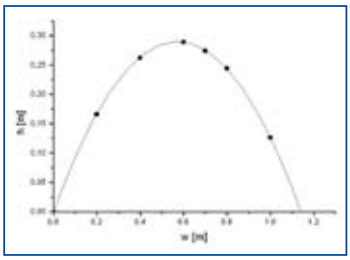
Projectile launcher located on the back of the ballistic pendulum



Typical results for measurement of 20 shots. L=range.



Horizontal launch: projectile height as a function of the projectile distance



Oblique launch: projectile height as a function of the projectile distance (launch angle: 45°)

U10361

Clamp for Projectile Launcher

Table clamp for Projectile Launcher (U10360) made of anodized aluminum.

Span:	10 mm – 65 mm
Dimensions:	approx. 150x70x80 mm³
Mass:	approx. 710 g

U10362

Ballistic Pendulum

Accessories for the (U10360) launcher for use in experiments on elastic and inelastic collision or to be used as a holder for experiments on trajectory. The speed of the balls as measured in launcher experiments or pendulum experiments agree to within approximately ±3%. Additional weights can be used to investigate how pendulums behave with differing angles of deflection at the same speed. For experiments investigating trajectories, the launcher can be set to 5 different launch heights 5, 10, 15, 20 and 30 cm when it is attached to the rear of the ballistic pendulum.

Height of pendulum:	370 mm
Extra weights:	17.5 g each
Base plate:	130x130 mm²
Span of bench clamp:	10 – 65 mm
Mass:	2.1 kg

Contents:

1 Ballistic pendulum with table clamp
2 Extra weights

Additionally required:

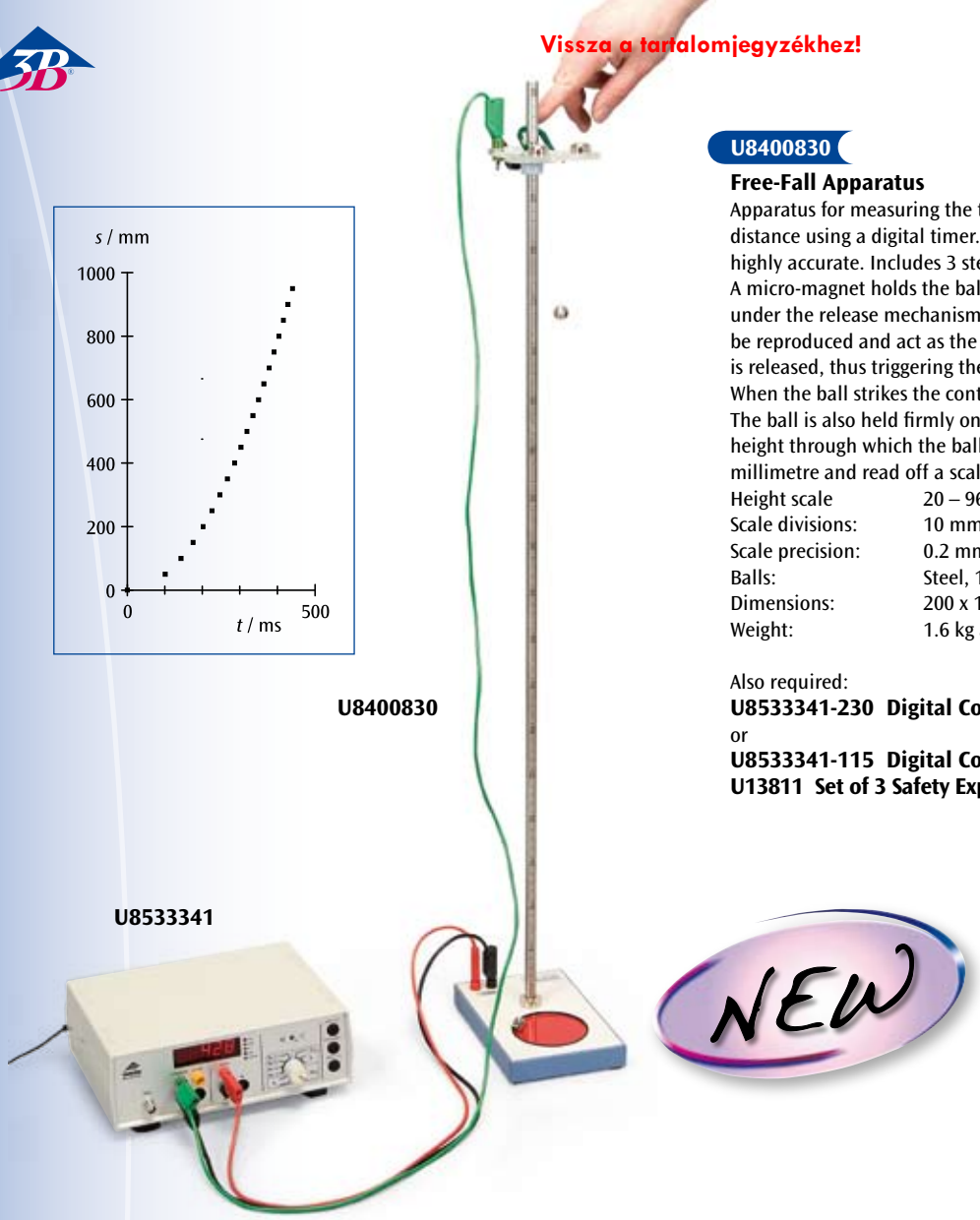
U10360 Projectile Launcher



U10362

U10360

Vissza a tartalomjegyzékhez!



U8400830

U8533341

NEW

U8400830

Free-Fall Apparatus

Apparatus for measuring the time it takes for a ball to fall a certain distance using a digital timer. Very easy to set up and use but nevertheless highly accurate. Includes 3 steel balls.
A micro-magnet holds the ball in its start position. Three contact pins under the release mechanism ensure that the start position of the ball can be reproduced and act as the contacts of a switch that opens when the ball is released, thus triggering the beginning of the timing measurement.
When the ball strikes the contact plate at the bottom, the timer is stopped. The ball is also held firmly on the plate so that it does not bounce. The height through which the ball drops can be adjusted to a fraction of a millimetre and read off a scale on the column.

Height scale	20 – 960 mm
Scale divisions:	10 mm
Scale precision:	0.2 mm
Balls:	Steel, 16 mm dia.
Dimensions:	200 x 130 x 1000 mm³ approx.
Weight:	1.6 kg approx.

Also required:
U8533341-230 Digital Counter (230 V, 50/60 Hz)
or
U8533341-115 Digital Counter (115 V, 50/60 Hz)
U13811 Set of 3 Safety Experiment Leads for Free-Fall Experiments

U40550

Atwood's Machine

Experiment for studying motion under constant acceleration, demonstrating Newton's second law and determining the acceleration due to gravity g. Includes an aluminium stand for affixing to a wall. A string with weights at both ends is passed over a rotating pulley. The set-up undergoes relatively slow but constant acceleration if the weights are slightly different. This motion is initiated by a tug on one string and stops when the dropping weight strikes a movable platform. To show the rotation of the pulley, it is divided into 20 segments of equal angle. It can easily be removed to measure its moment of inertia.

Axis:	Mounted on ball bearing
Diameter of pulley:	152 mm
Thickness of pulley:	10 mm
Weights:	150 g each
Slotted weights:	1 x 5 g, 2 x 2 g, 1 x 1 g each

Additionally recommended:
U40801 Mechanical Stopwatch, 15 min



U11983

Drop and Launch Apparatus

Equipment for demonstrating the independence of the horizontal and vertical components of motion (for projectiles).
A launching rail with returning spring is mounted on a wooden base. Two steel balls are used as test bodies. Upon triggering, one ball starts to fall downwards and simultaneously the other is launched horizontally. Both balls hit the ground at the same time. Two holes in the base plate are provided for storing the balls.

Ball diameter:	15 mm
Dimensions:	200x120x40 mm³ approx.
Mass:	1 kg approx.



U11983

Experiment topics:

- **Rotational motion: uniform and under constant acceleration**
- **Newton's equations of motion for rotational motion**
- **Moment of inertia and torque**
- **Moment of inertia as determined by experiment**
- **Simple harmonic motion of rotating objects**

U8405680-230

Rotating System on Air Bed (230 V, 50/60 Hz)

U8405680-115

Rotating System on Air Bed (115 V, 50/60 Hz)

Apparatus for investigating frictionless rotation. A small rotating disc with a protractor scale supports a cross bar to which weights can be attached. The disc is supported by a bed of air in which its axis is centred. A driving weight is suspended from a hook at the end of a string that is passed over a single pulley on one side and a multiple pulley on the other.
The rotation is very slow and can be measured using a stopwatch by hand. Alternatively, a digital timer may be used. This can be started by a mechanism that is supplied with the kit and halted by a signal from a laser reflection sensor when the wheel passes through angle zero.

Protractor scale:	0 – 360°
Scale divisions:	1°
Length of cross bar:	ca. 440 mm
Radii of perforations:	30 – 210 mm
Separation of perforations:	20 mm
Radii of multiple pulley:	5.0 mm/10.0 mm/15.0 mm
Moment of inertia of disc with cross bar:	0.16 g m² approx.
Maximum moment of inertia:	7.1 g m² approx.
Minimum driving torque:	0.05 mN m approx.
Maximum driving torque:	0.60 mN m approx.

Contents:

1 Air bed
1 Rotating disc with cross bar
1 Multiple pulley
1 Release mechanism
2 S-shaped hooks 1.00g
1 S-shaped hook 2.00 g
1 Set of weights (2x 12.5 g, 2x 25 g, 2x 50 g)
1 Compressor for connection to mains
1 Silicon tubing with by-pass valve (not illustrated)
1 Pulley
1 Stand rod with 3 securing screws and 2 screws for levelling
1 Stand rod with 2 securing screws
1 Stand rod, 250 mm
1 Levelling disc
1 Roll of cotton thread



U8405680

U8405690

NEW

U8405690

Supplementary Kit for Rotating System on Air Bed

Supplementary kit for the rotating system on air bed U8405680 for investigating frictionless rotational motion and oscillations using a large rotating disc. On the underside of the large disc is an angle grid that can be used to provide triggers to a U8533380 laser reflection sensor if the rotation is to be recorded with the help of the 3B NET*log*™ interface unit.

Typical oscillation periods:	20 s approx. to 2 mins approx.
Moment of inertia of large disc:	2.2 g m² approx.

Contents:

1 Large disc with protractor scale, 350 mm
1 Scaffold stand
1 Cross sleeve
1 Set of coupling springs with magnet (1 N, 2 N, 5 N)

Additionally recommended:
U8533380 Laser Reflection Sensor and
U8533341-230 Digital Count er (230 V, 50/60 Hz) or
U8533341-115 Digital Counter (115 V, 50/60 Hz) or
U11300-230 3B NET*log*™ (230 V, 50/60 Hz) or
U11300-115 3B NET*log*™ (115 V, 50/60 Hz)



Measuring the period of oscillation and determining the moment of inertia



U8408305

U8408305

Maxwell's Wheel

Spoked wheel with large moment of inertia for demonstrating the conversion of kinetic energy into potential energy and vice versa. Includes suspending rod and adjustable suspension mechanism.
The rotating axle is held in a horizontal position by two strings attached to a suspending rod and is moved upward by winding in the strings. If the equipment is released from its wound in position, the spoked wheel acquires kinetic energy on the way down, which can be seen by the constant increase in its speed of rotation. Two stops on the ends of the axle prevent the wheel from spinning free. At the lowest point when the strings are fully unwound, they start rewinding around the axle and the wheel rises upward again, losing its kinetic energy as it gets higher. To measure the inertial force during acceleration, the whole apparatus complete with stand is placed on a set of scales.

Moment of inertia:	10 kg cm² approx.
Diameter of wheel:	130 mm approx.
Mass of wheel:	470 g approx.
Suspending rod:	370 mm x 12 mm dia.

Additionally required:
Stand equipment

U45000

Bicycle Wheel Gyroscope

Spoked wheel with weighted rim for demonstrating conservation of angular momentum. Simple to use due to small wheel radius and ease of suspension.

Additionally recommended:
U45001 Turn Table
U8724980 Experiment Cord

U45001

Turn Table

Intended for use with the bicycle wheel gyroscope, this rotary platform allows operation on a laboratory stool or as a base surface.
Anti-skid design.

Digital Stroboscope

Portable microprocessor-controlled device with quartz-controlled time base for observation of periodic movements, as well as for frequency and rotation speed measurement.
Xenon flash tube built into a robust plastic casing with handle and photo thread for mounting on a stand, continuous frequency adjustment in two ranges through coarse and fine setting using control knobs, 4-digit digital display permits readings of the desired flash sequence per minute.

Meas. ranges:	100 rpm – 1000 rpm (approx. 1.5 Hz – 18 Hz) 1000 rpm – 10000 rpm (approx. 18 Hz – 165 Hz)
Accuracy:	± (0.05% + 1 digit)
Display:	4-digit LED
Resolution:	0.1 rpm (< 1000 rpm) 1 rpm (1000 rpm –9999 rpm) 10 rpm (10000 rpm)
Flash duration:	60 µs –100 µs
Flash energy:	4 Ws
Flash angle:	80°
Dimensions:	approx. 210x210x120 mm³
Weight:	approx. 1 kg

U40160-230

Digital Stroboscope (115 V, 50/60 Hz)

U40160-115

Digital Stroboscope (230 V, 50/60 Hz)

U40161

Spare Bulb, Stroboscope

Spare bulb for the Digital Stroboscope U40160.

U8405710

Rotation Apparatus

Rotating apparatus for determining angular acceleration as a function of the torque and for determining the moment of inertia depending on mass and distance from an axis. An axle on agate bearings supports a cross bar to which weights can be attached. The force from a driving weight is conveyed to the axle via a string wrapped around the axle and passed over a pulley and a second multiple pulley on the axle itself.

Length of crossbar:	600 mm
Radii of multiple pulley:	4.5 mm / 9.0 mm
Driving weights:	10 g / 20 g / 30 g / 40 g / 50g
Inertial mass of disc(s):	100 g / 200 g / 300 g
Dimensions of base plate:	200 x 140 mm²
Total weight:	1.3 kg approx.

Contents:

1 Basic apparatus	2 Slotted weights 10 g
2 100-g discs	1 Slotted weight 20 g
2 200-g discs	1 Pulley
1 Holder for slotted weights 10 g	1 Roll of string



U8403110

Watt's Governor

Symmetrical pendulum system on an axle, for demonstrating centrifugal force. Depending on the rotational speed, a metal cylinder connected to the governor's two pendulum arms is lifted against the force of gravity as the axle turns. This can then be used to control the speed of a steam engine.

Rotation diameter:	300 mm
Height:	230 mm
Diameter of axle:	10 mm

Additionally required:
U10375 Experiment Motor with Gearbox
U13271 Stand Base, Tripod, 185 mm

U8403120

Rings Demonstrating Flattening of the Earth

Apparatus on axle for demonstrating and explaining flattening of the earth and other planets due to their rotation. Two steel bands crossed over and bent into a ring with a guide rod.

Ring:	240 mm dia.
Guide rod:	10 mm dia.

Additionally required:
U10375 Experiment Motor with Gearbox
U13271 Stand Base, Tripod, 185 mm



U8403120



U8403110

U10375

U13271

U10375

Experiment Motor with Gearbox

Experiment motor for universal use in experiments on rotational motion, e.g. for experiments using the rings demonstrating flattening of the earth U8403120 or Watt's governor U8403110.
Can also be used as a generator in conjunction with the included hand crank. Robust clockwise and counter-clockwise rotating IDC motor with epicyclic gearbox and quick-action chuck in a tough anodized aluminum casing with removable and adjustable stainless steel stand rod. Can also be mounted on the clamp for the projectile launcher U10361. Speed of rotation is adjusted by altering the supply voltage. Adjustable torque. Includes 3 belt pulleys of different diameters on a mounting axle.

Speed without load:	approx. 480 rpm at 12 V
Speed sensitivity:	approx. 40 rpm per V
Span of chuck:	0.8 – 10 mm
Stand rod:	12 mm dia.
Pulleys:	10 mm dia., 20 mm dia., 40 mm dia.
Axle:	10 mm dia.
Drive belt:	130 mm dia. x 4 mm
Nominal voltage:	12 V DC, 5A
Connection:	via 4-mm safety sockets
Dimensions:	210x95x60 mm³
Mass:	1.2 kg

Contents:
Experiment motor
Stand rod with knurled screws
Hand crank
Pulleys
Drive belt

Additionally required:
U33020-230 DC Power Supply 0 – 20 V, 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 5 A (115 V, 50/60 Hz)

Experiment topics:

- **Moment of inertia of a disc**
- **Torque**
- **Angular momentum**
- **Precession**
- **Nutation**

U52006

Gyroscope

Gyroscope for demonstration as well as for quantitative determination of gyroscopic laws by means of practical experiments.
Experiment apparatus with a shaft that can be tilted and rotated while attached to a stand rod. On one side of the shaft there is a disc mounted on dual ball bearings, while on the opposite side there is a movable counterweight for establishing equilibrium. Fine adjustment is performed by thumb screw at the end of the shaft. To generate external torque an additional weight is provided that can also be moved along the shaft.
The shaft's angle of inclination can be read from an easily readable scale. A spirit level allows the gyroscope to be adjusted to the horizontal. The disc can be set rotating by hand or by means of a cord. The dual ball bearing system ensures that rotation is nearly frictionless and that rotation continues for lengthy periods of time. The open construction of the gyroscope allows gyroscopic phenomena to be observed easily and clearly.

Scale:	- 40° to + 40°	Mass of counterweight:	1400 g
Scale divisions:	1°	Mass of additional weight:	50 g
Disc:	250 mm dia.	Total weight:	4650 g
Mass of disc:	1500 g		

Additionally required:
U13271 Stand Base, Tripod, 185 mm
U15002 Stainless Steel Rod, 470 mm
U13250 Bosshead



U52010

U52006

U52010

Gyroscope Accessories

Accessories kit for Gyroscope (U52006) consisting of a gyroscope disc and counterweight. For demonstrating the canceling out of gyroscopic phenomena in the case of two discs rotating at the same speed in opposite directions.

U8404270

Rod Pendulum with Angle Sensor

Pendulum with low-friction pointed bearings and electromagnetic angle sensor for measuring simple harmonic motion of a weighted pendulum with movable weight.
The deflection of the pendulum is detected by a Hall sensor that converts the angle to an electrical signal proportional to the angle so that the oscillation can be recorded using an interface unit, a Y-t plotter or a storage oscilloscope.

Length of pendulum:	1 m
Mass of pendulum:	1 kg
Output voltage:	± 5 V
Output resistance:	500
Power supply:	12 – 16 V AC, floating earth
Diameter of tube:	10 mm
Weight:	0.3 kg approx.

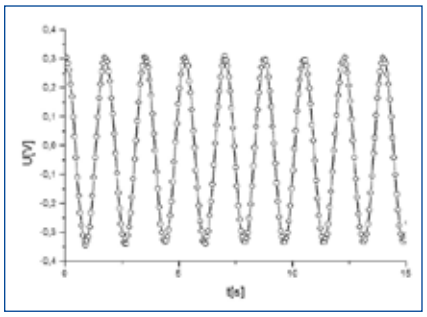
Additionally required:
U8475430-230 Transformer 12 V, 25 W (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 W (115 V, 50/60 Hz)
Stand Equipment

Additionally recommended:
U11300-230 3B NET*log*™ (230 V, 50/60 Hz)
or
U11300-115 3B NET*log*™ (115 V, 50/60 Hz)

U8404280

Rod Pendulum

Rod pendulum with low-friction pointed bearings as per U8404270 but with no Hall sensor or magnet for detecting angle.



Deflection of the pendulum as a function of time



U8404270



U30035

U30035

Set of 4 Pendulum Bobs

4 balls with securing eyes: made of brass, aluminum, steel and plastic for constructing a mathematical pendulum.

Diameter:	25 mm
Weights:	71.2 g, 25.2 g, 61 g, 10.5 g

Additionally required:
U8724980 Experiment Cord
Stand Equipment



U11984

U11984

Variable g Pendulum

Pendulum with continuously adjustable plane of oscillation for observing pendulum oscillations where the acceleration due to gravity g can appear to be varied.

Max. length of pendulum:	280 mm
Mass of pendulum:	0.5 kg
Angle of plane of oscillation:	0° – 90°
Dimensions:	300x250x550 mm³
Mass:	approx. 5 kg

Additionally required:
U13270 Stand Base, Tripod, 150 mm
U15002 Stainless Steel Rod, 47 cm

Experiment topics:

- **Pendulum oscillations**
- **Rotation of the earth**
- **Coriolis force**



U8403000

Foucault Pendulum

Pendulum for qualitative and quantitative demonstration of the rotation of the earth by means of observing the plane of oscillation.
To prevent the oscillation taking an elliptical path, the thread upon which the pendulum bob is suspended impinges on a Charron ring during each oscillation. The plane of the oscillation is detected with high accuracy by projecting the shadow of the thread onto a protractor scale. The rotation of the plane can thus be identified in a very short period of time. For longer periods of observation, the gradual damping of the oscillation can be compensated for by means of an electromagnetic boost that can be adjusted to an arbitrary value. The apparatus is presented in decorative fashion inside a box with all sides made of glass, that is lit from inside to make for a very eye-catching appearance.

Length of pendulum:	1200 mm
Mass of pendulum:	230 g
Diameter:	38 mm
Vertical alignment:	By means of four height-adjustable feet
Angular resolution:	0.1°
Dimensions:	400x400x1400 mm³
Mass:	approx. 40 kg

U8403000-230

Foucault Pendulum (115 V, 50/60 Hz)

U8403000-115

Foucault Pendulum (230 V, 50/60 Hz)



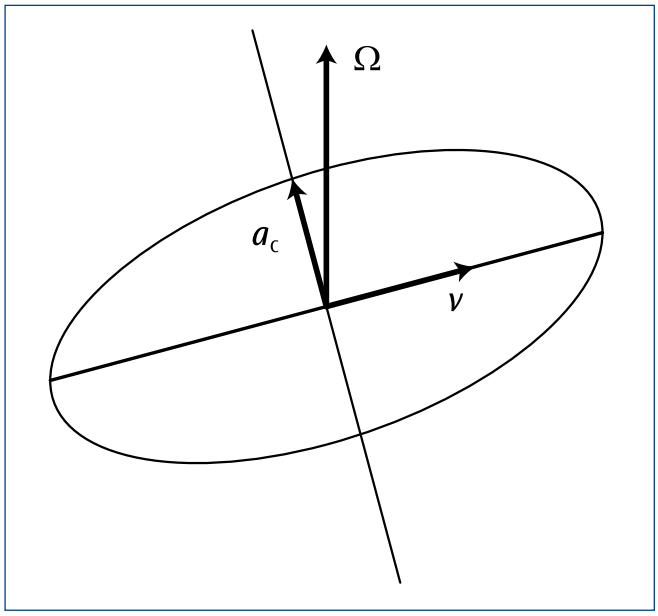
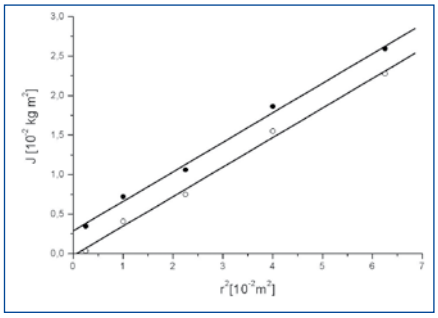


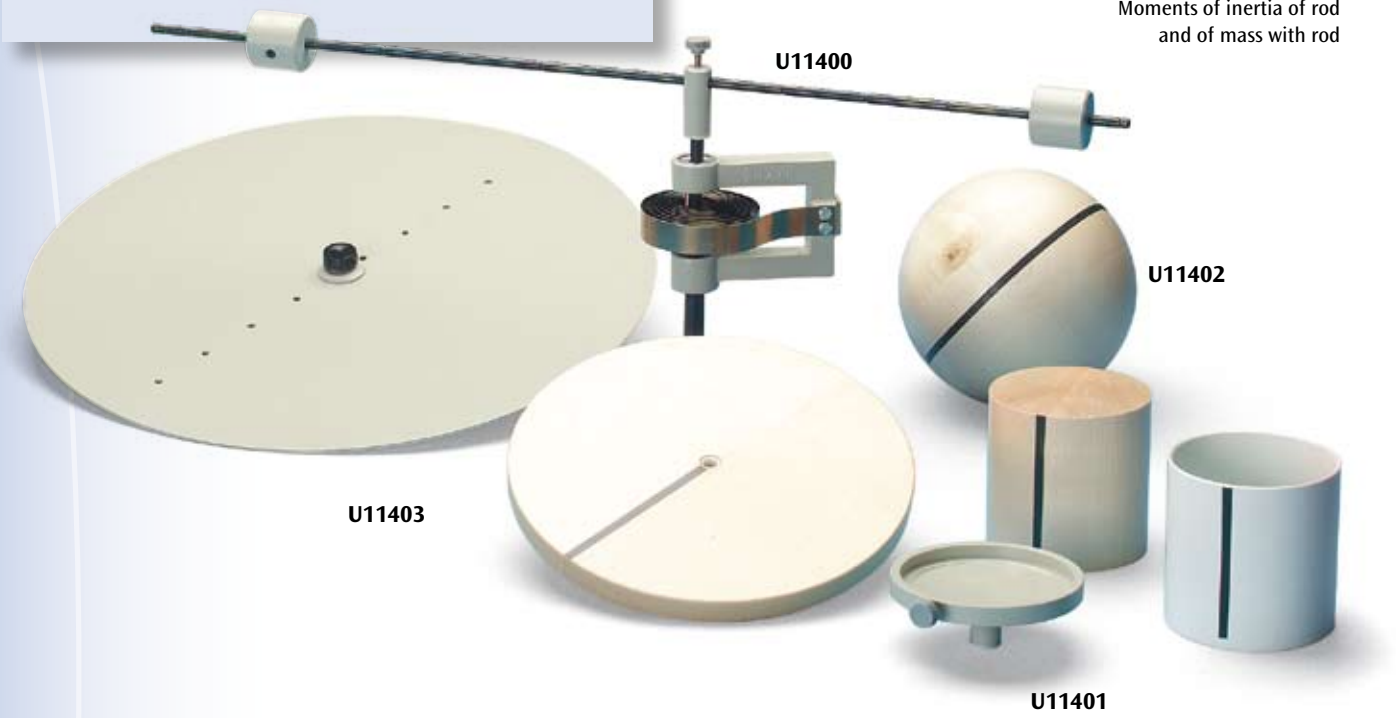
Diagram of Coriolis acceleration

Experiment topics:

- Rotary oscillations
- Determination of moments of inertia using the oscillation method
- Moments of inertia of various geometric bodies
- Steiner's theorem



Moments of inertia of rod and of mass with rod



U11400

Torsion Axle

Axle for investigating rotational oscillation of various test bodies and for determining their moments of inertia from the period of oscillation. With ballbearing mounted shaft, coil spring and holding lug. Including cross bar with various movable weights for use as the bodies under test.

Deflecting torque of the spring:	0.025 Nm/rad.
Height of the torsional axle:	approx. 200 mm
Mass of cross bar:	0.13 kg
Rod length:	approx. 600 mm
Mass of test bodies:	0.24 kg each
Oscillation period:	0.5 – 5 s

Additionally required:
U13271 Stand Base, Tripod, 185 mm

Additionally recommended:
U11902 Digital Stopwatch
U20032 Precision Dynamometer 1 N

U11401

Set of 3 Cylinders for Torsion Axle

Accessories for U11400 axle for experiments on determining moments of inertia. The cylinders have nearly identical weights but different weight distributions; the set includes a plate for mounting the solid wooden cylinder and hollow metal cylinder on the torsion axle. Inclusive mounting plate.

Mounting plate:	
Diameter:	100 mm
Weight:	approx. 0.12 kg
Solid wooden cylinder:	
Diameter:	90 mm
Height:	90 mm
Weight:	approx. 0.35 kg
Hollow metal cylinder:	
External diameter:	90mm
Internal diameter:	86.6 mm
Height:	90 mm
Weight:	approx. 0.35 kg
Wooden disc with bush:	
Diameter:	225 mm
Height:	15 mm
Weight:	approx. 0.35 kg

U11403

Disc for Torsion Axle

Accessories for U11400 axle for experiments on determining moments of inertia, also in the case of eccentric torsion axles, and for confirming Steiner's theorem. Equipped with various diametrically arranged boreholes and a fixture for mounting on the torsion axle.

Diameter:	approx. 400 mm
Weight:	0.74 kg approx.
Boreholes:	9
Borehole spacing:	20 mm

U11402

Wooden sphere for Torsion Axle

For experiments for determining moments of inertia.
Equipped with a socket for mounting on the torsion axle.

Material:	Wood
Diameter:	approx. 145 mm
Weight:	approx. 0.96 kg

Experiment topics:

- **Free rotary oscillations at various degrees of damping (oscillations with moderate damping, aperiodic oscillations and aperiodic borderline case)**
- **Forced oscillations and their resonance curves at various degrees of damping**
- **Phase displacement between the exciter and resonator during resonance**
- **Chaotic rotary oscillations**

U15040

Pohl's Torsion Pendulum

For investigating free, forced and chaotic oscillations at various degrees of damping. With slotted scale ring and pointers on resonator and exciter. An electric motor is included for exciting forced oscillations. It features coarse and fine speed adjustment and is coupled via an eccentric wheel. For damping, an electromagnetic eddy brake is used.
The equipment can also be used in demonstrations involving projection of shadows.

Natural frequency:	approx. 0.5 Hz.
Excitation frequency:	0 to 1.3 Hz
Connectors:	4-mm safety sockets
Motor:	max. 24 V AC/DC, 0.7 A
Eddy brake:	0 - 2 A DC, 20 V
Scale ring:	300 mm dia.
Dimensions:	400x140x270 mm³
Weight:	4 kg

Additionally required:
U33020-230 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
U33200-230 Plug-in Power Supply 24 V, 0.7 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)
U33200-115 Plug-in Power Supply 24 V, 0.7 A (115 V, 50/60 Hz)

U40801 Stopwatch, 15 min
U17450 Analogue Multimeters
Patch Cords

Plug-in Power Supply 24 V, 0.7 A

Plug-in power supply for the electric motor used with Pohl's pendulum U15040. Including cables and two safety plugs on the secondary side.

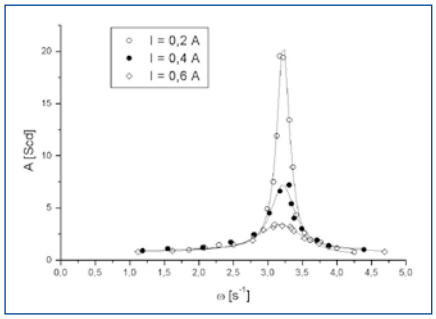
Output voltage:	24 V, 0.7 A
Length of cables:	1 m

U33200-230

Plug-in Power Supply 24 V, 0.7 A (230 V, 50/60 Hz)

U33200-115

Plug-in Power Supply 24 V, 0.7 A (115V, 50/60 Hz)

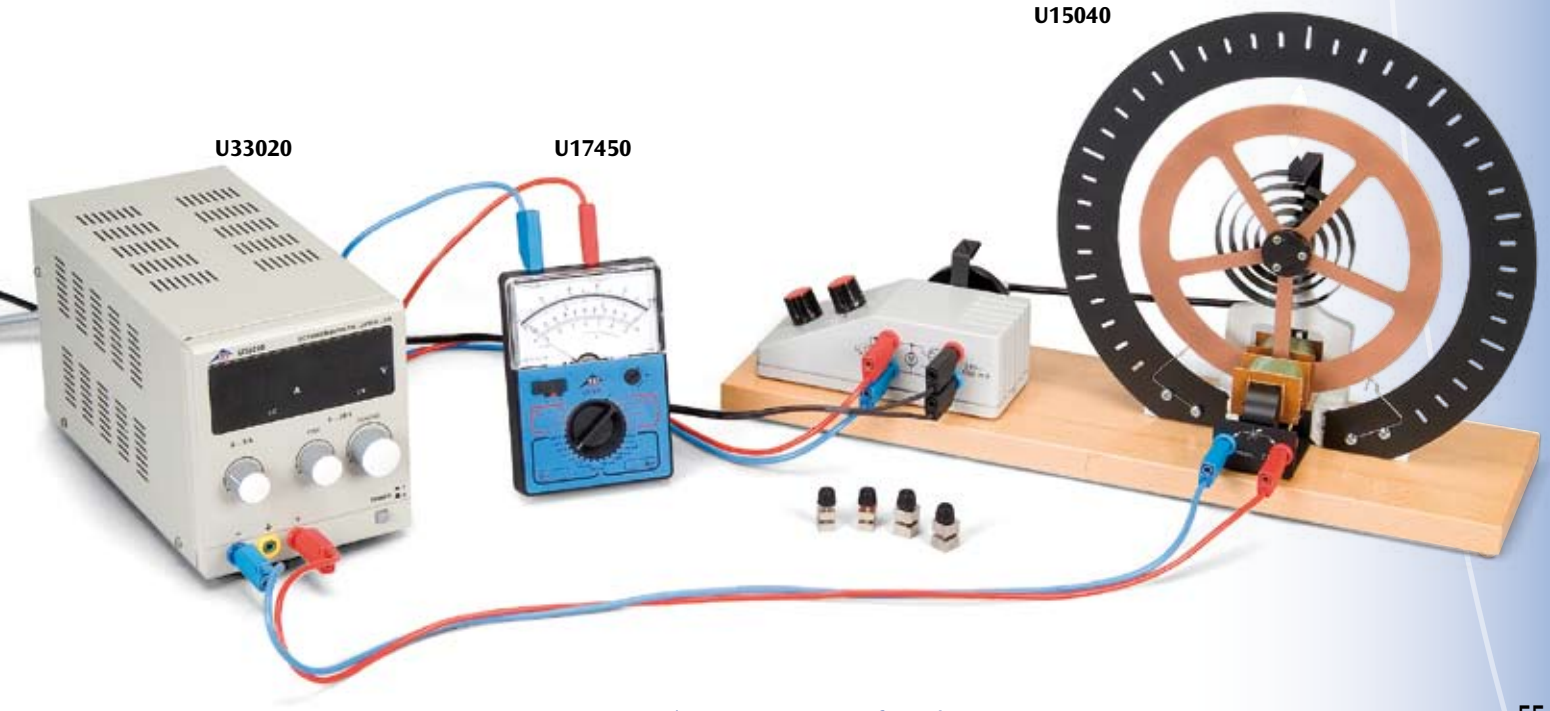


Resonance curve for different degrees of damping

U15040

U33020

U17450



U21110

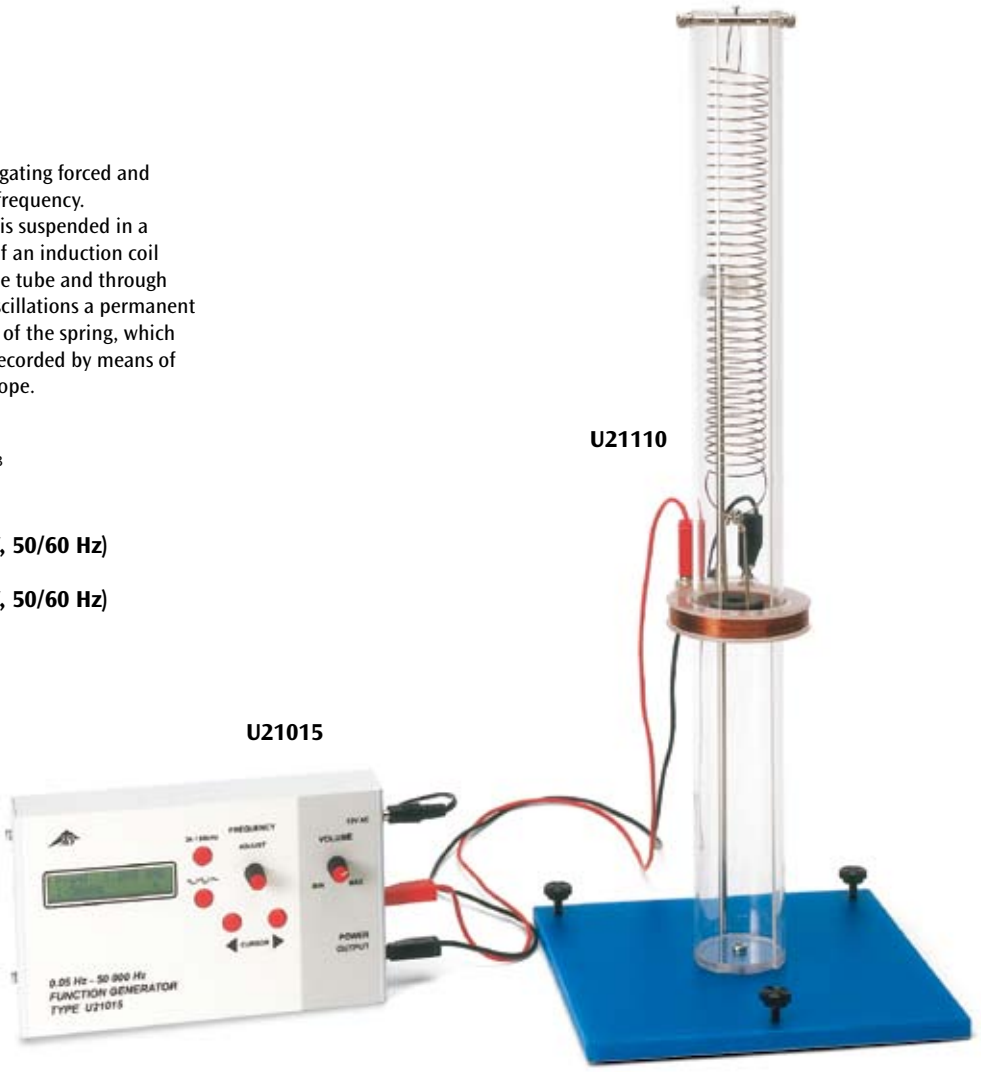
Oscillation Apparatus

Oscillating apparatus for demonstrating and investigating forced and unforced harmonic oscillations up to the resonant frequency.
A freely oscillating spring with a weight on the end is suspended in a Plexiglas tube and is set into oscillation by means of an induction coil attached to the outside that can be moved along the tube and through which an oscillating voltage passes. For unforced oscillations a permanent magnet is supplied that can be attached to the end of the spring, which induces an electrical signal in the coil that can be recorded by means of an interface unit, a Y-t plotter or a storage oscilloscope.

Diameter of tube:	45 mm
Connectors:	4-mm sockets
Dimensions:	520 x 200 x 200 mm³

Additionally required:
U21015-230 Function Generator F12 (230 V, 50/60 Hz)
or
U21015-115 Function Generator F12 (115 V, 50/60 Hz)

Additionally recommended:
U11300-230 3B NET*log*™ (230 V, 50/60 Hz)
or
U11300-115 3B NET*log*™ (115 V, 50/60 Hz)



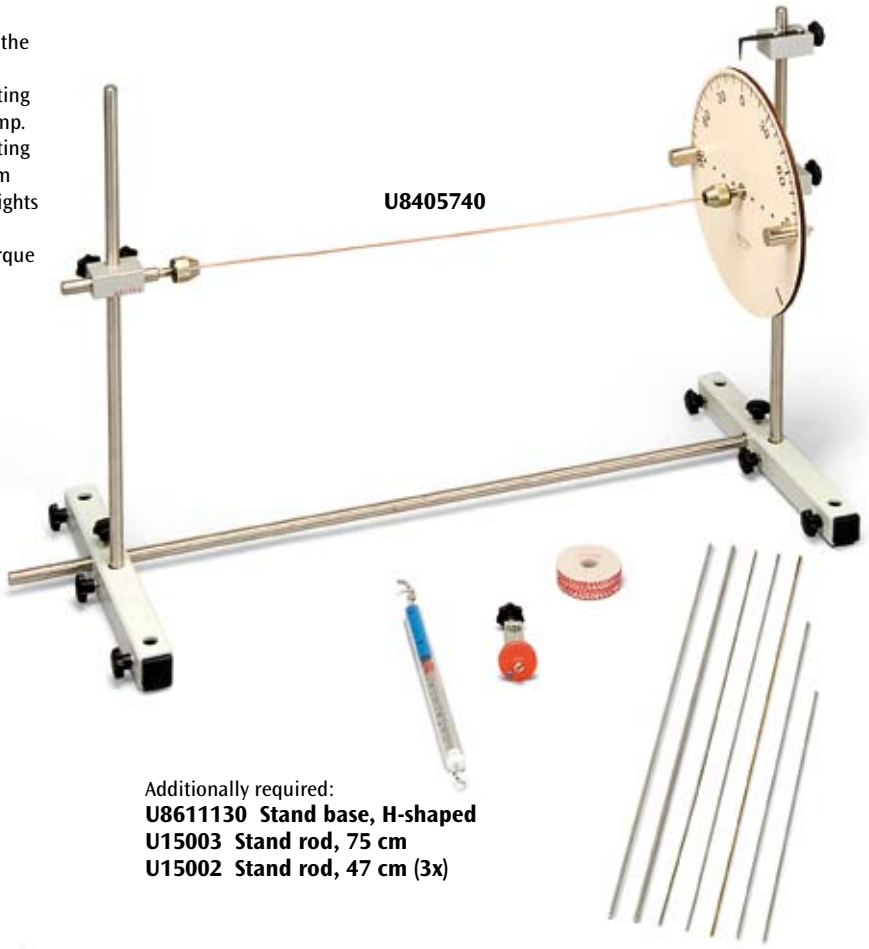
U8405740

Torsion Apparatus

Apparatus for determining torsion coefficient of metal rods by static or dynamic means as a function of the rod diameter and the material from which it is made.
The test objects are clamped between a fixed clamp and a rotating disc for angle measurement, which is also equipped with a clamp. For dynamic measurements the set-up takes the form of a rotating pendulum. The torsion coefficient can then be determined from the period of oscillation if the moment of inertia is known. Weights can be added to the disc to increase the moment of inertia.
For static measurements a pre-set torque is neutralised by a torque in the opposite direction and the torsion coefficient is thereby determined.

Diameter of disc:	250 mm
Dimensions:	600 x 400 x 200 mm³
Weight:	1.2 kg approx.

Contents:
1 Basic torsion apparatus consisting of one circular disc with bearings and chuck, 1 pointer, 1 counter bearing with chuck
1 Torsion rod, steel, 500 mm x 2 mm dia.
1 Torsion rod, brass, 500 mm x 2 mm dia.
1 Torsion rod, copper, 500 mm x 2 mm dia.
1 Torsion rod, aluminium, 300 mm x 2 mm dia.
1 Torsion rod, aluminium, 400 mm x 2 mm dia.
1 Torsion rod, aluminium, 500 mm x 2 mm dia.
1 Torsion rod, aluminium, 500 mm x 3 mm dia.
1 Torsion rod, aluminium, 500 mm x 4 mm dia.
1 Pulley, 30 mm dia., with 4 mm plug pin
1 Holder for pulley
2 Weights, 50 g, with 4 mm plug pin
1 Hank of twine, 100 m
1 Dynamometer, 5 N



Additionally required:
U8611130 Stand base, H-shaped
U15003 Stand rod, 75 cm
U15002 Stand rod, 47 cm (3x)

U8410355

Buoyancy Apparatus

Apparatus for demonstrating buoyancy of fluids, consisting of a flat ground glass tube and a metal disc with rubber covering to form a base plate to which a long string is attached.
The base plate makes a watertight connection with the glass tube and when both are immersed in water, the plate does not sink because buoyancy keeps it pushed up against the tube.

Glass tube:	200 mm x 28 mm dia.
Metal disc:	2 mm x 42 mm dia.
Length of string:	35 cm



U8410355

U40875

Device for Archimedes' Principle

For demonstrating Archimedes' principle of buoyancy in liquids. Consists of a hollow cylinder with a stirrup and hook, as well as a precisely fitted solid cylinder with an eyelet.

Diameter:	55 mm
Height:	53 mm



U40875

U14206

Free-Standing Cylinder, without Graduation

Made of Duran glass with round base and coarse ground rim, without graduation.

Height:	300 mm
Diameter:	40 mm



U14206

U14090

Cartesian Diver

For demonstrating a body floating, sinking or rising in water. A hollow figure made of coloured glass, with a narrow opening. The figure floats upright in a cylinder filled with water and can be made to float, sink or rise by applying pressure to the rubber cap. The rubber cap fits cylinder diameters of approx. 30 mm to 40 mm, e.g. U14206 free-standing cylinder.

Contents:

1 Cartesian diver
1 Rubber cap

Additionally required:
U14206 Free-Standing Cylinder, without Graduation



U14090





U8404556

U8404556

Set of 5 density bodies

Set comprising five rectangular prisms made of various materials and a transparent block with a hollow body, all with the same dimensions for demonstrating Archimedes' principle. The bodies have 2-mm bores by which they can be suspended.

Materials:	Wood, aluminium, iron, brass, copper
Dimensions of each body:	10x20x45 mm³

Additionally recommended:
U20032 Precision Dynamometer 1N



U15036 - U15039

Immersion Blocks

Immersible block with hooks. Can be used for determining buoyancy in conjunction with a dynamometer.

Art. Nr.	
U15036	Al, 50 cm³
U15037	Al, 100 cm³
U15038	Fe, 50 cm³
U15039	Fe, 100 cm³

Additionally required:
U20035 Precision Dynamometer 10 N

U8403315

Set of 3 Cylinders, Equal in Volume

Set of three cylinders of equal volume and unequal mass each with a hook.

Materials: Aluminium, iron, brass

Dimensions of cylinders: 40 mm x 20 mm dia. approx.

Additionally recommended:

U42050-230 Electronic scales 600 g (230 V, 50/60 Hz)

or

U42050-115 Electronic scales 600 g (115 V, 50/60 Hz)

U14205 Graduated cylinder, 100 ml

U8403325

Set of 3 Cylinders, Equal in Mass

Set of three cylinders of equal mass and unequal volume each with a hook.

Materials: Aluminium, iron, brass

Mass of cylinders: 100 g

Additionally recommended:

U42050-230 Electronic scales 600 g (230 V, 50/60 Hz)

or

U42050-115 Electronic scales 600 g (115 V, 50/60 Hz)

U14205 Graduated cylinder, 100 ml



U45056

Density Paradox Set

Two identical plastic cylinders with a density close to that of water. If the first is immersed in hot water, it will initially sink but will then float up to the surface after a short time. If the second one is then put into ice-cold water, it will initially float but will then sink to the bottom. The reason for this is that the density of the plastic changes more than that of the water when it is heated or cooled.

Additionally recommended:

2 Beakers from U14210

U14290

Alcohol Meter

Gay-Lussac alcohol meter for determining the alcohol content in percentage by volume of ethanol/water mixtures at a reference temperature of 15°C. Without thermometer, in storage container.

Scale: 0 to 100% vol

Division: 1%

Length: 260 mm

U14291

Universal Areometer

Areometer for determining the density of liquids in g/ml at a reference temperature of 20°C. Without thermometer, in storage container.

Measuring range: 0.7 – 2 g/ml^3

Scale division: 0.02 g/ml^3

Length: 310 mm

U14220

Gay-Lussac Pycnometer

Glass body with ground capillary stopper for determining the density of liquids.

Volume: 50 ml

U8411210

Compressed air pump

Bicycle pump for use with pressure container for measuring weight of air, U8412150.

Immersion Blocks

Immersible body of known volume. Can be used in conjunction with scales to determine the density of solid bodies. With hook.

Cat. No.	
U15036	Al, 50 cm³
U15037	Al, 100 cm³
U15038	Fe, 50 cm³
U15039	Fe, 100 cm³

Additionally recommended:

U42050-230 Electronic scales 600 g (230 V, 50/60 Hz)

or

U42050-115 Electronic scales 600 g (115 V, 50/60 Hz)



U16106

Set of 3 Areometers

Set of areometers for determining the density of liquids in g/ml at a reference temperature of 20°C / 68°F. Without thermometer, in storage container.

Measuring range	Scale division	Length
0.650 – 1.000 g/ml	0.005 g/ml	315 mm
1.000 – 1.500 g/ml	0.005 g/ml	235 mm
1.500 – 2.000 g/ml	0.005 g/ml	235 mm

U8412150

Pressure Container for Determining Weight of Air

Airtight metal can with valve for demonstrating weight of compressed air. With bicycle valve for pumping in air.
The weight of the air pumped in is determined by weighing and the volume can be determined by gauging the capacity.

Dimensions: 60x190 mm^2 approx.
Weight: 100 g approx.

Additionally required:
U42049-230 Electronic Scales 400 g (230 V, 50/60 Hz)
or
U42049-115 Electronic Scales 400 g (115 V, 50/60 Hz)
U8411210 Compressed Air Pump



U8412150

U8404509

Set of 7 Cubes for Determining Density

Set of seven cubes made of various materials for determining densities by weighing. Supplied in a storage case.

Materials: Wood, plastic, aluminium, iron, copper, brass, zinc
Side of cubes: 10 mm

Additionally required:
U42050-230 Electronic Scales 600 g (230 V, 50/60 Hz)
or
U42050-115 Electronic Scales 600 g (115 V, 50/60 Hz)



U8404509

U8422050

Sphere for Weighing Gases 1000 ml

Glass sphere with two taps and nozzles for attaching tubing for demonstrating the weight of air from the difference in weight between the sphere when filled with air and when evacuated.

Weight: 200 g approx.

Additionally recommended:
U42049-230 Electronic Scales 400 g (230 V, 50/60 Hz)
or
U42049-115 Electronic Scales 400 g (115 V, 50/60 Hz)
U20500 Vacuum Hand Pump



U8422050

U45057

Set of 2 Materials with 4 Different Weights of Each

Two sets of test bodies made of the same material but with four different weights for deriving the concept of density in school experiments. Supplied in storage containers.

Materials: Aluminium, PVC

Additionally recommended:
U42050-230 Electronic Scales 600 g (230 V, 50/60 Hz)
or
U42050-115 Electronic Scales 600 g (115 V, 50/60 Hz)
U14205 Graduated Cylinder, 100 ml



U45057

U45058

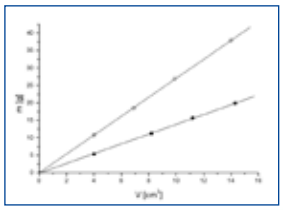
U45058

Set of 12 Materials with 4 Different Weights of Each

Twelve sets of test bodies made of the same material but with four different weights for deriving the concept of density in school experiments. Supplied in storage containers.

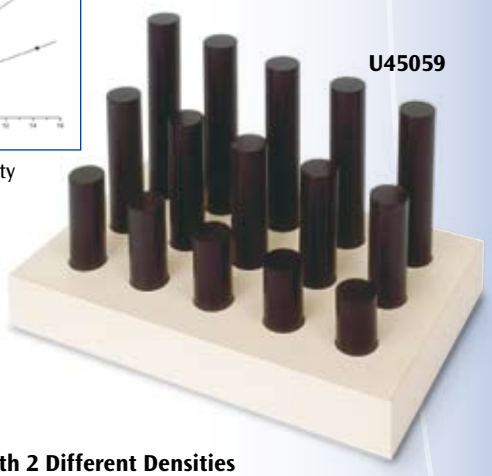
Materials: Wood, polypropylene, polyamide, acrylic (2 colours), polyurethane, phenol, PVC (3 colours), Teflon and aluminum

Additionally required:
U42050-230 Electronic Scales 600 g (230 V, 50/60 Hz)
or
U42050-115 Electronic Scales 600 g (115 V, 50/60 Hz)
U14205 Graduated Cylinder, 100 ml



Determining the density of Aluminum and PVC

U45059



U45059

Set of 15 Bodies with 2 Different Densities

Set of 15 test bodies of various masses made of two identical looking materials for deriving the concept of density in experiments at school. Supplied on a storage tray.

Materials: Plastic of density 1.41 g/cm^3 and 1.15 g/cm^3

Additionally required:
U42050-230 Electronic Scales 600 g (230 V, 50/60 Hz)
or
U42050-115 Electronic Scales 600 g (115 V, 50/60 Hz)
U14205 Graduated Cylinder, 100 ml



U10355

U21601





U14325

U21601

Outlet Vessel

Glass vessel for investigating the dependence of hydrostatic pressure on water depth through an observation of the outlet water jets. Consists of a glass cylinder with three outlets positioned at different heights.

Height:	350 mm
Diameter:	35 mm

U10355

Pressure Balance

Introducing the concept of pressure, for comparing pressures, for gas-compression experiments and for demonstrating overpressure and underpressure.

Two precision glass syringes of different volumes with ground piston and weight pans on stand. Includes 15 disc weights on a storage rod for adding to plunger. Connection between the syringe hoses via a tubing clamp, safety catch for the smaller piston.

Volume of syringes:	10 ml and 50 ml
Ratio of piston cross-sections:	10:3
Ratio of piston masses with weight pans:	10:3
Mass of weights:	approx. 400 mN each
Baseplate dimensions:	approx. 140x100 mm²

U14325

Pressure Distribution Apparatus for Liquids

Glass vessel with movable plungers for demonstrating equal distribution of pressure in all directions, observed by means of water jets forced out under pressure.

Total length:	450 mm
Diameter:	approx. 75 mm

U45053

Hydraulic/Pneumatic Lifting Platform

Complete equipment set for demonstration and practical training such as investigating transmission of hydraulic or pneumatic force, the relationship between force, surface area and pressure as well as verification of Boyle's law.

A plastic cylinder with piston (60 cm³ volume) is attached to a base between two holding plates. The lifting platform is positioned on the piston. Various levels of pressure can be exerted on the piston using a system of tubing with 4 simple hand pumps of different volumes. A hose fitting for connection of a pressure sensor required to record measured values with a datalogger is also included.

Dimensions:	145x90x170 mm³
Pump volumes:	3 cm³, 6 cm³, 12 cm³, 20 cm³

U8410450

U-tube Manometer

Manometer for measuring pressures in the range 0 to 10 hPa (cm water column). U-tube open on both sides with overflow basin on aluminium base plate with scale. Includes stand rod on the reverse for attaching to stand base.

Length of arms:	200 mm
Stand rod:	33 mm x 10 mm dia.
Base plate:	210x70 mm approx.
Weight:	80 g approx.

Additionally required:
U8410620 Indigo Solution

Additionally recommended:
U10146 Silicon Tube, 1 m



U8410450



U45053



U14321



U14320

U14321

Glass Cylinder with 2 Tubes

Glass vessel for demonstrating communicating tubes. Consists of a glass cylinder with two openings and GL screw connections, as well as two differently shaped glass tubes.

Height:	approx. 220 mm

U14320

Glass Cylinder with 3 Tubes

Glass vessel for demonstrating communicating tubes; also suitable as an overflow vessel. Consists of a glass cylinder with two openings and GL screw connections. Includes three differently shaped glass tubes.

Height:	approx. 300 mm
Diameter:	90 mm



U8411140

U8411140

Communicating Tubes

Glass vessel for demonstrating levels of liquid in linked tubes. Four differently shaped glass tubes linked together at the bottom on a plastic base.

Height:	220 mm approx.

U15070

Pascal's Vane Apparatus

For demonstrating the hydrostatic paradox and for quantitative measurements of ground pressure. This pressure is measured through the curvature of a membrane and indicated in magnified form with the help of a lever multiplier. Compensation for comparative measurements is possible. Includes four differently shaped vessels made of glass.

Height of the vessels:	220 mm
Tube diameter at the bottom:	22 mm
Total height:	350 mm
Base-plate area:	260x110 mm²
Weight:	0.8 kg

Gas Syringe

For storing and measuring quantities of gases and liquids. Consists of a glass cylinder with a scale having divisions of 0.5 ml or 1 ml. The ground finish of the glass cylinder ensures extreme tightness and smooth operation.

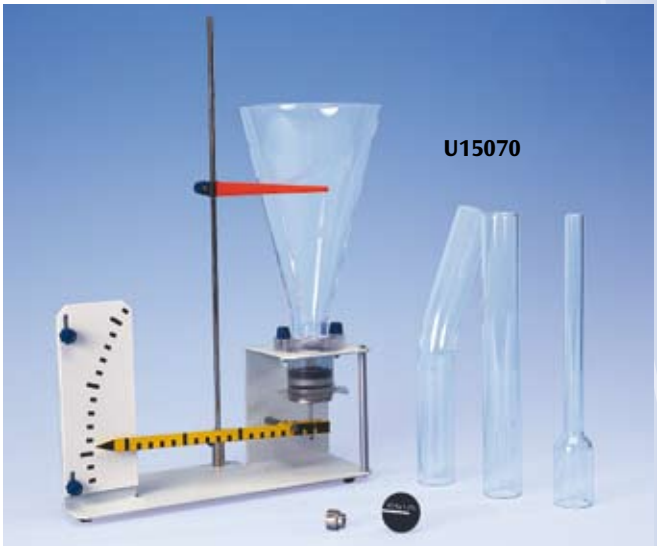


U14315

U14316

U14317

Art. Nr.	Volume	Division	Valve
U14315	100 ml	1 ml	1-way
U14316	50 ml	0.5 ml	–
U14317	25 ml	0.5 ml	–



U15070

U21851

Vacuum Bell Jar

Vacuum bell jar made of glass with grip knob and polished flange to be set on top of the vacuum experiment plate U21850.

Inner diameter: 190 mm
Total height: 220 mm

U21851



U21850

U21850

Vacuum Experiment Plate

Experiment plate for the assembly of a vacuum chamber in conjunction with the vacuum bell jar U21851 for experiments in the coarse and fine vacuum range.

Metal plate with sealing ring on a tripod, hose connection of the pump-side and ventilation cock. Includes two-pole current feed via 4-mm safety sockets and cable of approximately 1 m length with 4-mm safety plugs, plus a central bore with M12 thread for attaching experimental equipment.

Diameter: 250 mm
Height: 90 mm
Electrical limit specs.: max. 48 V, max. 12 A
Vacuum connection: 2 hose nozzles 12 mm and 8 mm dia.

Additionally required:
U21851 Vacuum Bell Jar
Vacuum Pump with Nozzle for Tubing

U8421230

Vacuum Cylinder

Glass cylinder for placing on vacuum base plate U8421220. Consists of ventilation valve, manometer, suction tap and holes for contacts.

Dimensions: approx. 200 mm x 240 mm dia.
Wall thickness: 5 mm
Weight: approx. 1.7 kg

Additionally required:
U8421220 Vacuum Base Plate
Vacuum Pump with Nozzle for Tubing

U8421220

Vacuum Base Plate

Base plate to accommodate vacuum recipients in conjunction with vacuum cylinder U8421230 for experiments involving coarse and fine vacuums. Made of melamine coated cardboard, includes rubber ring.

Dimensions: approx. 320x320x12 mm³
Weight: approx. 1.7 kg

U21854

Electric Doorbell

Bell for demonstrating electro-magnetic operation of apparatus and verifying that sound waves do not propagate in a fine vacuum (< 1 hPa). Open acrylic housing with 4-mm safety sockets.

Power supply: 6 V AC
Dimensions: 100x95x50 mm³

Additionally required:
U21850 Vacuum Experiment Plate
U21851 Vacuum Bell Jar
U17400-230 Rotary-Vane Pump, Two-Stage (230 V, 50/60 Hz)
or
U17400-115 Rotary-Vane Pump, Two-Stage (115 V, 50/60 Hz)

U21854





U21853

U21853

Baroscope

Beam balance on base with suspended polystyrene ball and adjustable counterweight for demonstrating buoyancy on a body due to atmospheric pressure. At a state of equilibrium a Baroscope is placed in a vacuum bell jar under atmospheric pressure. The air in the bell jar is then evacuated, the Styrofoam sphere falls on account of the reduction in lift.

Styrofoam sphere: 50 mm dia.
Base: 120x90 mm²
Height: 125 mm

Additionally required:
U21850 Vacuum Experiment Plate
U21851 Vacuum Bell Jar
Vacuum Pump with Nozzle for Tubing

U8421230



U8421220

U30010

Magdeburg Hemispheres

To demonstrate von Guericke's historical experiment on the effect of atmospheric air pressure. Two plastic hemispheres equipped with handles can be joined vacuum-tight using the insertable rubber sealing ring. One hemisphere is equipped with a stopcock and hose connection. Including air hose.

Vacuum connection: 8 mm
Diameter: 120 mm
Hose length: 110 mm

Additionally required:
U20500 Vacuum Hand Pump





U45054

U45054

Magdeburg Plates

Equipment set for demonstrations and practical teaching of Guericke's historical experiment investigating the effect of atmospheric pressure. Includes nozzle for tubing, a simple hand pump and tubing with built-in directional valves. Two transparent acrylic plates with handles that can be held together with a coarse vacuum between them. Two sealing rings of various sizes are supplied for sealing the plates. This allows the dependency of the force on the contact area to be investigated.

Acrylic plates: 13 mm x 97 mm dia.
Sealing rings: 5 mm x 85 mm dia. and 5mm x 50 mm dia.



U8422090

U8422090

Free-fall Tube (Guinea and Feather Apparatus)

This glass pipe can be evacuated to compare the free falling characteristics of different objects in a vacuum. A cork, feather and metal disc are included as falling objects.

Length: approx. 900 mm
Diameter: 50 mm dia.
Hose nipple: 8 mm
Weight: approx. 0.7 kg

Additionally recommended:
U20500 Vacuum Hand Pump



U14311

U14311

Woulffe's Bottle, 500 ml

Thick-walled, cylindrical glass bottle with 3 necks made of Duran glass. Intended for use as a gas production bottle, absorption vessel or series-connected bottle during experiments in a vacuum; allows simultaneous pressure control. Consists of a bottle, spring manometer and 2 glass tubes bent in a right angle.

Volume: 500 ml



U14312

U14312

Woulffe's Bottle, 1000 ml

Thick-walled, cylindrical glass bottle made of Duran glass. Intended for experiments at negative pressure; allows simultaneous pressure control. Consists of a bottle, spring manometer, 2 hose nipples and ventilation screw. The inside of the bottle is coated with polyurethane.

Volume: 1000 ml

U8421210

Piston Vacuum Pump

Robust two-stroke piston pump for vacuum experiments, for final vacuum pressures down to 0.4 bars. Air is pumped out on both the upward and the downward stroke of the piston. Includes carrying rod with handles and heavy base plus vacuum hose dia. 5 mm.

Final pressure:	400 hPa
Tubing nozzle:	5 – 15 mm dia.
Dimensions:	approx. 160x235x560 mm³
Weight:	approx. 1.7 kg



U16050



U8421210

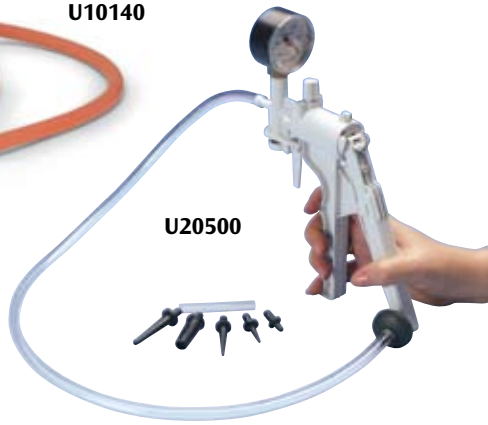
Vacuum Hoses

Vacuum hoses made of natural rubber according to DIN 12865. Colour red.

	U10140	U10141
Length	1 m	1 m
Internal diameter	8 mm	10 mm
Wall strength	5 mm	5 mm
Temperature range	-30° – + 85°	-30° – + 85°



U10141 U10140



U20500

U16050

Water-Jet Pump

Pump for experiments in a coarse vacuum; equipped with an integrated non-return valve to prevent water rise; can be disassembled.

Material:	Plastic
Suction capacity:	approx. 4 l/min (dependent on water pressure)
Final total pressure:	approx. 15 hPa (dependent on water temperature)
Pump-out time for a 5 l container:	6 to 10 minutes
Threaded joint:	R 1/ 2“ with inserts for R 3/8“ and R 3/4“

U20500

Vacuum Hand Pump

Simple mechanical air pump for evacuating small containers; equipped with a pointer manometer, ventilation valve, two hoses (long and short) and six connecting adapters.

Spring manometer:	0 – -1000 hPa
Tubing nozzle:	7 mm dia.
Hose:	600 mm x 6.5 mm dia. 150 mm x 6.5 mm dia.
Dimensions:	approx. 270x100x40 mm³
Weight:	approx. 0.2 kg

Rotary-Vane Vacuum Pump, Two-Stage

High-performance, compact, two-stage, oil-sealed rotary vane pump for vacuum experiments. With gas ballast valve, thermal overload protection, handle, low weight and high water vapor tolerance. Including pump oil.

Suction capacity:	33 l/min
Final pressure:	0.01 hPa
Motor power:	120 W
Hose nipple:	12 mm dia.
Dimensions:	approx. 300x150x260 mm³
Weight:	approx. 7.3 kg

Membrane Vacuum Pump

Oil-free diaphragm pump that can be used as a vacuum pump or compressor. Compact design with motor and direct flange, not sensitive to condensation, light and easy to use, low-noise and ready for use. With pressure release valve and tubing nozzles for suction and pumping.

Final vacuum:	13 hPa
Maximum pressure over atmospheric:	1500 hPa
Pumping performance:	26 l/min approx. (at atmospheric pressure)
Tubing nozzle:	9 mm dia.
Power:	200 W
Weight:	11.3 kg approx.

U17400-230

Rotary-Vane Vacuum Pump, Two-Stage (230 V, 50/60 Hz)

U17400-115

Rotary-Vane Vacuum Pump, Two-Stage (115 V, 50/60 Hz)



U17400

U8421119-230

Membrane Vacuum Pump (230 V, 50/60 Hz)

U8421119-115

Membrane Vacuum Pump (115 V, 50/60 Hz)



U8421119



U14510

U14511

U14512

U14516

U14515

U14513

U14514

U14510

2-Way Ball Valve DN 16 KF

Connection: DN 16 KF
Length: 100 mm

U14511

Crosspiece DN 16 KF

Connection: DN 16 K
Dimensions: 80 x 44 mm²

U14512

T-Piece DN 16 KF

Connection: DN 16 KF
Dimensions: 50 x 44 mm²

U14514

Dummy Flange DN 16 KF

Connection: DN 16 KF

U14515

Adapter Flange DN 16 KF / Shaft 12 mm

Adapter flange for connecting a vacuum hose to ISO-KF systems.

Connection: DN 16 KF
Tubing nozzle: 12 mm
Length: 40 mm

U14516

Adapter Flange DN 16 KF / NS 19/26

Adapter flange for connecting components with internally ground nozzles, e.g. gas discharge tube U14300, to ISO-KF systems.

Connection: DN 16 KF
Core: 19/26 NS
Length: 40 mm

U14513

Ventilation Valve DN 16 KF

Connection: DN 16 KF
Dimensions: 36 mm x 26 mm Ø

Rotary-Vane Vacuum Pump, PK 4 D

Compact, two-stage rotary pump with high suction capacity. Automatic lubrication of the rotary valve and ball bearings using optimized oil pressure increases the final pressure levels achievable, stabilizes the pump temperature and prolongs the pump's working life. Includes direct drive with elastic coupling. Device exhibits good resistance to chemicals and a high degree of water vapour compatibility. A suitable mechanism prevents the oil from rising back to contaminate the recipient. Lightweight device that operates with low noise. High-quality parts make the device capable of continuous operation. The pump is complete and ready for connection with a full complement of oil, centering ring, locking ring, motor protection circuit breaker, mains switch and connection cable with mains plug

Connecting flange:	DN 16 KF
Suction performance (nominal):	67/80 l/min at 50/60 Hz
Suction performance (Pneurop):	62/73 l/min at 50/60 Hz
Final pressure (without partial gas ballast):	2 x 10^{-4} hPa
Final pressure (with total gas ballast):	3 x 10^{-3} hPa
Water vapour tolerance:	33 hPa
Motor output:	180 W
Oil capacity:	550 ml
Dimensions:	415 x 132 x 220 mm approx.
Weight:	12.5 kg approx.

U14501-230

Rotary-Vane Vacuum Pump PK 4 D (230 V, 50/60 Hz)

U14501-115

Rotary Vane Vacuum Pump PK 4 D (115 V, 50/60 Hz)

U14513



Connecting ISO-KF connectors

U14517

U14518

U14512

U14517

Tension Ring DN 10/16 KF

Tension ring for mechanically secure connection of ISO-KF components.

U14518

KF External Centring Ring DN 10/16 KF

Rubber sealing ring for ISO-KF connections.

Pirani Vacuum Gauge

An easily programmable desktop device for measurement and control in fine and coarse vacuums using a Pirani vacuum gauge. Includes a clearly arranged membrane keypad, measuring line (3m) and mains cable.

Vacuum connection	DN 16 KF
Measuring range:	120 – 0.001 hPa
Measurement uncertainty:	< 20% of the display value
Display:	Digital LED display in mbar/torr
Digit height:	10 mm
Readout:	5 per s
Recorder output:	0 – 10 V
Threshold switch:	2 x 230 V, 2 A, independently adjustable
Switching accuracy/hysteresis:	± 1 digit
Permissible overload:	2 bar absolute
Power consumption:	max. 15 W
Dimensions:	98x98x152 mm³ approx.
Weight:	1.2 kg approx.

U14501



U14505-230

Pirani Vacuum Gauge (230 V, 50/60 Hz)

U14505-115

Pirani Vacuum Gauge (115 V, 50/60 Hz)

U14505



U8404250

Jet Nozzle (Flow Laminator)

Nozzle for emitting a near laminar air stream, e.g. for experiments with the set of drag and lift objects or experiments on recoil. Mounted on a stem. The very light air nozzle contains no moving parts and generates no spin. It spreads out the air stream from a connected fan. Air that comes out of the tubular nozzles near the plastic ring mixes with the secondary air to form a overall air stream of a large diameter.

Air inlet:	33 mm
Air outlet:	120 mm
Dimensions:	255x150 mm²
Stand holder:	10 mm
Weight:	approx. 350 g

Additionally required:

U15425-230 Air Flow Generator (230 V, 50/60 Hz)

or

U15425-115 Air Flow Generator (115 V, 50/60 Hz)



U8404250

U8404261

Component Balance

Scales for measuring components with holding mechanism for measuring air resistance and buoyancy of bodies from set U8404260. On rod.

Measuring range:	0 – 0.3 N
Diameter of the scale:	170 mm
Dimensions:	approx. 350x220 mm²
Rod diameter:	10 mm
Weight:	approx. 0.9 kg

U8404261





U8404260

U8404260

Set of bodies for air resistance and buoyancy experiments

Set of 7 wooden models on stems for measuring buoyancy and fluid resistance of various bodies in laminar air flows. Including storage block.

Contents:

1 streamlined body, smooth, l = 120 mm
1 streamlined body, rough, l = 120 mm
1 ball, d = 50 mm
1 circular disc, d = 47 mm
1 circular disc, d = 68 mm
1 plate, 150 mm x 40 mm
1 wing profile, l = 150 mm

Additionally required:

U8404250 Jet Nozzle (Flow Laminator)
U8404261 Component balance

Air Flow Generator

Fan allowing continuous adjustment of air flow. Includes a hose.

Hose length:	approximately 1.5 m
Power consumption:	max. 1100 W
Dimensions:	300x180x170 mm³
Weight:	4.4 kg

U15425-230

Air Flow Generator (230 V, 50/60 Hz)

U15425-115

Air Flow Generator (115 V, 50/60 Hz)



U15425

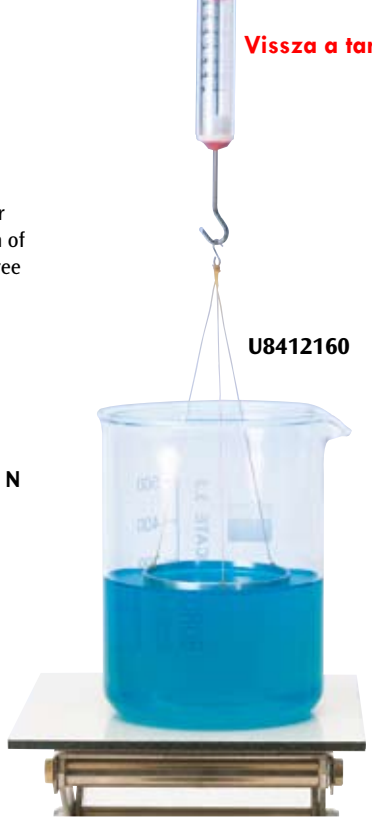
U8412160

Surface Tension Ring

Aluminium ring with a blade for determining the surface tension of liquids. Includes a hook and three threads for suspension from a dynamometer.

Diameter: 60 mm
Weight: 5 g approx.

Additionally required:
U15020 Laboratory Jack
U20030 Dynamometer 0.1 N
U14210 Beaker, 600 ml
Stand equipment



U8412160

U8411130

Wedge shaped Vessel

Wedge shaped vessel made of transparent acrylic for demonstrating the surface tension of liquids and capillary forces.

Length: 100 mm



U8411130

U8404300

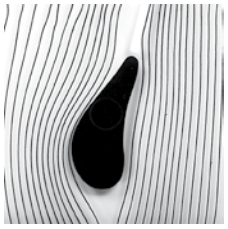
Air Flow Apparatus

Apparatus for demonstrating air flow patterns around bodies of different shapes. The air flow patterns can be projected on to a wide screen using an overhead projector.
Two strings are fastened on one side at equal distances between two glass plates. The strings move according to the air currents between the two glass plates. Bodies of different shapes can be introduced in the air current. The inserted bodies can be moved to various positions in the air current from outside.

Dimensions: approx. 385x310x75 mm^3
Weight: approx. 3.2 kg

Contents:
1 Air flow apparatus
1 Circular body
1 Rectangular body
1 Streamlined body
1 Wing section
2 Bodies to demonstrate narrowing of flow

Additionally required:
U15425-230 Air Flow Generator (230 V, 50/60 Hz)
or
U15425-115 Air Flow Generator (115 V, 50/60 Hz)



Example of an air flow pattern



U8404300

U8404255

Laminar Flow Apparatus

For demonstrating and investigating the laminar flow properties of water. The emergence of currents in water, the flow of current in the case of straight laminar flow and the overflow of differently shaped bodies can be studied. The flow of current at a narrows can also be demonstrated clearly. A rectangular piece of velour paper is placed in the apparatus consisting of an upper and lower trough. Owing to capillary forces, water from the upper trough is drawn in by the paper. The water flows down into the velour paper. The flow of water in the upper level is marked with a dye at constant intervals. Owing to the low speed of flow of approx. 2 mm/s, the development of currents can be observed with the help of the dye. After the velour paper has been dried, a lasting current pattern remains, which can be copied and evaluated.

Dimensions: approx. 220x140x240 mm^3
Weight: approx. 1.3 kg

Contents:
2 Glass basins
1 Mask
20 Sheets of velour paper with cut-outs
1 Mini-flask with dye
Swab for dye



U8404255

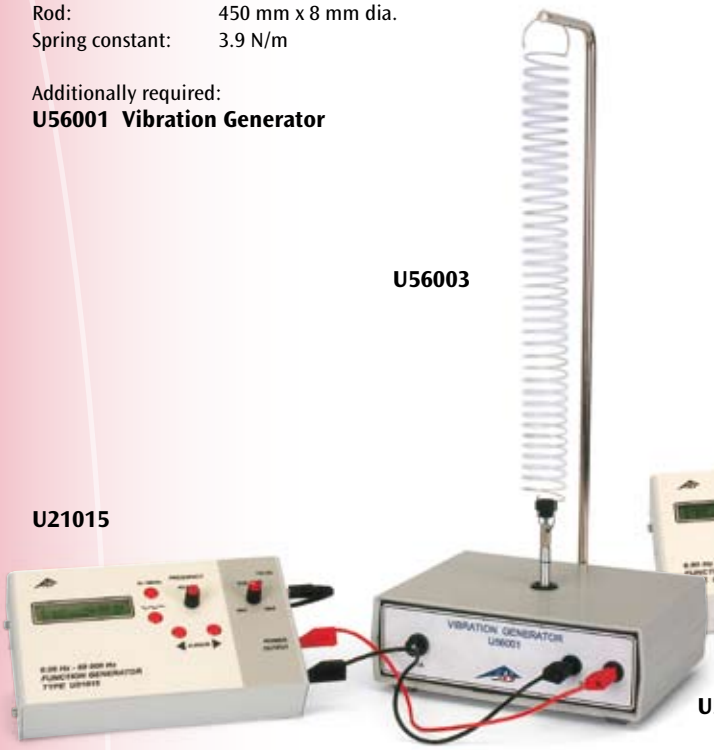
U56003

Accessories for Spring Oscillations

Accessories for vibration generator U56001 for demonstrating standing longitudinal waves in a coil spring. Consisting of angled stand rod, coil spring and connector pin for attachment of the spring to the vibration generator.

Rod: 450 mm x 8 mm dia.
Spring constant: 3.9 N/m

Additionally required:
U56001 Vibration Generator

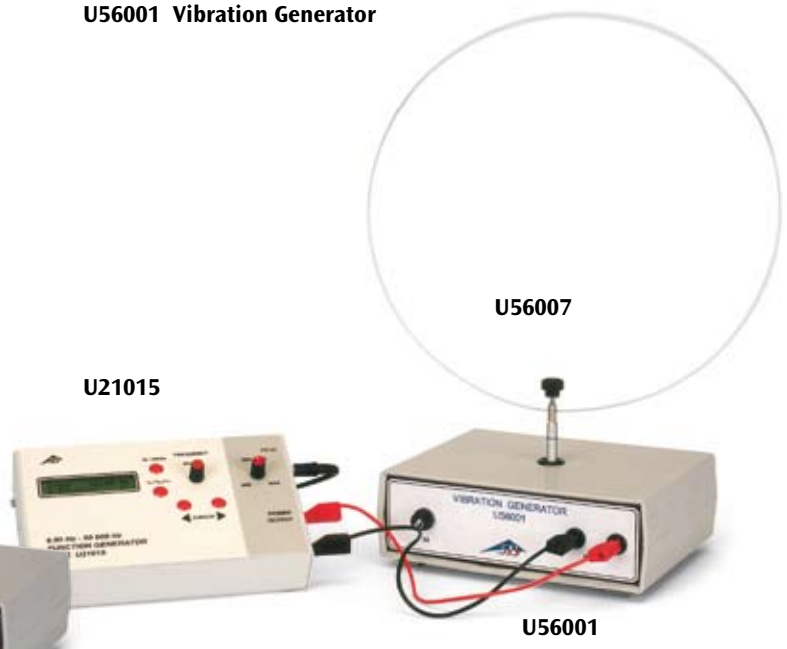


U56007

Resonance Wire, Ring Shaped

Accessories for vibration generator U56001 for demonstrating the vibration knots in determination of different frequencies. Wire ring with 4 mm plug.
Diameter: 290 mm

Additionally required:
U56001 Vibration Generator



U56002

Rubber Band

For demonstrating stationary waves and wave propagation e.g. using of the vibration generator U56001. Wound on a board, 25 m, 2 mm dia.

Additionally required:
U56001 Vibration Generator

U56008

Accessories for Rope Waves

Accessories for vibration generator U56001 for the investigation of standing transversal waves and their wavelengths as a function of the rope tension at constant frequency. Consisting of a base plate with stand rod, holder for dynamometer, deflection device and rubber rope.
Rope: 1m
Base plate: approx. 180x180x25 mm³

Additionally required:
U56001 Vibration Generator
U20033 Dynamometer 2 N



U56001

Vibration Generator

Vibration generator for exciting oscillations and waves mechanically, e.g. in coil springs, a rubber cord, a wire ring or a Chladni plate. In robust plastic housing including mounting pin with 4 mm socket for attaching accessories (Chladni plates, resonance wire, rubber band etc.).
Including holder for stand rod (up to 8 mm Ø) on the rear side of the apparatus for the demonstration of standing waves in a coil spring.
The generator is equipped with overload protection.
Connection: via 4-mm safety sockets
Impedance: 8 Ω
Frequency range: 0 up to 20 kHz
Overload protection: 1 A fuse
Dimensions: approx. 200x160x70 mm³
Weight: aprox. 1.4 kg

Additionally required:
U21015-230 Function Generator (230 V, 50/60 Hz)
or
U21015-115 Function Generator (115 V, 50/60 Hz)



Chladni's Plates

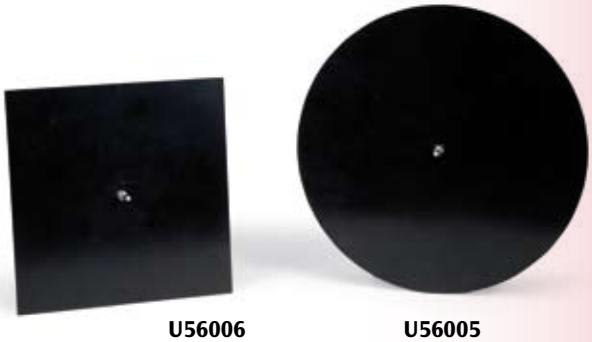
Metal plates for generating acoustically excited figures in fine dry sand, as in the experiment by Chladni. To be used for instance in conjunction with vibration generator U56001 or horn speaker U8432680. With 4-mm plugs.

U56005

Chladni Plate, circular, 240 mm dia.

U56006

Chladni Plate, square, 180x180 mm²



U56006 U56005

Additionally required:
U56001 Vibration Generator
or
U8430245 Holding Rod with 4-mm Bore
U8611200 Barrel Foot
U8432680 Horn Loudspeaker
U8533550 Sine-Wave Generator
U8475430-230 Transformer 12 V, 25 W (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 W (115 V, 50/60 Hz)



U56006
U8611200, U8430245
U8432680
U8533550



U21015 U56006
U56001

U8552330

DC Motor 12 V

Compact experiment motor – can also be used as a tachogenerator, oscillation generator or for the excitation of rope waves.
The motor has a coreless rotor and thus has a high starting torque at a lower moment of inertia. It is characterised by a very short starting time, smooth running and low running noise. On its axis, the motor has a threaded bush with a screw on retaining pulley. Thus, plates and levers too can be fixed on to the axis.

Nominal voltage/current:	12 V/260 mA DC
Run-up voltage/current:	0.5 V/45 mA DC
Power consumption:	3.6 W
Nominal speed	3900 rpm
Nominal rated torque:	0.5 Ncm
Direction of rotation:	Reversible
Dimensions in mm:	approx. 130x55 mm²
Weight:	approx. 200 g

U8431776

Band Wave Device

Equipment set for demonstrating transverse standing waves with a cord and investigating how the tension and mass per unit length of the cord affects the wavelength at constant frequency.

Dimensions:	700x150x230 mm³
Weight:	approx. 4.4 kg

Contents:
1 Chassis
1 Rubber cord
2 Pulleys on an axle
2 Axle clips
1 Stand rod, 40 cm
1 Weight holder with two slotted weights (3 x 10 g)

Additionally required:
U8552330 DC Motor 12 V
U8533550 Sine-Wave Generator
U8475430-230 Transformer 12 V, 25 W (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 W (115 V, 50/60 Hz)



U8552330
U8552330
U8533550
U8431776

Experimental topics:

- Propagation of a moving wave
- Wavelength, frequency and phase velocity
- Reflection of waves at fixed or moving ends
- Standing waves and resonance in the case of fixed or moving ends
- Constructive and destructive reinforcement of waves
- Propagation and speed of communication for a disturbance of equilibrium.
- Reflection of a disturbance of equilibrium at fixed or moving ends
- Damping of moving waves
- Reflection at a transition (experiment only possible with full set)
- Coupling at a transition (experiment only possible with full set)



U8405830

U8405830

Coil Spring Slinky

Long coil spring for demonstrating the propagation and reflection of longitudinal waves.

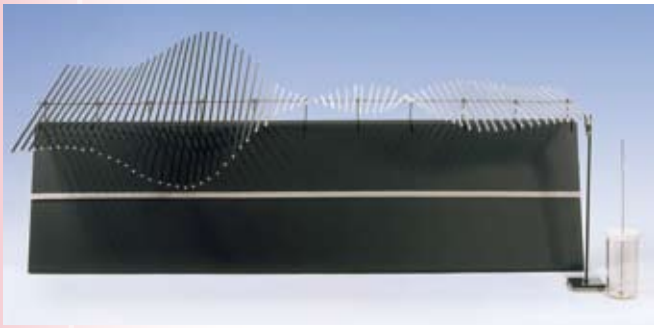
Length:	200 mm – approx. 5 m
Total number of turns:	approx. 330
Coil diameter:	approx. 70 mm
Weight:	approx. 550 g

U8431805

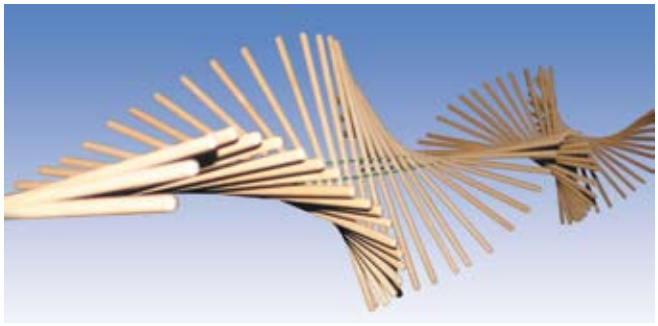
Wave Machine, Hand-Held Device

Demonstration equipment for displaying propagation, reflection, diffraction and superimposition of transverse waves.
A chain of wooden double-ended pendulums joined together by a bifilar thread.
Two handles allow the chain to be held by hand and excited.
Pendulum weights are supplied for altering the moment of inertia.

Number of double pendulums:	79
Length:	3 m
Weight:	approx. 0.8 kg



U45012



U8431805

U45012

Demonstration Wave Machine, Single Module

Wave machine for conducting various demonstration experiments to show the behaviour and properties of transverse waves.
The motion of the wave is demonstrated by a chain of 73 steel pendulum bars each soldered at their mid-point along a rod spring that can be subjected to torsion. The ends of the bars are painted on one side in fluorescent paint and on the other side with white paint. The machine is mounted on a foldable steel base. A damping mechanism is also supplied and a retaining clamp on a stem for demonstrating reflections at a fixed end.

Number of bars:	73
Length of bars:	460 mm
Total length:	920 mm

U45011

Demonstration Wave Machine, Complete Set

Supplement to the demonstration wave machine comprising a module with short pendulum bars, a transition module and two module couplers. If the two models with differing bar lengths and thus differing wave velocities are coupled together, then reflections can be observed at the point where they are joined together. This can be avoided by adding the transition module.

Length of bar module 1:	460 mm
Length of bar module 2:	230 mm
Length of bars for transition module:	230 – 460 mm
Total length:	2440 mm

U45011



Experiment topics:

- **Excitement of periodic and non-periodic waveforms**
- **Deflection, phase and amplitude**
- **Frequency and wavelength**
- **Phase and group velocities**
- **In-phase and out-of phase superimposition of waves**
- **Reflection of a wave**
- **Standing waves**

BESTseller

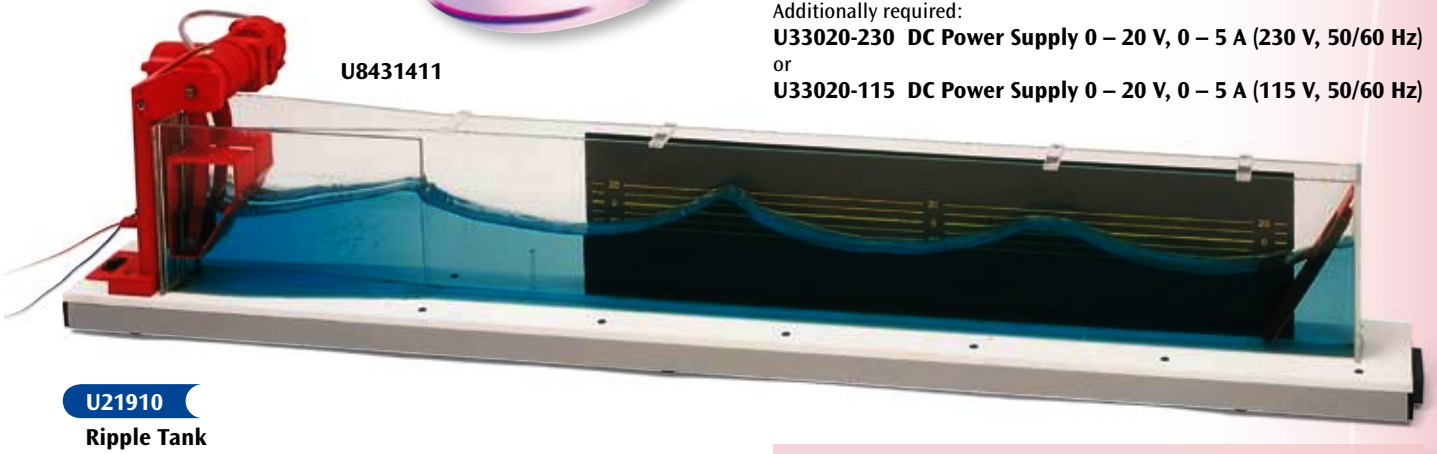
U8431411

Water Wave Channel

Wave channel for demonstrating or investigating the basic properties of waves using waves in water.
A plexiglas duct is filled with water and a sinusoidal wave is generated that propagates with no reflection at the end thanks to an absorber mechanism. The frequency and thus the wavelength of the resulting movement can be varied continuously. In order to investigate reflection, the absorber at the end can be removed. Two exciting mechanisms are supplied that can be operated in or out of phase and the waves they generate can be viewed separately or superimposed. By applying a pulsed input to the exciters, non-periodic waves can be generated.

Supply voltage:	9 – 12 V DC
Power consumption:	40 W max.
Connectors:	4-mm safety sockets
Frequency range:	Continuously adjustable
Dimensions:	approx. 1500x150x290 mm³
Weight:	approx. 12.6 kg

Additionally required:
U33020-230 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)



U8431411

U21910

Ripple Tank

Equipment set for demonstrating or investigating the basic properties of waves using waves in water.
The ripple tank consists of a shallow basin with a glass bottom inside an aluminium frame. A halogen lamp operated via a stroboscope illuminates the tank from above. Underneath the tank is a diagonally aligned mirror that is used to project the waves onto a frosted glass screen. Waves in the water are produced via the oscillation of an electromagnetic vibrator, to which dippers for straight waves or up to three dippers for making concentric waves can be attached. A control unit sets the amplitude and frequency of the vibrations and the frequency of the stroboscope either synchronously or asynchronously. 4-mm safety sockets are provided for connecting a counter/timer in order to measure the frequency of the vibrations.

Frequency range:	Continuously adjustable
Supply voltage:	9 – 12 V DC
Connectors:	4-mm safety sockets
Lamp:	Halogen lamp 12 V / 100 W, GY6.35
Dimensions of tank:	approx. 295x395x10 mm³
Dimensions of frame:	approx. 340x440x345 mm³

Contents:

1 Ripple tank with projection mirror; lamp and stroboscope
1 Control unit
1 Vibrator
1 Dipper for straight waves
3 Dippers for concentric circular waves
1 Holder for circular wave dippers
3 Bodies that can be laid in the tank to demonstrate reflection and diffraction (prism, bi-concave and bi-convex lenses)
1 Obstruction with a wide gap and four separate small gaps
2 Narrow covers
2 Wide covers
1 Drainage tube
1 Tube clamp

Additionally required:
U33020-230 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

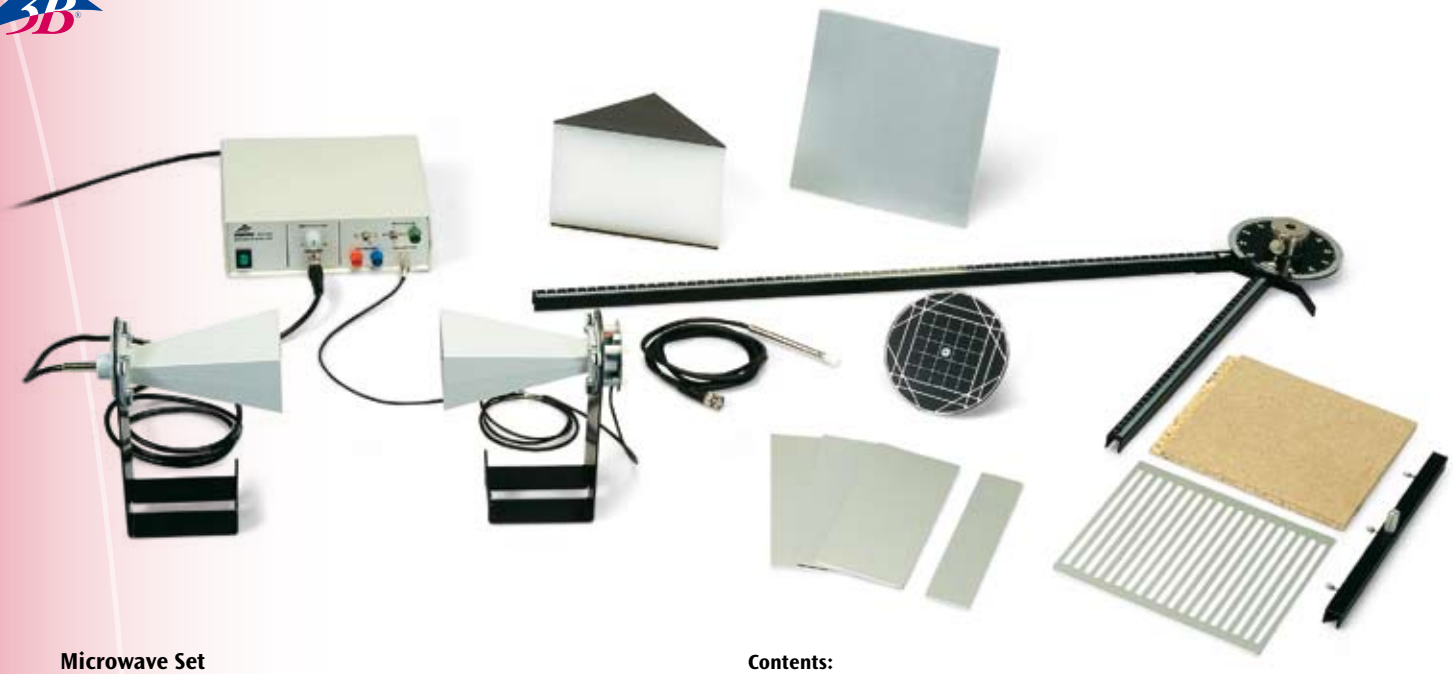
Experiment topics:

- **Generation of circular and straight waves**
- **Reflection**
- **Refraction**
- **Interference**
- **Diffraction**
- **Doppler effect**

BESTseller



U21910



Microwave Set

Equipment set for conducting wave optics experiments involving wavelengths in the cm range.

A transmitter with a horn antenna radiates a narrow beam of linearly polarised electromagnetic waves with a wavelength of about 3 cm. The direction of polarisation can be altered by rotating the antenna around the axis of propagation. To detect the waves, a horn antenna receiver and a microwave sensor are provided. A control unit converts the intensity of the signal received into a proportionally large output voltage that can be measured using a voltmeter. It is also possible to switch on an acoustic signal with a volume that is proportional to the intensity of the signal.

Oscillator frequency:	9.5 GHz
Power of transmitter:	10 – 25 mW
Internal modulation:	100% switchable
Internal modulator frequency:	3 kHz approx.
Acoustic signal:	Switchable
External modulation:	0 – 150 mV (Urms) / 50 Hz – 50 kHz
Output voltage:	10 V max.
Receiver with horn antenna:	Silicon diode with resonator
Microwave sensor:	Silicon diode with resonator
Dimensions of basic apparatus:	approx. 160x200x75 mm³

Contents:

1 Control unit
1 Transmitter with horn antenna
1 Receiver with horn antenna
1 Microwave sensor
1 Microwave bench, 800 mm
1 Folding microwave bench, 400 mm
1 Plate holder
1 Metal plate, 195 x 195 mm
3 Metal plates, 195 x 80 mm
1 Metal plate, 195 x 40 mm
1 Polarisation grating, 195 x 200 mm
1 Fibre absorption plate, 95 x 195 mm²
1 Paraffin prism
1 Prism table

U8492900-230

Microwave Set (230 V, 50/60 Hz)

or

U8492900-115

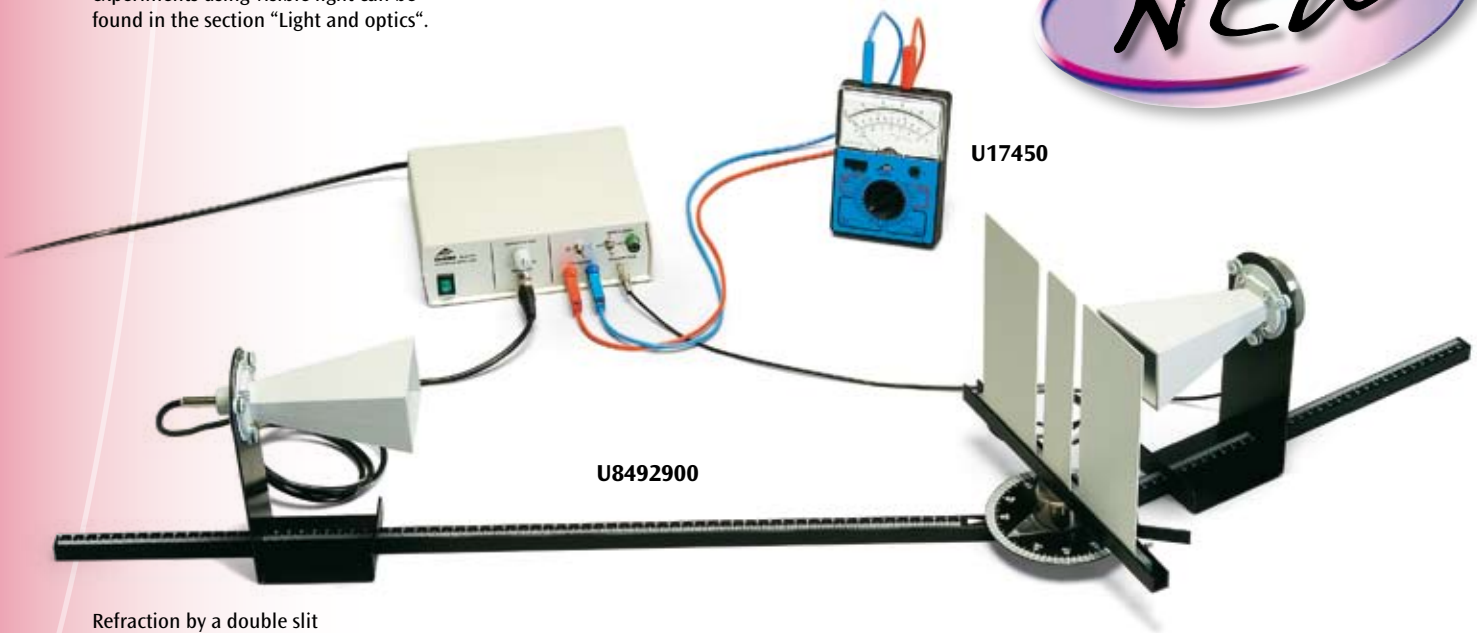
Microwave Set (115 V, 50/60 Hz)

Additionally recommended:

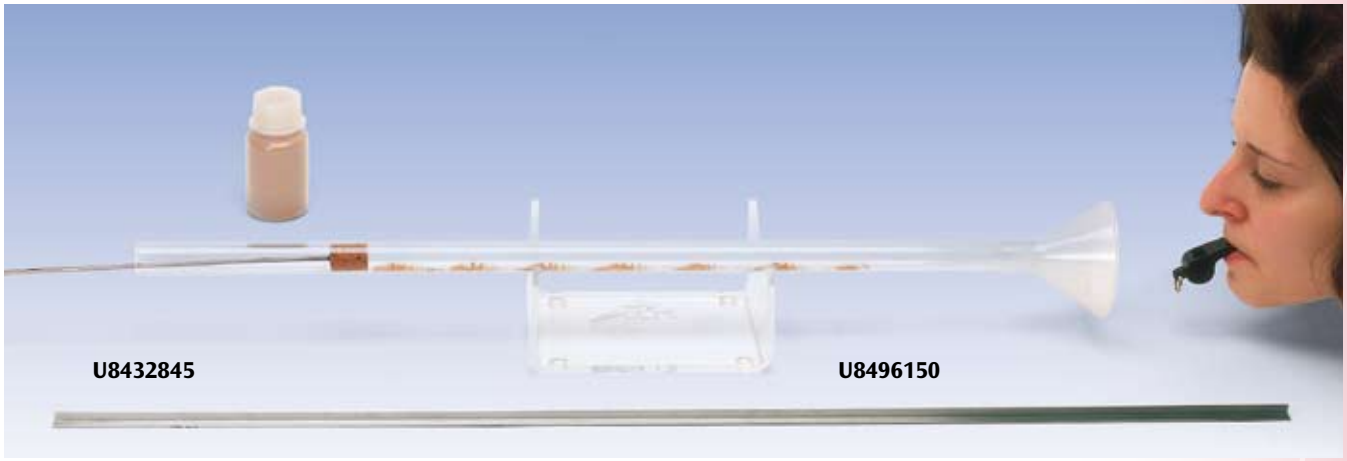
U17450 Analogue Multimeter

Note:

Our recommendations for wave optics experiments using visible light can be found in the section “Light and optics“.



Refraction by a double slit



U8432845

Kundt's Tube

Glass tube for demonstrating standing sound waves and calculating wavelengths of sound using cork powder in a method devised by Kundt. Cork powder is spread evenly throughout the tube by means of a filler chute. Then a sound source, e.g. a whistle, a 1700 Hz tuning fork (U10115) or a horn speaker (U8432680), is used to excite the powder into a regular pattern of nodes and anti nodes. The effective length of the tube can be altered by means of a piston.

Length:	600 mm
External diameter:	20 mm
Internal diameter:	17 mm

Contents:

1 Glass tube with funnel
1 Plunger
1 Filler chute
1 Whistle
1 Bottle of cork powder

Additionally recommended:
U8496150 Plexiglas Stands



U8432850

U8432850

Cork Powder, 10 g Bottle

Fine cork powder for use in Kundt's glass tube (U8432840).

U20602

Battery Box

Accessories for probe microphone U20601 including a power supply and equipment for connecting the microphone to a meter or oscilloscope. The equipment includes a battery compartment for one 9 V alkaline battery and a voltage regulator to output the requisite 5 V DC.

Output voltage:	5 V DC
Input channels:	two 6-pin DIN sockets (180°), 8-pin DIN socket (270°)
Outputs:	two 5-pin DIN sockets, two 4-mm safety sockets.
Dimensions:	approx. 143x84x37 mm³

U20600

Kundt's Tube with Scale

Transparent acrylic tube with scale and end plates for measuring standing acoustic waves and determining their wavelength in air or in other gases. With tubing nozzles for filling the tube with various gases, built-in speaker at one end, a bore and guide for accommodating moving piston or probe microphone U20601 at the other end. Includes retaining clips for mounting on stands and a connector lead for the speaker.

Tube nozzle:	7 mm dia.
Length:	1000 mm
Diameter:	70 mm

Additionally required:
U8611200 Barrel Foot, 0.9 kg (2x)
U20601 Probe Microphone
U21015-230 Function Generator F12 (230 V, 50/60 Hz)
or
U21015-115 Function Generator F12 (115 V, 50/60 Hz)

U20601

Probe Microphone

Probe microphone for measuring changes in sound pressure in a Kundt's tube with the assistance of a scale U20600. A miniature microphone is attached to one end of a long stainless steel rod.

Frequency range:	20 Hz – 20000 Hz
Dimensions:	approx. 740 mm x 8 mm dia.
Connector lead:	2 m
Connectors:	DIN plug suitable for battery box U20602.

Additionally required:
U20602 Battery Box



U20602



U20601



U20600

U8611200



U55001

U55001

Demonstration Tuning Fork

Large tuning fork for demonstrating the vibrating legs of the fork.

Length:	750 mm



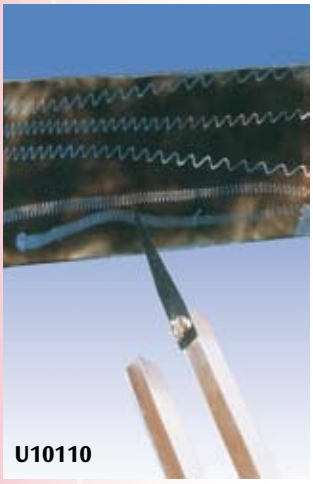
U8431030

U8431030

21 Hz Tuning Fork with Plotter Pen

Tuning fork that allows for plotting oscillations on a sheet of paper. The oscillation is triggered by pushing the prongs of the fork together. The oscillation of the tuning fork is highly visible both with the naked eye or with the aid of a stroboscope. Includes a plotter pen with holder and a counterweight.

Natural frequency:	21 Hz
Length:	245 mm
Total weight:	approx. 170 g



U10110



U10117

U10110

Recording Tuning Fork, c 128 Hz

For demonstrating and recording sound oscillations. For recording the oscillations on a sooted glass plate one of the two prongs is equipped with a metal tip. Complete with a glass plate.

Natural frequency:	128 Hz
Total length:	approx. 280 mm
Glass plate:	120x50 mm^2

U10117

Tuning Fork, 2000 Hz

Tuning fork with handle for demonstrating the Doppler Effect. The effect can be exhibited very impressively by moving the fork slowly toward and away from the audience.

Natural frequency:	2000 Hz
Length of the tuning fork:	220 mm

Additionally recommended:
U10118 Hard Striking Hammer



U10115



U10116

U10115

Light Metal Tuning Fork, 1700 Hz

Suitable as a source of intense, high-frequency sound, for example, for producing stationary sound waves in Kundt's tube.

Natural frequency:	1700 Hz
Length:	approx. 105 mm

U10116

Light Metal Tuning Fork, 1000 Hz

Suitable as a source of intense, high-frequency sound, for example, for producing stationary sound waves in Kundt's tube.

Natural frequency:	1000 Hz
Length:	approx. 115 mm



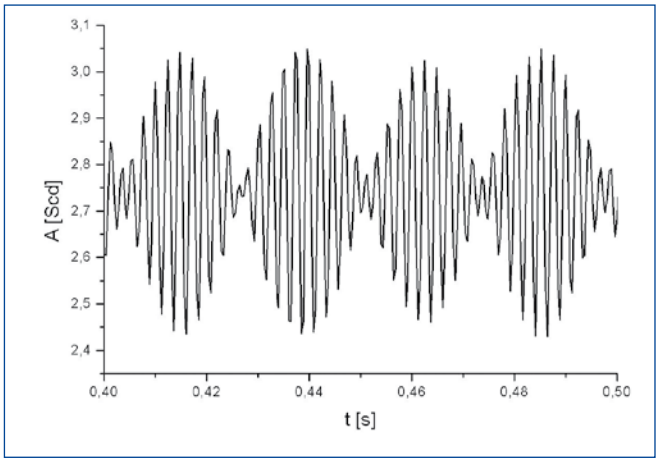
U10121

U10121

Tuning Fork, 440 Hz, on Resonance Box

Long-sustain tuning fork mounted on a resonant chamber made of clear grained fir wood. Removable, includes a soft striking hammer U10122.

Natural frequency:	440 Hz
Length of the tuning fork:	approx. 170 mm
Resonance box:	180x90x50 mm^3



Acoustic beats

BESTseller



U10120

U10120

Pair of Tuning Forks, 440 Hz, on Resonance Boxes

Pair of Tuning Forks for experiments on beats; the tuning forks are identical with (U10121). Complete with a soft striking hammer (U10122) and a pair of tuning weights (U10119).

U10125

Set of Tuning Forks, C-Major Chord, on Resonance Boxes

Set of four tuning forks for demonstrating C major chord. Supplied on a sound box made of clear grained pine for especially long sustain from which the tuning forks can be removed. Includes a soft striking hammer (U10122).

Natural frequency:
c' = 256 Hz
e' = 322 Hz
g' = 384 Hz
c'' = 512 Hz



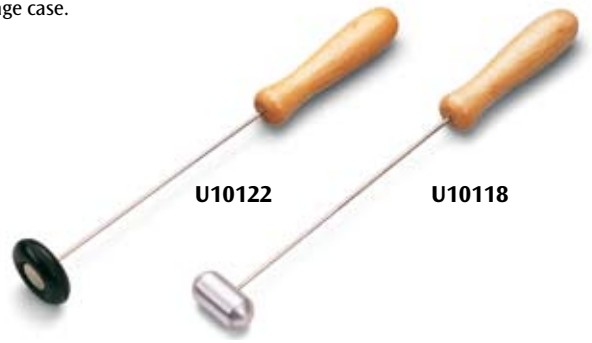
U10125

U10100

Set of Tuning Forks for the C-Major Scale

Set of 8 tuning forks in a storage case.

Frequencies:
c' = 256 Hz
d' = 288 Hz
e' = 320 Hz
f' = 341⅓ Hz
g' = 384 Hz
a' = 426⅔ Hz
h' = 480 Hz
c'' = 512 Hz



U10122 U10118



U10100

U10122

Striking Hammer, Soft

Rubber beater particularly suited for striking low-frequency tuning forks, e.g. tuning forks on sound box (U10120, U10121 and U10125).

U10118

Striking Hammer, Hard

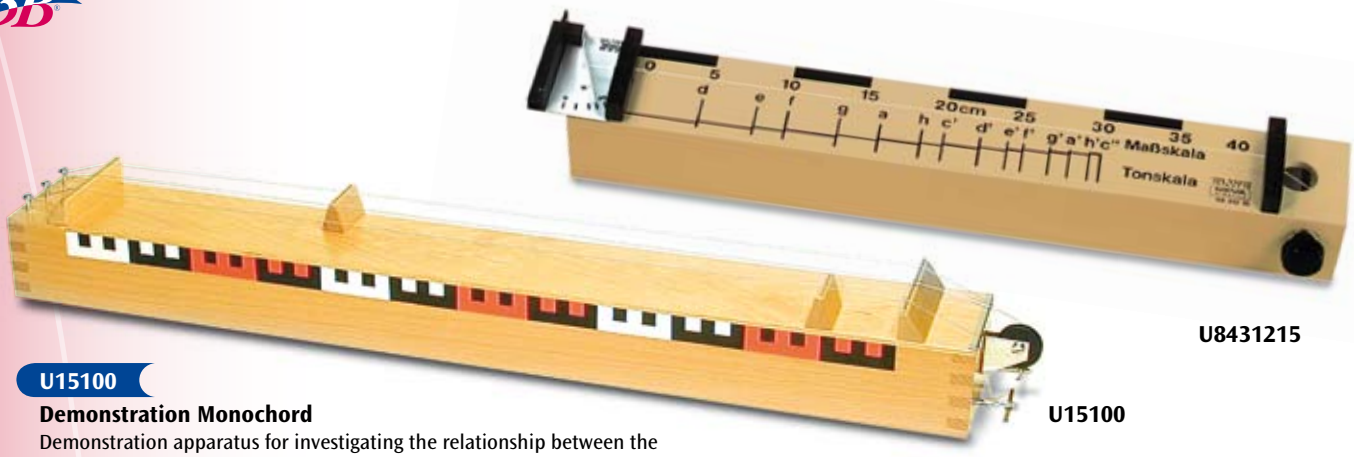
Aluminium beater particularly suited for striking high-frequency 2000 Hz tuning fork (U10117).

U10119

Pair of Tuning Weights

Two tuning weights for changing the frequency of tuning forks for beat experiments; intended for the 440-Hz tuning fork mounted on a resonance box (U10121).

Vissza a tartalomjegyzékhez!



U8431215

U15100

U15100

Demonstration Monochord

Demonstration apparatus for investigating the relationship between the pitch of a sound and the length of the string making it. Also for investigating overtones formed by harmonic waves with intermediate nodes and the dependence of the pitch on string tension.
Two steel strings and one nylon string are stretched over a sound box. The tension on two of the strings can be altered by tuning pegs while the other's tension can be changed by adding weights or using a dynamometer at the end of a cord passed over a pulley. The effective length of the strings can be altered by means of two moving bridges.

Scale length:	600 mm
Scale division:	cm and dm
Dimensions of the resonance box:	approx. 700x90x70 mm³

Additionally required:
U40815 Dynamometer 50 N

U15101

Set of 3 Monochord Strings

Two steel and one nylon string with eyelets, fitting the monochord U15100.

U8431215

Monochord

A wooden box open at both ends, with a clamping mechanism for a string to demonstrate the relationship between pitch and string length and the dependence of pitch on string tension. Includes an indicator for the tensioning force, as well as a steel string (tuned to B) and a nylon string.

Dimensions:	approx. 490x70x60 mm³

U8430160

Reed Pipe

Reed pipe with 8 valves, tuned to G major.

Length:	37 cm
Weight:	approx. 90 g



U8430160

Helmholtz Resonator

Hollow glass bulb with a narrow tube leading out for demonstrating acoustic resonance. The fundamental oscillation is generated by blowing into the opening or tapping on the outside of the bulb.
The elasticity and inertial mass of the air in the bulb cause the bulb to act as an acoustic resonator with a highly distinct resonant frequency. The frequency is dependent on the dimensions of the bulb and the tube.
With a whole set of Helmholtz resonators it is possible to demonstrate how tones combine to form a tonal mixture.

Opening on the glass bulb:	14 mm dia.
Length of tube:	15 mm
Internal diameter of tube:	6 mm

U8430310

Helmholtz Resonator, 70 mm dia.

U8430320

Helmholtz Resonator, 52 mm dia.

U8430330

Helmholtz Resonator, 40 mm dia.

U8430340

Helmholtz Resonator, 32 mm dia.

U15110

Lip Whistle

Lip whistle for experiments on pitch as a function of resonance space. Closed wooden whistle with a square cross-section and movable piston, chromatic range from g1 (392 Hz) to g2 (794 Hz).

Frequency range:	approx. 400 Hz –800 Hz
Resonance space:	approx. 180x24x24 mm³
Length:	approx. 550 mm



U15110



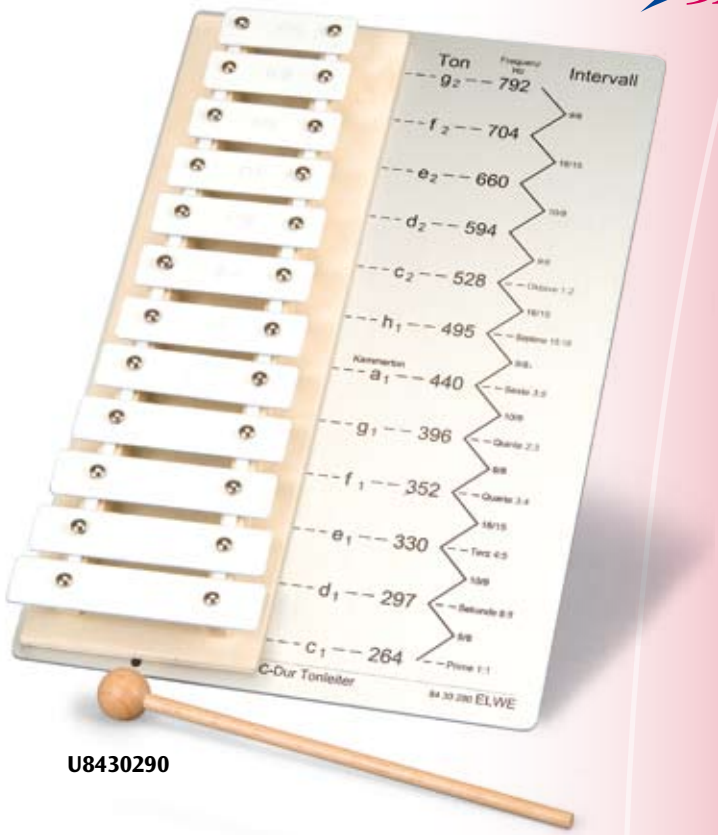
U8430310 U8430320 U8430330 U8430340

U8430290

Metallophone

Metallophone for demonstrating a C major scale from c1 to g2.
Note labels, frequencies and intervals are printed on the base plate.
With striking hammer.

Dimensions:	approx. 320x210 mm²
Weight:	approx. 510 g



U8430290



U8432780

U8432780

Low-Frequency Loudspeaker

Bass loudspeaker in a housing with 4-mm sockets. Loudspeaker diaphragm and spherical cap visible.

Frequency range:	20 – 7000 Hz
Max. load capacity:	40 W
Impedance:	4 Ω
Dimensions in mm (LxWxH):	approx. 190x180x200 mm³
Weight:	approx. 2.3 kg

U8432680

Horn Speaker

Speaker that approximates to being a point source for excitation of Chladni plates U56005 and U56006 or Kundt's tube U8432845, for example.
Without barrel foot.

Frequency range:	300 Hz – 10 kHz
Max. load capacity:	6 W (max. 10 W)
Impedance:	8 Ω
Shaft:	10 mm dia.
Weight:	approx. 470 g

Additionally recommended:
U8533550 Sine Wave Generator

U11801

Sound Level Meter, Digital

Universally deployable meter used to determine the sound level of any number of acoustic sources across a wide sound range. Device is housed in a robust plastic casing with integrated calibration signal and large LCD display for easy reading of measured values. Includes range selection switch and maximum hold function. There are two evaluation levels (A and C) available for the frequency. The measurement in the A-range is oriented on the human ear and is particularly well suited for measurements out in the open, while the C-range is designed for measurements of motor noise. The device's response time can be adjusted between fast and slow. The slow mode brings about attenuation of the measurement i.e. the measured value displayed corresponds to the average sound level. Fast mode is used to measure brief noise sequences and to determine the maximum noise level. Furthermore, the device also offers the option of connecting an external measuring instrument (e.g. for compiling and printing out measurement sequences) via an analogue output (phone jack). On the underside of the sound level meter there is a drill hole for attaching to a stand.
Supplied in a foam lined portable bag.

Measurement range:	35 – 130 dB
Resolution:	0.1 dB
Accuracy:	± 3.5 dB at 94 dB (1kHz)
Display:	3½-digit LCD display
Digit height:	17 mm
Microphone:	Electret capacitor micorphone
Power supply:	9 V block-type battery
Dimensions:	251x64x40 mm³
Weight:	approx. 250 g

U11801





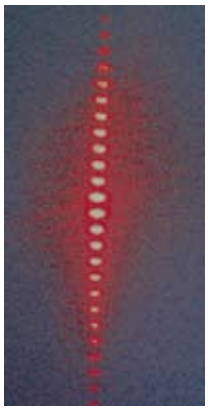
U8432680

U8611200

Debye-Sears Effect

In 1932, Debye and Sears for the first time demonstrated the refraction of light as it passed through a liquid being subjected to high-frequency vibrations. In this process, the density maxima and minima of a stationary ultrasonic wave act like the elements of an optical diffraction grating. The grating constant here is equal to half the wavelength and therefore dependent on the frequency and speed of the ultrasonic waves transmitted through the medium (e.g. water, glycerin, oil).





Equipment for the Debye-Sears Effect:
U100061 Ultrasonic CW Generator
U10008 Test Vessel
U10007 Laser Diode for the Debye-Sears Effect, red
U10009 Laser Diode for the Debye-Sears Effect, green

U100061

Ultrasonic cw Generator

Ultrasonic generator for producing continuous, high-powered ultrasonic waves in a wide frequency range of up to 20 MHz. Includes a multi-frequency probe with waterproof cast sound transmitting surface.
The transmitter frequency can be adjusted in digital increments of 1 Hz and is indicated on a display. The acoustic power can also be adjusted by regulating the transmitter voltage of the ultrasonic converter and can be turned on and off separately. The transmitting mode is shown by an indicator lamp. The transmitter voltage is shown on an LCD display. The transmitter output supplies a sinusoidal signal with a maximum amplitude of 40 V. The transmitter frequency can also be output as a TTL signal from a monitor terminal.
There is also a suitable voltage output for controlling the red and green laser diodes in the Debye-Sears experiment. This, too, can be turned on and off separately and has its own indicator light. The apparatus automatically detects any laser probe that is connected and adjusts the control voltage accordingly.

Generator frequency:	≤ 20 MHz
Multi-frequency probe:	1 – 13 MHz
Frequency increment:	1 Hz
Signal amplitude:	2 – 40 V
Output:	Transmitter signal (sinusoidal), separately switchable with indicator light, TTL (0 – 5 V, square)
Connection:	Laser diode, adjustable, separately switchable with indicator light
Display:	Voltage/frequency
Power consumption:	approx. 100 VA
Mains voltage:	90 – 230 V, 50/60 Hz
Dimensions:	approx. 256x185x160 mm³

U10008

Test Vessel

Made of transparent acrylic, with a lid and a transducer mounting for conducting the Debye-Sears experiment or projecting ultrasonic waves with divergent light. Three adjustment screws can be used to produce a stationary wave. A laser fixture with a lens mounting aligned vertically to the sound axis. Includes a plano-convex lens on a square mounting for the projection.

Test vessel:	100x100x120 mm³
Testing volume:	approx. 1 litre
Laser fixture:	18 mm dia.
Lens:	Plano-convex, f=100 mm, 16 mm dia.

U10007

Laser Diode for Debye-Sears Effect, Red

Laser diode of protection classification II with 1 m connector lead and barrel connector for connecting ultrasonic cw generator U100061. Fits the laser holder of test vessel U10008. All lasers have been measured to determine their wavelength specifically and the results are logged.

Wavelength:	approx. 550 nm
Power:	< 1 mW
Supply voltage:	3 V DC
Current consumption:	max. 30 mA
Dimensions:	90 mm x 17 mm dia.

U10009

Laser Diode for Debye-Sears Effect, Green

Laser diode of protection classification IIIa with 1 m connector lead and barrel connector for connecting ultrasonic cw generator U100061. Fits the laser holder of test vessel U10008. All lasers have been measured to determine their wavelength specifically and the results are logged.

Wavelength:	approx. 432 nm
Power:	< 5 mW
Supply voltage:	3 V DC
Current consumption:	max. 250 mA
Dimensions:	90 mm x 17 mm dia.

U10010

Ultrasonic Echoscope

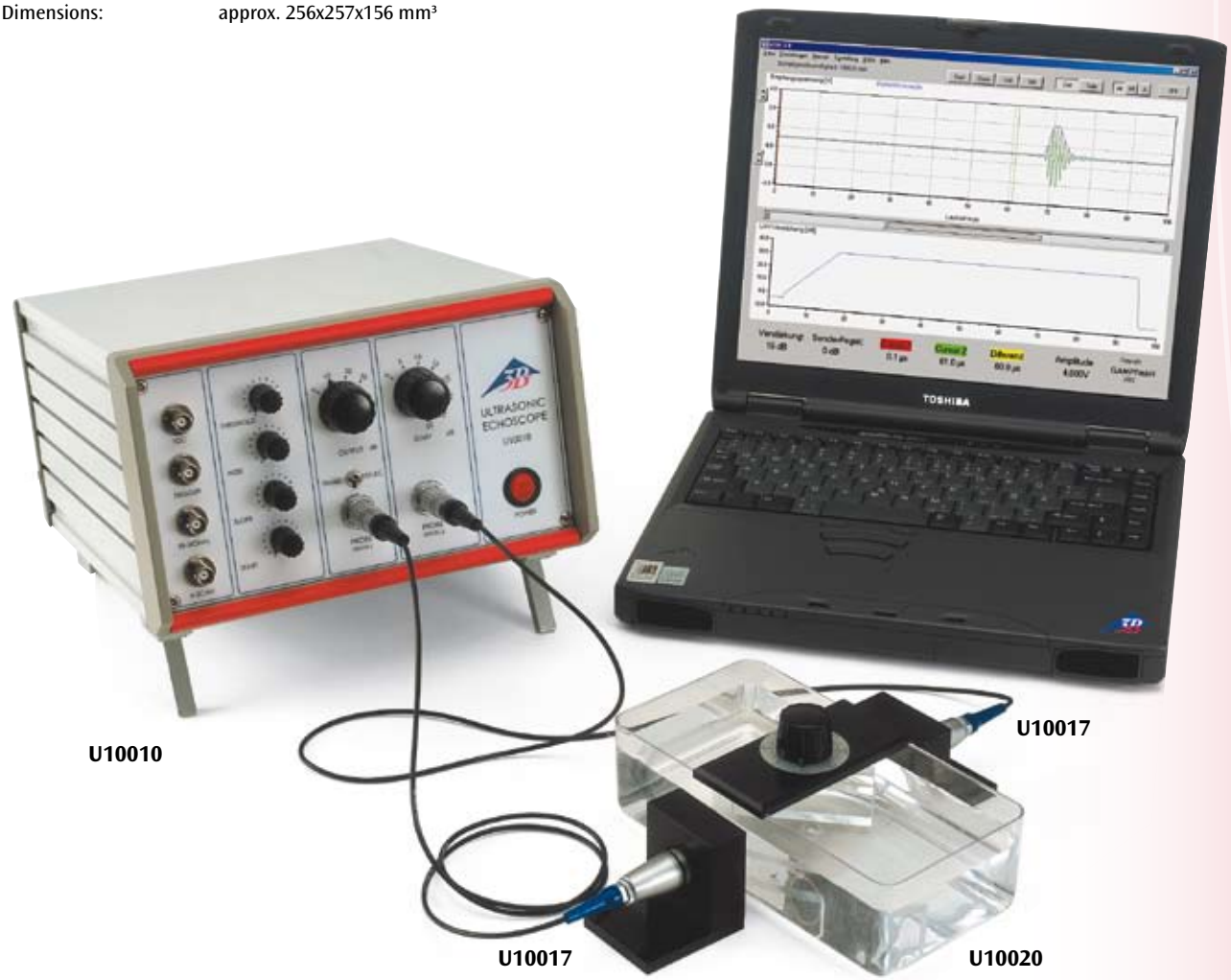
Operational device for conducting ultrasonic experiments in reflection mode (pulse echo principle) or in through-transmission mode with 1 MHz (U10015), 2 MHz (U10016) and 4 MHz (U10017) transducers. With the built-in transmission and receiving unit, time gain control (TGC), integrated analogue-digital converter and microprocessor for connection to the measuring and evaluating computer via the parallel interface.
Connection of the ultrasonic transducer via robust snap-in sockets with automatic frequency recognition. Compensation on intensity losses of the transmitted ultrasonic pulse in the test bodies or test liquids using time gain control (TGC) with adjustable threshold value, starting value and location or time-dependent amplification factor. The most important function signals (trigger, TGC, AF signal (amplitude signal), RF signal) are available via BNC sockets on the front of the device.
Includes measurement and evaluation software for Windows 32 bit operating systems, Windows 95/98/ME/NT/2000/XP supported. Screen display of the receiver signal (echogram) and the simultaneous TGC signal, whereby the AF and RF signals can be recorded individually or both simultaneously in the echogram as a function of time or penetration depth. Display of all currently set system parameters (transmission power, frequency, gain etc.), Fast Fourier Analysis, depiction of 2-dimensional ultrasonic images (B-image) and the time characteristic of time motion reflection layers (Time-Motion Methods). Ultrasonic transducer not included.

Frequency range:	1 – 5 MHz
Transmission signal:	Dirac pulse (< 1 µs, 10 V to 300 V)
Transmission power:	0 – 30 dB, in 10 dB steps
Gain:	0 – 35 dB, in 5 dB steps
TGC:	Continuously adjustable threshold value, start value, rise time and gain time, Maximum gain of 30 dB
Connections:	TGC signal, trigger, low-frequency signal, high-frequency signal via a BNC jack in each case
PC connection:	Parallel, LPT, Sub D 25
Scanning rate:	10 MHz per channel
Power consumption:	approx. 20 VA
Mains voltage:	90 – 230 V, 50/60 Hz
Dimensions:	approx. 256x257x156 mm³

Experiment topics:

- **Propagation of longitudinal and transverse ultrasonic waves in solid bodies**
- **Determining velocity of longitudinal and transverse ultrasonic waves in solid bodies**
- **Determination of shear modulus, modulus of elasticity and Poisson number**
- **Attenuation of sound in solid bodies and liquids**
- **Frequency dependence of sound attenuation**
- **Time-dependent gain**
- **Frequency dependence of resolution**
- **Recording brightness images**
- **Recording ultrasonic echoes from moving boundaries (time-motion mode)**
- **Measurement of anomalies**

Equipment:
U10010 Ultrasonic Echoscope
U10008 Test Vessel
U10017 Ultrasonic Transducer 4 MHz (2x)



U10010 U10017 U10017 U10020

Vissza a tartalomjegyzékhez!



U10015

Ultrasonic Transducer, 1 MHz

Ultrasonic probe for tests involving large penetration depths or high acoustic power at low depth resolutions. It includes a 16-mm piezo-ceramic disc in a die-cast metal case and a 1-m long cable with a frequency-coded snap-in plug. The equipment is adapted to sound in water/acrylic glass.

Dimensions: 65 mm x 27 mm dia.

U10016

Ultrasonic Transducer, 2 MHz

Ultrasonic probe for investigations at medium penetration levels and depth resolution. It includes a 16-mm piezo-ceramic disc in a die-cast metal case, adapted to sound in water/acrylic glass, a 1-m long cable with a frequency-coded snap-in plug.

Dimensions: 65 mm x 27 mm dia.

U10017

Ultrasonic Transducer, 4 MHz

Ultrasonic probe for investigations with small penetration depths and maximum depth resolution. It includes a 16-mm piezo-ceramic disc in a die-cast metal case and a 1 m long cable with a frequency-coded snap-in plug. The equipment is adapted to sound in water/acrylic glass.

Dimensions: 65 mm x 27 mm dia.

U10020

Longitudinal and Transversal Wave Equipment Kit

Equipment kit for the investigation of the propagation of longitudinal and transversal waves (shear waves) as well as for the determination of elastic constants (shear modulus, elasticity modulus and Poisson's ratio) in solid bodies. Further for the determination of ultrasonic attenuation in liquids by means of time dependent amplitude measurement with sliding reflector (U10022). Consisting of acoustic basin, polyacrylic test plate in holder with protractor scale and two converter holders to accommodate and precisely position two 1 MHz (U10015), 2 MHz (U10016) or 4 MHz (U10017) ultrasonic converters on the acoustic basin.

Sound trough: 200x100x60 mm³
Test plate: 104x75x50mm³
Protractor scale: 360°, 5° divisions
Polyacrylate block: 70x45x10 mm³

Additionally recommended:
U10022 Aluminum Test Block with Protractor Scale
U10023 Polyoxymethylene Test Block with Protractor Scale

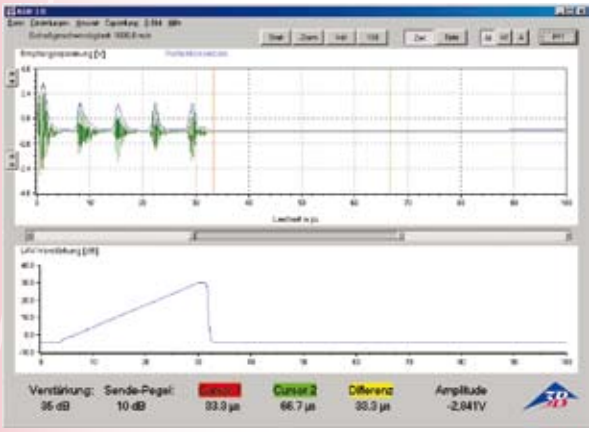
U100251

Pair of Reflection Blocks

These polished polyacrylate blocks are used to investigate multiple echoes and measure frequency-dependent attenuation.
A 4 MHz transducer (U10017) is especially suitable for such measurements. An echo pattern comprising at least 3 echoes is recorded, and the spectra of the individual echoes analysed. The result of the analysis is a shift in the average frequency toward lower frequencies, due to a stronger attenuation of the signal's high-frequency components.

Dimensions: 80x40x10 mm³





Multiple reflections from a mirror plate

U10022

Aluminum Test Block with Protractor Scale

This accessory to equipment set U10020 for longitudinal and transverse waves is used to examine the propagation of transverse waves in metals and ascertain the elastic constants of aluminum, such as its shear modulus, modulus of elasticity and Poisson ratio. The test block's very high reflectivity with high reflection coefficient in water provides sizeable signal amplitudes for measurements of attenuation in liquids (e.g. water, cooking oil or glycerin).

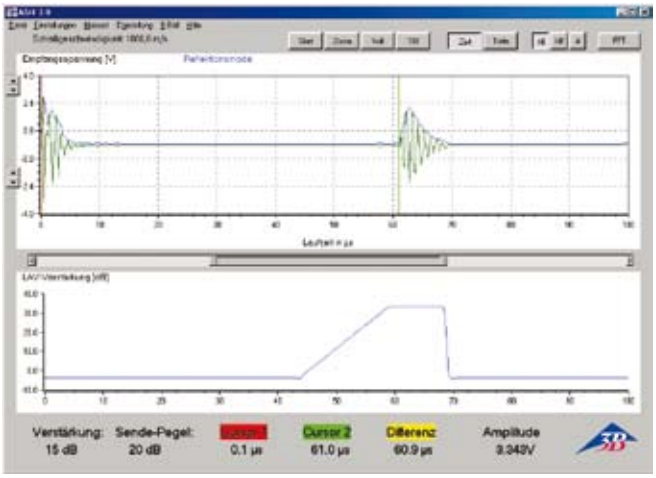
Protractor scale: 360°, 5° divisions
Aluminum block: 70x45x10 mm³
Dimensions: 104x75x50 mm³

U10023

Polyoxymethylene Test Block with Protractor Scale

This accessory to equipment set U10020 for longitudinal and transverse waves is used to examine the propagation of transverse waves in plastic and ascertain the elastic constants of polyoxymethylene (POM) such as its shear modulus, modulus of elasticity and Poisson ratio.

Protractor scale: 360°, 5° divisions
POM block: 70x45x10 mm³
Dimensions: 104x75x50 mm³



Pulse echo signal from a hole



U10027

XP999

Ultrasonic Coupling Gel

(not illustrated)

Secure the ultrasonic transducers to solid test objects with this special coupling gel, for example the sound trough (from U10020).

Volume: 250 ml

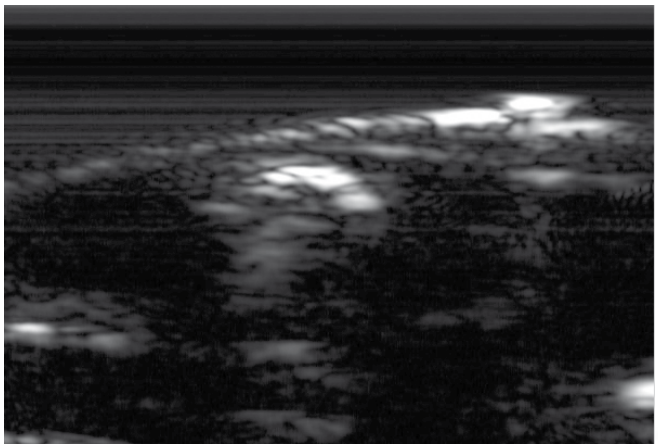
L55/1

Single Breast Model with Benign Tumor

Model of a woman's breast made of 3B SKIN*like*™ silicone with simulated benign tumor for the demonstration of ultrasonic B-image mode.



L51/1



B-image: breast model

U10027

Acrylic Body with Drilled Holes

Polished polyacrylic block with bores of various diameters and varying distance from the surface to determine the speed of sound and the attenuation of ultrasonic signals in polyacrylate, to localize defects, investigate aberrations resulting from acoustic shadows and ground returns, analyse frequency-dependent resolving power and display manual B-images. Both the 1 MHz (U10015) and 4 MHz (U10017) transducers are required for studying resolution.

Polished polyacrylate cuboid with holes of different sizes used to simulate defects located at various distances from the surface of the block.

Dimensions: 150x80x40 mm³

U10026

Set of 3 Cylinders

These polished polyacrylate cylinders are used to ascertain the speed of sound and the attenuation of ultrasonic waves in transparent acrylic. Measurements can be performed in reflection mode or through-transmission mode.

Length : 40 mm, 80 mm and 120 mm

Diameter: 40 mm

U10029

Heart Valve Model

This double vessel with a rubber membrane and pressure regulator is used to demonstrate the operation of a heart valve by means of the time-motion technique. In the experiment the membrane vessel produce images similar to those of a beating heart's valve during echocardiography in medical diagnostics.

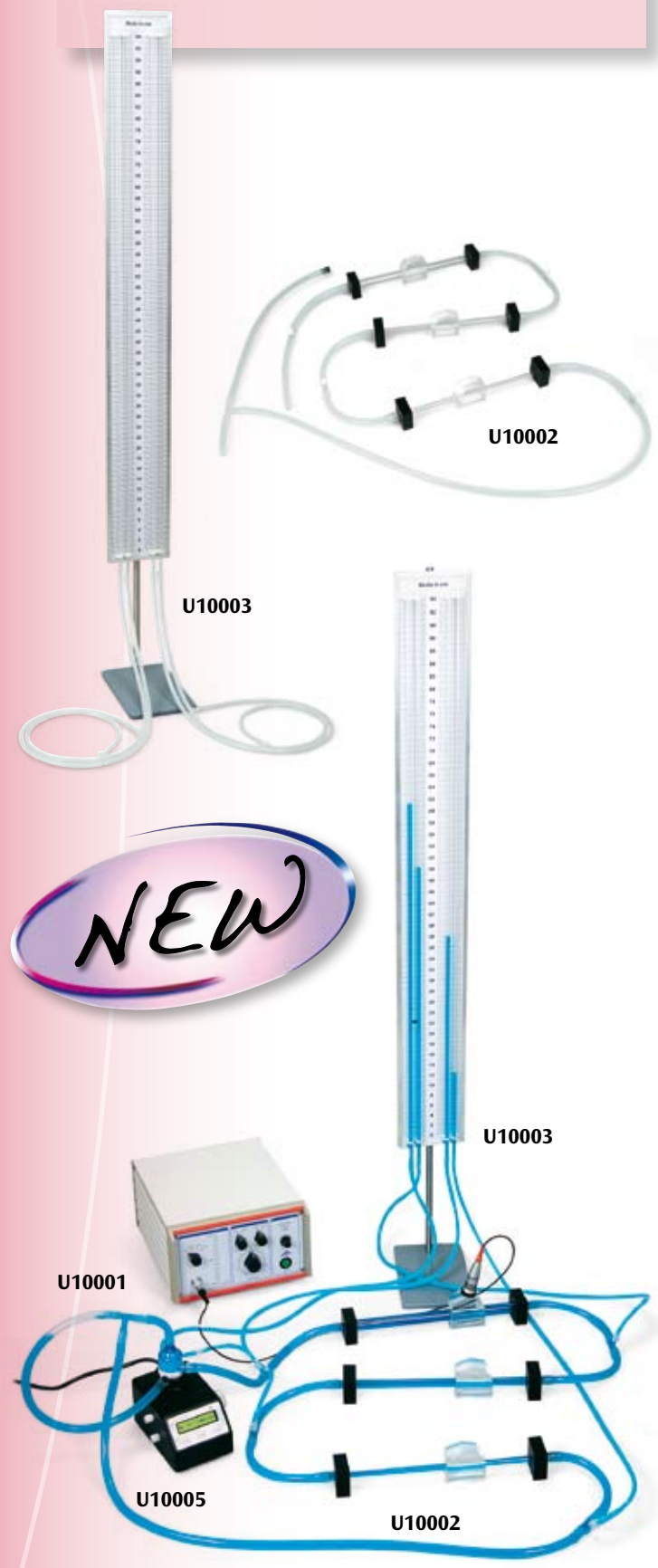
Dimensions: 160x70 mm²



U10026 U10029

Experiment topics:

- Investigation of fluid flows using ultrasonic waves
- How the Doppler shift depends on the speed of flow
- Measurement of flow profiles
- Continuity equation and Hagen-Poiseuille law



Equipment:
U10001 Ultrasonic Doppler Pulse Generator
U10016 Ultrasonic Transducer 2 MHz
U10002 Flow Tubes and Hose Equipment Set
U10003 Riser Tubes for Pressure Measurement
U10004 Doppler Phantom Fluid
U10005 Centrifugal Pump

U10001

Ultrasonic Doppler Pulse Generator

Control unit for conducting ultrasonic Doppler experiments using 2 MHz ultrasonic converter (U10016). Includes measurement and evaluation software for Windows operating system.
If the radiated waves are reflected or scattered from moving particles or bubbles in fluid flow, the Doppler shift in frequency can be detected. The equipment detects the scattered waves and generates an audio signal at a volume that reflects the amplitude of the reflected signal and a frequency that reflects the speed of the scattering. At the same time, the amplitude is also displayed on an LED bar display. Sensitivity and volume can be adjusted by means of appropriate controls.
The controller can also pass on data to a PC for detailed recording and evaluation. During measurement the current LF Doppler signal is displayed. Evaluation is by means of a Fourier transformation in the frequency domain and the result can be interpreted as the distribution of velocity within the flow.

Frequency:	2 MHz
Gain:	10 – 40 dB
Display:	LED bar display and acoustic signal with volume control
PC connector:	Parallel, LPT, Sub D 25
Mains voltage:	90 – 230 V, 50/60 Hz
Dimensions:	approx. 256x185x160 mm³

Additionally required:
U10016 Ultrasonic Transducer 2 MHz

U10002

Flow Tubes and Hose Equipment Set

Equipment set including plastic tubes and hoses of various diameters and lengths for investigating flow phenomena using ultrasonic waves. Includes Doppler prisms for connecting an ultrasonic transducer to the tubes or hoses at three different angles.

Contents:
1 Doppler prism 1/4“
1 Doppler prism 3/8“
1 Doppler prism 1/2“
1 Flow tube 1/4“, 300 mm
1 Flow tube 3/8“, 300 mm
1 Flow tube 1/2“, 300 mm
1 Hose 1/4“, 1000 mm
1 Hose 3/8“, 3000 mm
1 Hose 1/2“, 1000 mm
Various hose connectors, T-pieces and stopcocks

U10003

Riser Tubes for Pressure Measurement

Set of four riser tubes arranged in front of a millimetre scale for measuring pressure status at up to four measuring points along the line of a flow. Includes tubing and Luer Lock connectors to make a circuit in which the fluid flows.

Length:	1000 mm
Connectors	Luer Lock, male
Length of tubing:	1200 mm
Tubing connector:	3/8“ female Luer Lock connector

Additionally required:
Stand Equipment

U10005

Centrifugal Pump

Fluid pump for generating adjustable constant fluid velocity for investigating flow phenomena in a good approximation of laminar flow.
The magnetic transmission of motor power to the pump head means the fluid is completely isolated from the drive module. To generate pulsing flows, the pump can be operated with a periodic signal.



U10005

U10004

Doppler Phantom Fluid

Phantom fluid with encapsulated micro-bubbles with excellent properties for scattering ultrasonic waves in the frequency range 1 – 6 MHz.
In plastic bottle.

Volume:	1 l
Ultrasonic scattering:	1 – 6 MHz
Colour:	Milky white



U10004

U52003

Ultrasound Transducer, 40 kHz, Equipment Kit

Equipment set for experiments on geometric and wave-mechanical acoustics.
Based on the piezo-effect discovered by the Curie brothers, an AC voltage is applied to a piezo-electric body causing it to oscillate. Sound waves can also be used to excite the body and the oscillations can be converted into an electrical voltage signal. Converters can thus be used as both transmitters and receivers.

Resonant frequency:	40 kHz
Band width:	6 kHz approx.
Capacitance:	2000 pF
Connector:	Coaxial cable with two 4-mm safety plugs
Stand rod:	145 mm x 10 mm dia.
Dimensions:	40 mm x 25 mm dia.

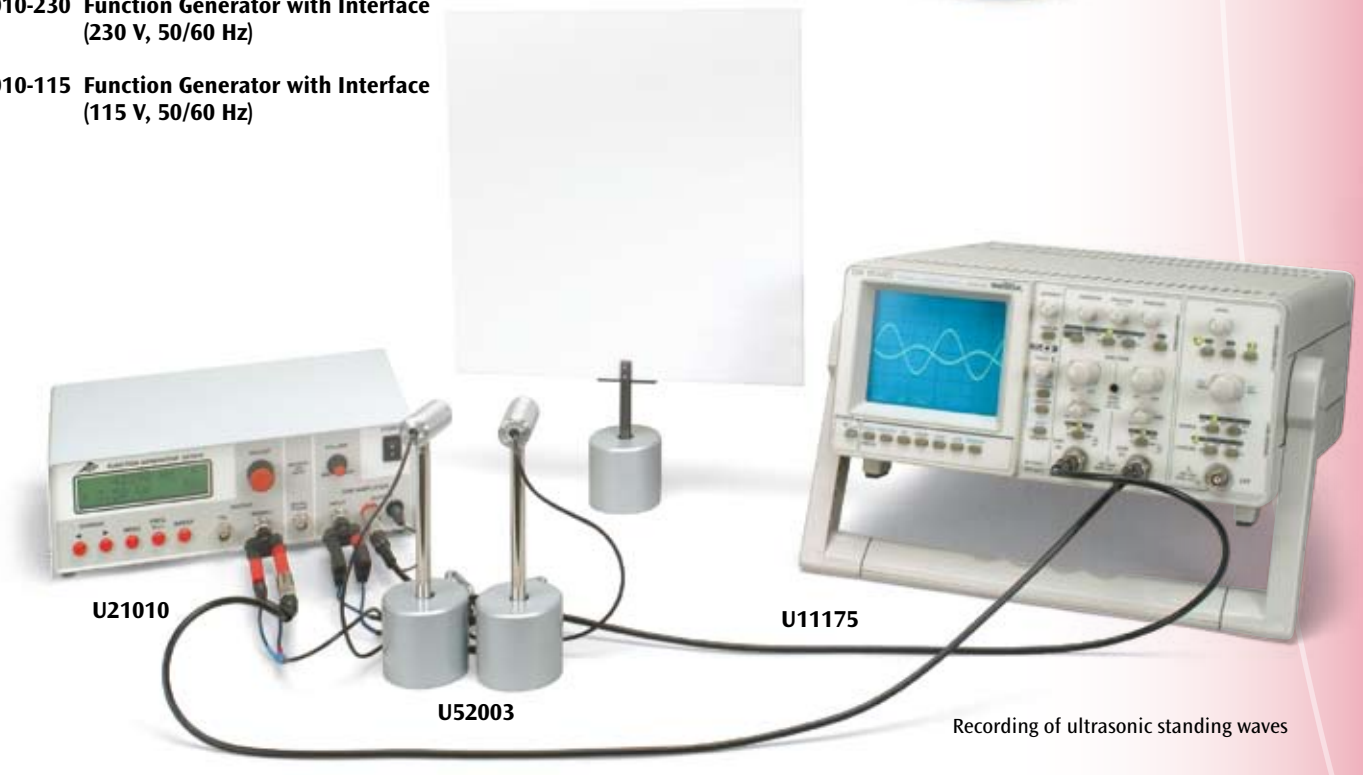
Contents:

2 Ultrasonic Transducer, 40 kHz on stand rod
1 Projection Screen

Equipment:

U52003 40 kHz Ultrasonic Converter Equipment Set
U8611210 Barrel Foot, 0.5 kg (3x)
U11175 Analog Oscilloscope, 2 x 30 MHz
U11257 HF cable, BNC/4-mm plugs (2x)

U21010-230 Function Generator with Interface (230 V, 50/60 Hz)
or
U21010-115 Function Generator with Interface (115 V, 50/60 Hz)



U21010

U11175

U52003

Recording of ultrasonic standing waves



U8461150



U8691150



U8461130

U8461150

Solar Cell – 0.5 V / 200 mA

Small-area solar cell for demonstrating conversion of light energy into electrical energy. On an angled plexiglass base.

Open-circuit voltage:	560 mV
Short-circuit current:	200 mA
Maximum power output:	45 mW
Output current at maximum power:	100 mA
Solar panel:	20x40 mm²
Base:	80x80 mm²

Additionally recommended:
U8691150 Small Electric Motor

U8461200

Solar Energy Basic Kit

Set of equipment including four test bodies with different surface coating, heat insulators and covers for experiments on the utilisation of solar energy. Four series of measurements that can be completed in approximately 25 minutes elucidate the temperature characteristics and peaks of the test bodies when exposed to sunlight. The kit comes in a robust storage case.

Storage capacity:	approx. 365x310x70 mm³
Weight:	approx. 1 kg

Contents:

4 Solar measuring bodies, each of a different colour
2 Insulating housings
2 Mounts for the measuring bodies
1 Transparent acrylic plate
4 Thermometers, -10 – +110° C

Additionally required:
U8476713-230 Halogen Lamp, 500 W (230 V, 50/60 Hz)
or
U8476713-115 Halogen Lamp, 500 W (115 V, 50/60 Hz)

U8691150

Small Electric Motor

Small electric motor with low starting current for detecting weak currents. In round transparent acrylic housing with a fan at the front.

Maximum operating voltage:	15 V
Starting voltage:	700 mV
Starting current:	10 mA
Internal resistance:	9 Ω

U8461130

Solar Cell – 0.5 V/1.3 A

Solar cell for demonstrating conversion of light energy into electrical energy. In plastic frame with handle.

Open-circuit voltage:	560 mV
Short-circuit current:	1300 mA
Maximum power output:	360 mW
Output current at maximum power:	800 mA
Solar panel:	100x40 mm²
Frame:	120x85 mm²

Additionally required:
U8611210 Barrel Foot, 0.5 kg

Halogen Lamp - 500 W

Strong light source for experiments, e.g. for use with solar energy basic kit (U8461200). With handle.

U8476713-230

Halogen Lamp 500 W (230 V, 50/60 Hz)

U8476713-115

Halogen Lamp 500 W (115 V, 50/60 Hz)

Additionally required:
U13270 Stand Base

Spare Bulbs for Halogen Lamp - 500 W

U8476714-230

Spare Bulbs for Halogen Lamp - 500 W (230 V, 50/60 Hz)

U8476714-115

Spare Bulbs for Halogen Lamp - 500 W (115 V, 50/60 Hz)



U8461200



U8476713



U8461300



U8441301

U8461300

Bolometer

Designed to measure heat radiation from the sun, this device consists of an aluminium tube with a blackened front enclosed in a cardboard tube blackened on the inside. Includes a borehole for a thermometer.

Aluminium tube:	30 mm x 40 mm dia. approx.
Cardboard tube:	195 mm x 50 mm dia. approx.
Weight:	350 g approx.

Additionally required:

U8451700 Thermometer, +10 – +30° C
U13261 Universal Clamp
Stand Equipment

U8441301

Moll Thermopile

Sensitive probe for measuring heat radiated by a black body or Leslie cube, as well as for detecting visible light and ultra-violet radiation. Comprises a metal housing with a polished, conical reflector and a black surface 15 mm in diameter with 17 linked thermocouples. With two 4 mm connectors mounted on a stem.

Sensitivity:	approx. 0.28 mV/µW
Internal resistance:	approx. 1 Ω
Setting duration:	40 s (95 %)
Tripod:	156 mm x 10 mm dia.
Dimensions:	94 mm x 40 mm dia.
Weight:	approx. 200 g

U8460500

Greenhouse Effect Kit

A set of equipment permitting quick and easy experiments to demonstrate the effect of greenhouse gases on the absorption of infra-red radiation. Solar radiation received by the earth is simulated here by means of short-wave infrared radiation that is attenuated by absorption in water and visible light from a reflector lamp. Infra-red radiation emitted by the earth is simulated by heating a black metal disc. Both types of radiation are made to pass through air or butane gas in a metal tube and subsequently registered with a thermopile. Comparison of the obtained values reveals that long-wave infra-red radiation is absorbed to a high degree by butane gas. Consequently butane gas released into the atmosphere causes it to heat up, i.e. butane gas is a greenhouse gas.

Contents:

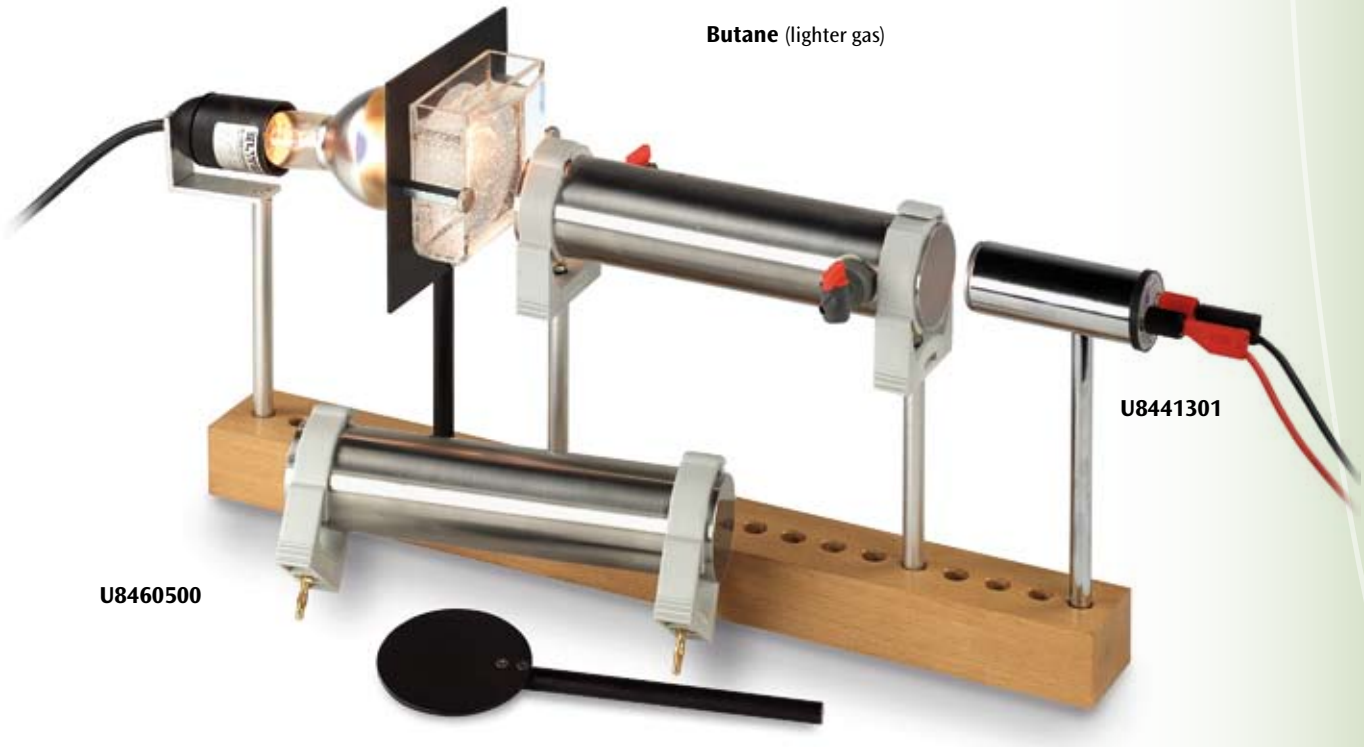
1 Base plate
1 Lamp holder with reflector lamp
1 Cuvette
1 Black metal disc
1 Metal tube, simple
1 Metal tube, with taps
2 Mounting stems
1 Silicone hose
1 Storage case

Additionally required:

U8441301 Moll Thermopile

U8530501-230 Microvoltmeter (230 V, 50/60 Hz)
or
U8530501-115 Microvoltmeter (115 V, 50/60 Hz)

Butane (lighter gas)



U8441301

U8460500

Tomorrow's Energy Carriers

Fuel cells, electrolysers, solar hydrogen technology – significant contributors to a sustainable energy supply in the future: Preservation of the environment and resources while maintaining today's standard of living. Now you can demonstrate the mode of operation of this fascinating technology to your students. Pure water is broken down by means of electrolysis into hydrogen and oxygen for the purpose of energy storage with the help of regenerative energy. During reconversion of the gases in a fuel cell, electricity, heat and water are formed. The resolute use of membrane technology in the training and demonstration systems does away with the use of corrosive liquids and only distilled water is required.

U10956

Fuel Cells for Cars

Fascinating working model of a hydrogen fuel cell for a car. Designed for graphic demonstration of the practical use of hydrogen technology and a pioneering drive system.

Special features:

- Robust design guarantees long working life
- Simple to operate
- Only distilled water and no corrosive fluids required
- Acrylic glass construction permits good visibility and thus better understanding of how fuel cells actually work

Fuel cells are essential components of a sustainable energy supply of the future which will ensure that modern living standards are maintained while also preserving our environment and natural resources. To store energy for regeneration, pure water is broken down into its components, hydrogen and oxygen, by means of electrolysis. Current, heat and water are produced when the gases are recombined in the fuel cell. The power is used to drive a vehicle at a speed of approx. 20 cm/s. The hydrogen fuel cell's efficiency is about twice as high as that of a combustion engine. After being filled up with distilled water and connected to the mains via the plug-in power supply (alternatively the solar module that is also included) the vehicle is ready to drive after just two minutes.

Power:	1 W (during electrolysis), 500 mW (fuel cell operation)
Gas storage cell:	15 cm^3 H_2, 15 cm^3 O_2
Charging time:	approx. 2 min
Driving time:	approx. 8 min
Speed:	approx. 20 cm/s
Plug-in power unit:	100 V up to 240 V, 50/60 Hz
Solar module:	2 V, 350 mA
Dimensions:	approx. 200x90x75 mm^3
Weight:	approx. 260 g

U10900

PEM Solar Hydrogen Model

Solar hydrogen model consisting of solar cell, PEM electrolyser, gas accumulator, PEM fuel cell and electrical load. Complete experiment assembly on baseplate.

Solar module:	2.0 V / 350 mA
Electrolyser:	2 W
Gas accumulator:	40 cm^3 H_2
Fuel cell:	300 mW
Electrical load:	10 mW
Dimensions:	140x470x150 mm^3
Weight:	1.0 kg

U10950

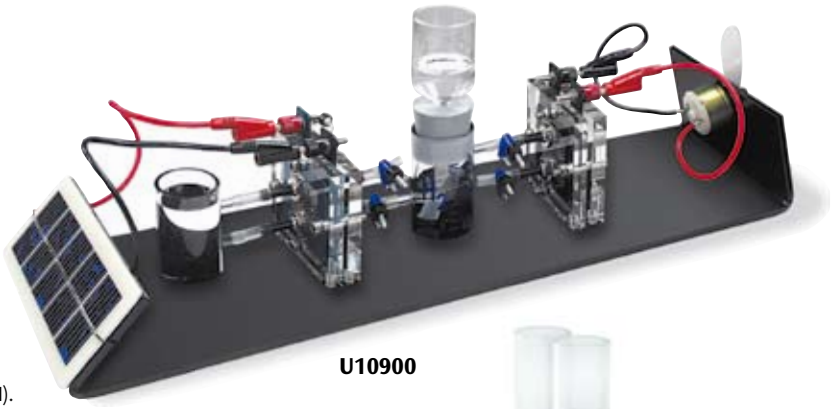
Fuel Cell Demonstration System

Model showing the function of a hydrogen solar cell consisting of:

- Solar module
- PEM electrolyser
- Hydrogen and oxygen accumulators
- PEM fuel cell
- Fan

Conveniently arranged on a baseplate.

Solar module:	2.0 V / 350 mA
Electrolyser:	1 W
Fan output:	10 mW
Dimensions:	approx. 200x300x150 mm^3



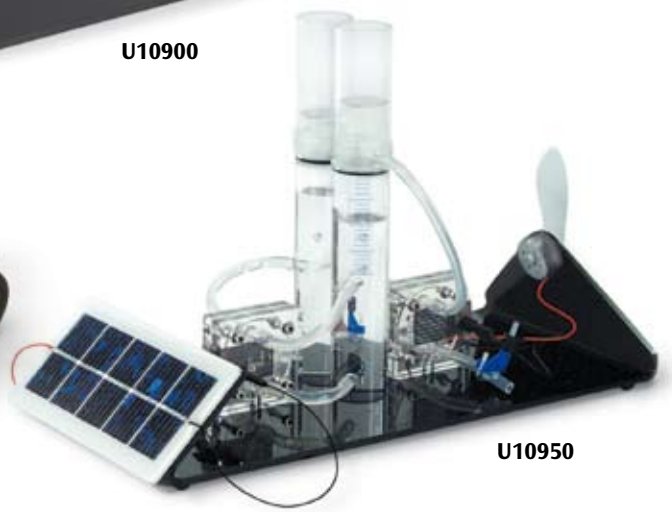
U10900

For your Safety:

All devices KOH free. Exclusive use of distilled water.
No corrosive electrolytes such as potassium hydroxide (KOH).



U10956



U10950

U11819

Infrared Temperature and Humidity Gauge

Digital measuring device for contact-free temperature measurement from large distances, e.g. of hot or moving objects or inaccessible points of measurement, and for simultaneous humidity display. With laser diode as detection aid, integrated in the measuring probe, illuminated LCD display, max and data-hold function, switchable between °C and °F, automatic switch-off. Includes pouch and battery.

Measuring range, temperature:	-50° C – +500° C; -58° F – +932° F
Divisions:	0.1° C/F
Accuracy:	± 2% of measured value ± 2° C / 4° F
Measuring range, humidity:	5% – 95%
Divisions:	0.1%
Accuracy:	± 3.5%
LCD dual-function display:	3½-digit, 21 mm with backllighting
Voltage supply:	9 V battery
Dimensions:	approx. 90x170x45 mm³
Mass:	approx. 360 g



U11819

U14294

Maximum-Minimum Thermometer

Reading of maximum, minimum and instantaneous temperature. In plastic housing with reset button and hanging strap. Mercury filling.

Measuring range:	- 38° C – 50° C
Divisions:	1° C
Dimensions:	approx. 230x85 mm²



U14294

U14293

Precision Hair Hygrometer

Hygrometer for measuring the relative air humidity, consisting of a round plastic housing with a human hair as the measuring element. The specially treated hair exhibits an almost inertia free response to changes in humidity. Wall mountable.

Measuring range:	0% – 100% relative humidity
Temperature range:	- 35° C – + 65° C
Reading accuracy:	± 5%
Diameter:	100 mm



U16102



U14293

U16102

Digital Hygro-Thermometer

Digital measuring device for displaying exterior and interior temperature and humidity. With min/max function and acoustic signal if exterior temperature drops to or below zero, switchable between °C and °F, on/off button, eyelet for hanging up and fold-out stand.

Measuring range:	
Temperature (interior):	0° C – 50° C / 32° F – 122° F
Temperature (exterior):	-50° C – 70° C / -58° F – 158° F
Humidity:	20% – 99%
Divisions:	0.1° C/F, 1%
Accuracy (temp.):	± 1° C / ± 2° F
Accuracy (humidity):	± 3%0
Exterior temperature sensor:	Cable length 3 m

U10260

Demonstration Aneroid Barometer

Barometer for measuring air pressure and demonstrating how an aneroid barometer operates. The measurement system consists of two flat, highly-evacuated metal cans which deform in response to changes in the air pressure. This deformation is indicated by a pointer. The pointer mechanism and metal cans are situated behind a glass cover for easy observation. By pumping the attached rubber ball the action caused by the air pressure changes can be demonstrated.

Measuring ranges:	955 mbar up to 1070 mbar, scale division 1 mbar 715 mmHg up to 800 mmHg, scale division 1 mmHg
Scale diameter:	120 mm
Housing diameter:	130 mm
Weight:	650 g



U10260



U8452570

Thermometer clip
Stainless steel clip for holding thermometers in beakers.



U8451700

U14297



U14296 **U14295**

U40911
U40913
U40915
U40916



U8451310



U16115



U16120



U40170

U40170

Insertion Thermometer
For measuring the temperature in air, liquids and soft materials. Temperature sensor made of stainless steel with protective case, switchable between °C and °F, On/Off switch and automatic switch-off.

Measuring range:	- 50° C – 150° C / - 58° F – 302° F
Division:	0.1° C/F
Accuracy:	±1° C / ±2° F
Temperature sensor:	130 mm x 4 mm dia.
Mass:	29 g



U11853

U11853

Digital Quick-Response Pocket Thermometer
For instantaneous measurements on surfaces, in liquids, soft plastic media, air/gases, very small objects. For connection to a K-type NiCr-Ni measurement sensor. Sensor not included in scope of supply.

Measuring range:	-65° C – 1150° C / -85° F – 1999° F in 2 ranges
Division:	0.1° C/1° C/F
Accuracy in lowest range:	0,05% of measured value ±0,2% FS
Display:	3½-digit LCD display, 13 mm in height
Dimensions:	106x67x30 mm³
Mass:	approx. 135 g

Additionally required:
U11854 K-Type NiCr-Ni Immersion Sensor, - 65° C to 550° C
or
U11855 K-Type NiCr-Ni Immersion Sensor, - 200° C to 1150° C



U11855

U11854

U11854

K-Type NiCr-Ni Immersion Sensor, - 65° C to 550° C
Temperature measurement sensor with stainless steel (V4A)-tube, spring-mounted (rigid) and silicone cable.

Measuring range:	-65° C – 550° C
Response time:	approx. 3 s
Tube:	30 mm x 1.5 mm dia.

U11855

K-Type NiCr-Ni Immersion Sensor, - 200° C to 1150° C
Sheath thermocouple with stainless steel (Inconel) tube, flexible and silicone cable.

Measuring range:	-200° C – 1150° C
Response time:	approx. 3 s
Tube:	150 mm x 1.5 mm dia.

Art. Nr.	Scale division	Measuring range	Scale division	Dimensions	Remarks
U8451700	Thermometer	+10° – 30°C	0.2°C	140 mm x 6 mm dia.	Tube type, white coated capillary, red alcohol filling.
U14297	Pocket Thermometer	-10° – 110° C	1° C	165 mm x 10 mm dia.	Tube type, scale on white background, special red filling, in yellow plastic protective case with clip.
U14295	Tube thermometer, Graduated	-10° – 110° C	1° C	260 mm x 6 mm dia.	Glass thermometer with eyelet, scale on white background, special red filling, in transparent square plastic case.
U14296	Tube thermometer, not Graduated	–	–	260 mm x 6 mm dia.	For demonstrating function and mode of operation of thermometers. Like U14295 but without scale.
U40911	Thermometer	-20° – 110° C	1° C	295 mm x 6,3 mm dia.	Tube type with anti-roll design, white coated capillary, red alcohol filling, packed in a plastic tube.
U40913	Thermometer	-10° – 150° C	1° C	295 mm x 6,3 mm dia.	Tube type with anti-roll design, white coated capillary, red alcohol filling, packed in a plastic tube.
U40915	Thermometer	20° – 110° C / 0° – 230° F	1° C/F	295 mm x 6,3 mm dia.	Tube type with anti-roll design, white coated capillary, red alcohol filling, packed in a plastic tube.
U40916	Thermometer	-20° – 150° C / 0° – 300° F	1° C/F	295 mm x 6,3 mm dia.	Tube type with anti-roll design, white coated capillary, red alcohol filling, packed in a plastic tube.
U8451310	Rod thermometer	-10° – 100° C	1°	350 mm x 8 mm dia., Length of rod: 150 mm	Rod thermometer with internal scale made of frosted glass, prismatic capillary tube and red liquid.
U16115	Thermometer	-1° – 101° C	0.2° C	460 mm x 7 mm dia.	Stable tube type thermometer with biodegradable special blue filling, scale on yellow background, with eyelet.
U16120	Demonstration Thermometer	-10° – 110° C	1° C	650 mm x 30 mm dia.	Extra-large tube type thermometer with biodegradable special blue filling, easy-to-read scale on yellow background.

U16101

Digital Thermometer, Min/Max

Insertion thermometer with Hold and Min/Max function in robust plastic housing and temperature sensor made of stainless steel. Switchable between °C and °F, On/Off switch, hanging strap and folding angled support.

Measuring range: -50° C – 200° C / -58° F – 392° F
Division: 0.1° C/F
Dimensions: 95x65x20 mm³
Cable length: 1400 mm
Measurement probe: 120 mm



U16101

U40173

Digital Pocket Thermometer

Temperature sensor made of stainless steel with protective case, watertight, switchable between °C and °F, Min/Max/Hold function, automatic switch-off.

Measuring range: -40° C – 200° C / -40° F – 392° F
Division: 0.1° C/F
Accuracy: ±1° C / ±2° F
Dimensions: 150x20x18 mm³
Mass: 20 g



U40173

Infrared Thermometer

Surface thermometer for non contact temperature measurement from a safe distance, e.g. in inaccessible places, hot or moving objects.
With laser diode for laser sighting, illuminated LCD display, range overflow display, measured value storage function, selection between Celsius and Fahrenheit, automatic switch-off. Includes bag and battery. U118151 also includes inputs for measuring minimum temperature, maximum temperature, temperature differences and average temperature, input for type K thermocouple and High/Low alarm function.

	U118151	U11816
Designation	Infrared Thermometer, High-Temperature	Infrared Thermometer
Measuring range	-50° C – +750° C -58° F – +1382° F	-50°C – 280°C -58°F – 536°F
Division	0.1° C/F	1° C/F
Accuracy	±1.5% of measured value ± 2° C / 4° F	2% of measured value +2° C / 4° F
Response time	< 1 s	< 1 s
Optical resolution	12:1	8:1
Voltage supply	9 V battery	9 V battery
Dimensions	240x110x56 mm³	160x82x47 mm³
Mass	290 g	177 g



U118151



U11816



U11817
U11818

Digital Thermometer

Versatile digital thermometer for type-K temperature sensors with single or dual input (U11818) for measuring instantaneous or differential temperature (T1 – T2 U11818). Measurement of temperature difference with regard to absolute zero in Kelvin also possible (U11817). With storage of maxima and Data-Hold function. Includes type-K temperature sensor (U11818 2x), battery, holster and carrying bag.

	U11817	U11818
Designation	Digital Thermometer, 1 Channel	Digital Thermometer, 2 Channels
Measuring range	-50° C – +1300° C -58° F – +2000° F 223 K – 2000 K	-50° C – +1300° C -58° F – +2000° F
Division	0.01° C/F, 1 K	0.01°C/F
Accuracy	±0.5% +1° C / +2° F ±1% +2 K	±0.5% +1° C / +2° F
Display	3½-digit illuminated LCD	3½-digit illuminated LCD
Digit size	21 mm	21 mm
Voltage supply	9 V battery	9 V battery
Dimensions	approx. 90x170x45 mm³	approx. 90x170x45 mm³
Mass	350 g	350 g



pH and Temperature Meter

For measuring ph values and temperature. Temperature compensation of the measured pH value is performed automatically with the connected temperature sensor. If no temperature sensor is connected, the ambient temperature of the device is used as the reference temperature. Includes a digital display for the pH value and temperature. The temperature can be displayed in ° C or K. Allows a connection of all standard commercial pH sensors with a BNC plug and all NiCr-Ni thermocouples of type K (e.g. U11854, U11855, U21036).
Equipped with an integrated serial RS232 PC interface, as well as an analogue output for connecting a recorder. Includes a Windows program and interface cable. The software allows a graphic representation of measured data as well as export of the data to a spreadsheet program.

pH measurement range:	0.10 pH – 14.00 pH
Accuracy:	±0.01 pH ±1 digit
Input:	BNC jack
Temperature measurement range:	-20 – +1200°C
Accuracy:	0.5% of the display or ±0.1° C
Input:	Thermocouple jack type K (NiCr-Ni)
Digital display:	4-digit LED, (7 segments), 19 mm
Analogue output:	100 mV/pH
Computer connection:	RS232 serial interface for PC
Power consumption:	10 VA
Dimensions:	95 x225x160 mm³
Weight:	2.2 kg

U21035-230

pH and Temperature Meter (230 V, 50/60 Hz)

U21035-115

pH and Temperature Meter (115 V, 50/60 Hz)

Additionally required:
U11111 pH Combined Electrode
U21036 NiCr-Ni Temperature Sensor
or
U11854 K-Type NiCr-Ni Immersion Sensor, -65°C – 550°C
or
U11855 K-Type NiCr-Ni Immersion Sensor, -200°C – 1150°C

U21036

NiCr-Ni Temperature Sensor

Clad thermocouple for temperature measurement in conjunction with the energy meter (U21020) or pH and temperature meter (U21035); equipped with a 2-pole, standard flat connector.
Measurement range: -40° C – 500° C



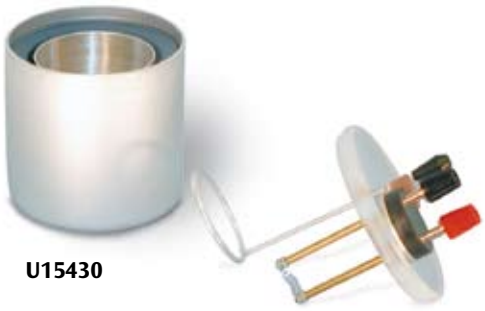
U21036

U11111

pH Combined Electrode

pH combined electrode with shaft made of plastic and a BNC plug.
Length of cable: 1 m
Dimensions: 120 mm x 12 mm dia.





U15430



U8441050



U8441000

U15430

Calorimeter with Heating Coil, 150 ml

For determining the specific heat capacity of solids and liquids and for measuring the electric heat equivalent. Two mutually insulated aluminum beakers, lid with rubber stopper with boreholes for thermometer and stirrer, with heating coil.

Capacity of insulated container: 150 ml
Connection sockets: 4 mm
Electric heater: 3.5 V/3.5 A max.

Additionally required:
U8451310 Tube Thermometer, -10 – +100° C

Additionally recommended:
U8442610 Aluminium Shot, 100 g
U8442620 Copper Shot, 200 g
U8442640 Glass Shot, 100 g

U33020-230 DC Power Supply, 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply, 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

U8441050

Calorimeter, 200 ml

For determining temperatures of mixtures, specific heat capacities, conversion energies of substances and heat of fusion of ice. Designed for simple experiments for students. Plastic container with styrofoam inlay.

Capacity of insulated container: 200 ml
Weight: 80 g

Additionally required:
U8451310 Tube Thermometer, -10 – +100° C

Additionally recommended:
U8442610 Aluminium Shot, 100 g
U8442620 Copper Shot, 200 g
U8442640 Glass Shot, 100 g



U8442640 U8442610 U8442620

U8441000

Calorimeter with Heating Coil, 1,500 ml

Calorimeter for determining temperatures of mixtures, specific heat capacities, conversion energies of substances and heat of fusion of ice. Consists of a large double-walled, stainless steel thermal vessel with heating coil and stirrer. Also includes a lid with an opening for a thermometer and two 4-mm plugs for connecting the power supply for the heating coil.

Volume of the insulated vessel: 1.500 ml
Electric heater: max. 24 V/ 7 A
Weight: 1000 g

Additionally required:
U8451310 Tube Thermometer, -10 – +100° C

Additionally recommended:
U8442610 Aluminium Shot, 100 g
U8442620 Copper Shot, 200 g
U8442640 Glass Shot, 100 g

U33020-230 DC Power Supply, 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply, 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

U14205

Graduated Cylinder, 100 ml

Duran glass, tall form with spout, hexagonal base.

Scale: 100 ml
Divisions: 1 ml



U14205

Pellets

Granules for filling calorimeters.

U8442610
Aluminium Shot, 100 g

U8442620
Copper Shot, 200 g

U8442640
Glass Shot, 100 g

U10365

Heat Equivalent Apparatus

Apparatus for determining the specific heat capacity of aluminum and for confirming the energy conservation law. The robust heat equivalent apparatus consists of a shaft with ball bearings at both ends, an integrated counter for measuring the number of revolutions performed and an attached table clamp for securing the device. The aluminum calorimeter body heats up as a result of frictional work or electrical energy from the integrated heating element. An NTC thermistor, acting as a temperature sensor and located in an aluminum case, determines the temperature. The calculation can be performed easily using the temperature calibration table printed on the apparatus.

Length:	230 mm
Span of the table clamp:	10 – 65 mm span
Cord length:	approx. 1.80 m
Calorimeter body:	50 mm x 48 mm dia.
Electric heater power:	10 V, 1 A
Heating element connection:	via 2-mm sockets
Mass:	250 g
Total mass :	approx. 1200 g

Contents:

1 Basic unit
1 Aluminum calorimeter
1 Temperature sensor
1 Pair of adapter cables with 4 mm safety plugs/2 mm plugs
1 Friction belt
1 Bucket, 5 l
1 Counterweight

Additionally required for temperature measurement:
U11155 Digital Multimeter

Additionally required for power supply:
U33020-230 DC Power Supply, 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply, 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Additionally recommended:
U10366 Copper Calorimeter

U11155

U10365



U10366

U10366

Copper Calorimeter

Calorimeter body for the heat equivalent device for determining the specific heat capacity of copper. With borehole for holding temperature sensor and with integrated heating element.

Electric heater power:	10 V, 1 A
Heating element connection:	via 2-mm sockets
Dimensions:	50 mm x 48 mm dia.
Mass:	750 g

Additionally required
U10365 Heat Equivalent Device



U33020

DC Power Supply, 0 – 20 V, 0 – 5 A

Universal power supply unit with digital display for current and voltage. Continuously adjustable output voltage and current. The device can be operated as a constant voltage source with current limitation or as a constant current source with voltage limitation.

Output voltage:	0 – 20 V
Output current:	0 – 5 A
Output power:	100 W
Terminals:	4 mm safety sockets
Display:	2x 3-digit LED
Dimensions:	180x260x150 cm³
Weight:	4.8 kg approx.

U33020-230

DC Power Supply, 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)

or

U33020-115

DC Power Supply, 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

U8442200

Linear Expansion Apparatus with Three Pointers

Apparatus for measuring the linear expansion of different kinds of solids simultaneously. The set includes three sample tubes (brass, aluminium and glass) which are heated by passing steam through them. Linear expansion is indicated on a mirror scale by three differently coloured pointers mounted on rollers. Includes silicone tubing.

Dimensions of the tubes:	700 mm x 6 mm dia.
Dimensions:	approx. 830x80x70 mm³
Weight:	approx. 1.2 kg

Additionally required:
U8624700-230 Steam Generator (230 V, 50/60 Hz)
or
U8624700-115 Steam Generator (115 V, 50/60 Hz)

Steam Generator

For generation of steam, e.g. in experiments on thermal expansion. Aluminum vessel with cork lid and handle, with thermal overload protection on hotplate.

Hotplate:	90 mm dia.
Power consumption:	550 W
Vessel volume:	250 ml
Dimensions:	150 mm x 105 mm dia.
Hose connection:	6 mm dia.
Total mass:	approx. 1kg

U8624700-230

Steam Generator (230 V, 50/60 Hz)

U8624700-115

Steam Generator (115 V, 50/60 Hz)



U8624700



U8442200

U15405

U15405

Linear Expansion Apparatus

A device for measuring the linear expansion of solids as a function of length and material. Includes three sample tubes (iron, copper and glass) which are heated by passing water vapour through them. Consists of a base strip with a clamping spring, pointer, scale and hose nipple.

Pointer ratio:	1:50
Tube length:	approx. 630 mm
Dimensions:	530x60x240 mm³
Weight:	0.6 kg

Additionally required:
U8624700-230 Steam Generator (230 V, 50/60 Hz)
or
U8624700-115 Steam Generator (115 V, 50/60 Hz)
U10146 Silicone Tubing, 1 m

U15400

Linear Expansion Apparatus (Dilatometer)

A device for measuring the linear expansion of solids as a function of length and material. Includes three sample tubes (steel, brass and glass) which are heated by passing water vapour through them. Consists of a base strip with a fixed bearing, pilot bearing, pointer and projectable scale.

Scale dimensions:	140x200 mm²
Measuring range:	1 mm
Reading accuracy:	0.05 mm
Tube length:	approx. 650 mm
Dimensions:	approx. 730x50x200 mm³
Weight:	approx. 2 kg

Additionally required:
U8624700-230 Steam Generator (230 V, 50/60 Hz)
or
U8624700-115 Steam Generator (115 V, 50/60 Hz)
U10146 Silicone Tubing, 1 m



U15400



U409001

U409001

Ball and Ring

Brass ball and brass ring with plastic handles for demonstrating the thermal expansion of solid bodies. After heating in a burner flame, the ball no longer fits through the cold ring.

Length:	approx. 250 mm



U8442500

U8442500

Ball with Ring

An arrangement for demonstrating the expansion of solids on heating. After heating in a burner flame, the ball no longer fits through the bore in the bracket. Steel ball with chain and handle.

Dimensions of the bracket in mm:	40x50x40 mm²
Diameter of ball:	22 mm
Length of handle with shaft:	225 mm
Weight:	approx. 175 g



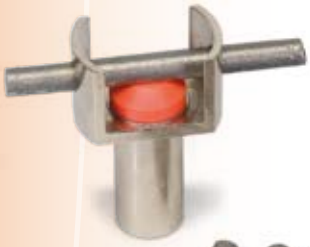
U8442100

U8442100

Tyndall's Bar Breaker

U-shaped clamping set up with a metal rib and fastening screw for demonstrating the linear expansion of metals on heating, as well as the tremendous forces which can be exerted in the process. The set includes 10 cast-iron bolts for breaking in the course of the experiment.

Diameter for bolt hole:	10 mm
Length of clamping fixture:	approx. 275 mm
Weight:	approx. 900 g



U8442120



U8442120

Ice Bomb

Clamping set up for demonstrating volumetric expansion of water on freezing, as well as the tremendous forces which can be exerted in the process. Comprises a steel cylinder with a clamping rib and plastic lid. The set includes 10 cast-iron bolts for breaking in the course of the experiment.

Diameter for bolt hole:	10 mm
Dimensions:	approx. 40x30x75 mm³
Weight:	approx. 620 g



U8442110

U8442110

Cast Iron Bolts, Set of 10 Bolts

Spare bolts to be used with Tyndall's bar breaker U8442100 or the Ice bomb U8442120.

U409051

Heat Conductivity Device

A device with five metal bars for comparing the thermal conductivity of aluminium, brass, steel, zinc and copper – by melting wax balls at the rod ends. The five rods extend in a star-shaped configuration from a brass hub. Each rod has a notch for holding wax.

Length: 340 mm



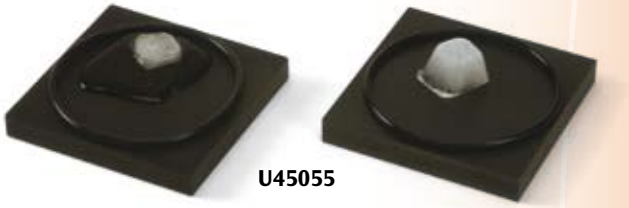
U459051

U45055

Thermal Conductivity Equipment Kit

Kit for the qualitative investigation of the heat conductivity of aluminum (extremely high thermal conductivity) and expanded polystyrene (very low thermal conductivity). Even at room temperature the varying material temperatures are evident to the touch. In the experiment ice cubes are placed on the plates. The ice cube on the seemingly colder aluminum plate melts much more quickly (in 1-2 minutes), while there seems to be no melting at all of the ice cube on the seemingly warmer plastic plate. Two rubber rings which prevent the ice cubes from slipping off the plates complete the experiment kit.

Plate dimensions: approx. 95x95x13 mm³



U45055

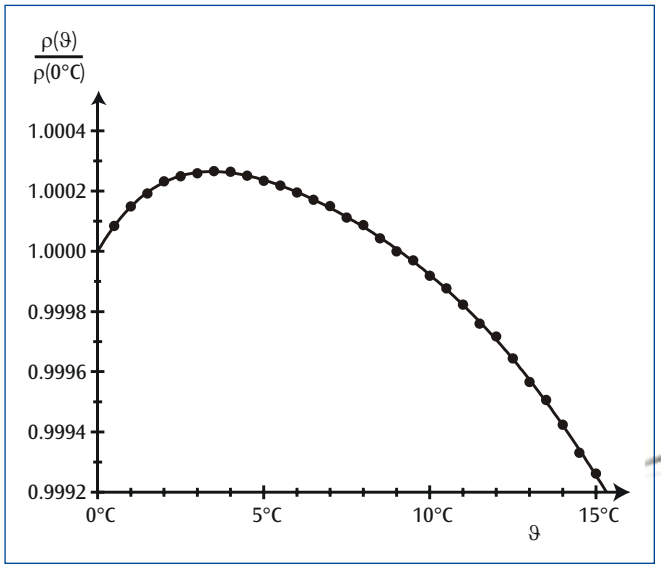
U14318

Device for Demonstrating the Anomaly of Water

Apparatus for demonstrating the thermal anomaly of water, measuring its thermal expansion and determining its maximum density. Comprises a Duran glass vessel with an inlet tube and two GL screw connections for mounting the riser tube with a mm scale and a temperature sensor or thermometer. Includes stirring rod.

Volume: 250 ml
Riser tube: 400 mm
Capillary: 1.5 mm dia.
Hose nipple: 8 mm
Overall height: approx. 500 mm

Additionally required:
T52006 Plastic Trough
U11876 Magnetic Stirrer
U16115 Tube Thermometer
or
U11817 Digital Thermometer
and
U11854 K-Type NiCr-Ni Immersion Sensor, -65°C – 550°C



Determining the maximum density of water



U14318

T52006

U11817

U11876

U14340

Heat-Flow Device

Device for demonstrating heat flows resulting from uneven heating of a liquid. Consists of a right-angled glass tube with a filling neck and GL25 screw connection for pouring in liquids and colouring agents.

Dimensions: approx. 470x420x30 mm dia.

Additionally required:
Stand Equipment
Burner
Colouring Agents



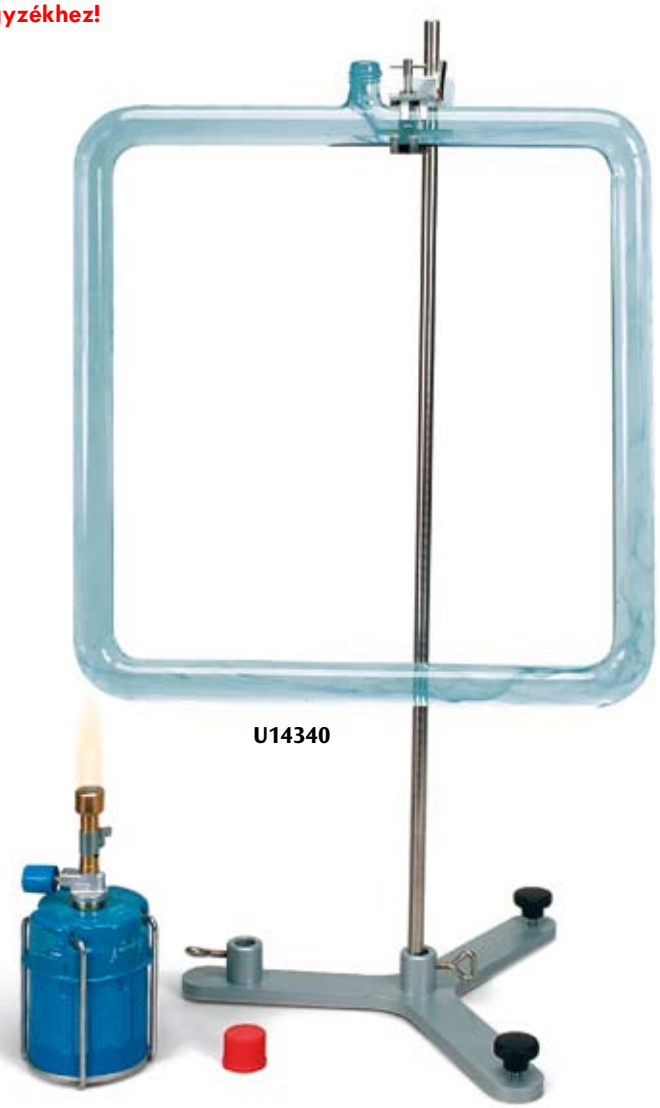
U20020

U20020

Vane Wheel

Device for demonstrating air and heat flows generated by a burning candle, water vapor or other heat sources. Made of aluminum and mountable on a long needle.

Additionally required:
Long Needle



U14340

U14300

Crookes Radiometer

Device for demonstrating the conversion of radiation energy into kinetic energy.
Rotary-vane wheel mounted on a metal tip and equipped with four plates, each coloured black on one side; housed in an evacuated glass bulb.

Height: 210 mm
Ball diameter: 80 mm

U8441301

Moll Thermopile

Sensitive probe for measuring heat radiated by a black body or Leslie's cube, as well as for detecting visible light and ultraviolet radiation. Comprises a metal housing with a polished, conical reflector and a black surface 15 mm in diameter with 17 linked thermocouples.
With two 4 mm connectors mounted on a stem.

Sensitivity: approx. 0.28 mV/µW
Internal resistance: approx. 1 Ω
Setting duration: 40 s for 95 % of the measured value
Tripod: 156 mm x 10 mm dia.
Dimensions: 94 mm x 40 mm dia.
Weight: approx. 200 g

U8442830

Leslie's Cube

A hollow copper cube for investigating a heat radiation from a hot body as a function of its temperature and surface. With a removable lid for pouring in hot water and an opening for inserting a thermometer or thermal sensor. One side each is polished, matt, black and white. A thermopile (U10430) is necessary for measuring thermal radiation.

Dimensions: 100x100x100 mm³
Weight: approx. 300 g

Additionally required:
U8441301 Moll-Type Thermopile



U8441301



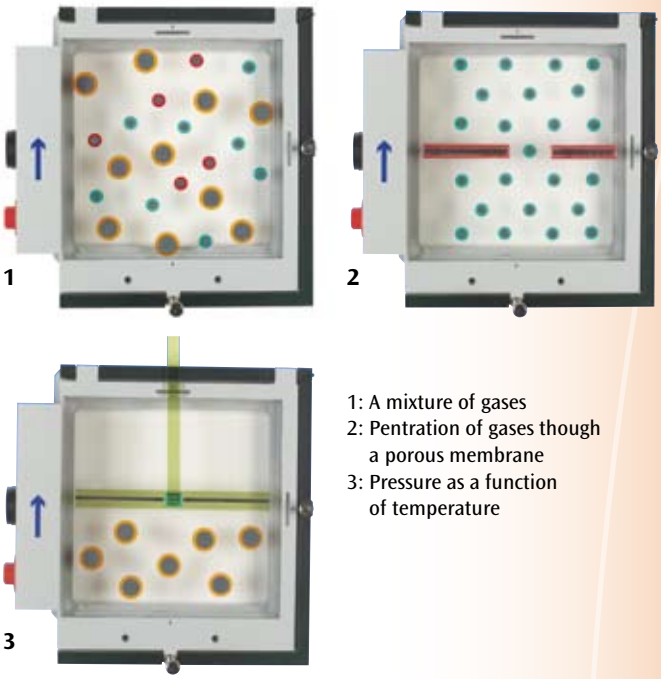
U14300



U8442830

Experiment topics:

- **Thermal motion of atoms and molecules in various states of aggregation**
- **Electrical conduction processes**
- **Models of atomic physics**
- **Mechanical motion**



1: A mixture of gases
2: Pentration of gases though a porous membrane
3: Pressure as a function of temperature

U15420

Air-cushion plate

An ideal device for demonstrating a series of experimental models intended to study the motion of atomic particles:

a) Objects hovering on the air cushion experience near-zero friction and are used to simulate particle motion. The set contains five different transparent, coloured plastic or aluminium elements with round ceramic magnets fitted to them to ensure elastic collisions.

b) Magnetic barriers can be used to modify the plastic-bordered experimentation surface. This allows elastic collisions between the hovering bodies and the borders.

c) A lattice model with a fixture is available for emulating crystal lattices in experiments on electrical conductivity in semiconductors, for instance. Comprises a height-adjustable plexiglass plate from which 25 ceramic magnets are freely suspended.

d) Two rod-shaped metal electrodes can be positioned in parallel with the experimentation surface in order to generate an electrical field. The effect of electrical fields on charged particles can also be simulated by inclining the experimentation surface.

The equipment system is characterized by a clear and simple design, minimum preparatory adjustment requirements, clear visibility of all experiments through overhead projection, simple operation and high reliability. The device consists of a robust frame with a pressure chamber whose cover plate is furnished with 1089 fine perforations and serves as an experimentation surface. Air is supplied to the pressure chamber by a blower via a hose, causing the coloured bodies to hover. An additional air stream from an impulse valve makes it possible to alter the motion of the hovering bodies. The air-cushion table is equipped with two adjustment screws. With two adjustable screws for horizontal alignment.

Dimensions: 350x350x75 mm³

Additionally required:
U15425-230 Air Flow Generator (230 V, 50/60 Hz)
or
U15425-115 Air Flow Generator(115 V, 50/60 Hz)

Contents:

Air-cushion plate
Magnetic hovering bodies:
- Red, 16 mm dia. (30x)
- Green, 16 mm dia. (25x)
- Aluminum, 21 mm dia. (5x)
- Orange, 28 mm dia. (25x)
- Blue, 48 mm dia. (1x)

Magnetic barriers:
- 253 mm (2x)
- 233 mm (1x)
- 233 mm with a recess (1x)
- 233 mm with an opening, flat, with 4 magnets (1x)

Magnetic piston
Lattice model
Fixture for lattice model
Pair of electrodes
Plexiglass plate
Manipulation rod
Tweezers
Experiment manual
Wooden storage box



U15420

Qualitative observations

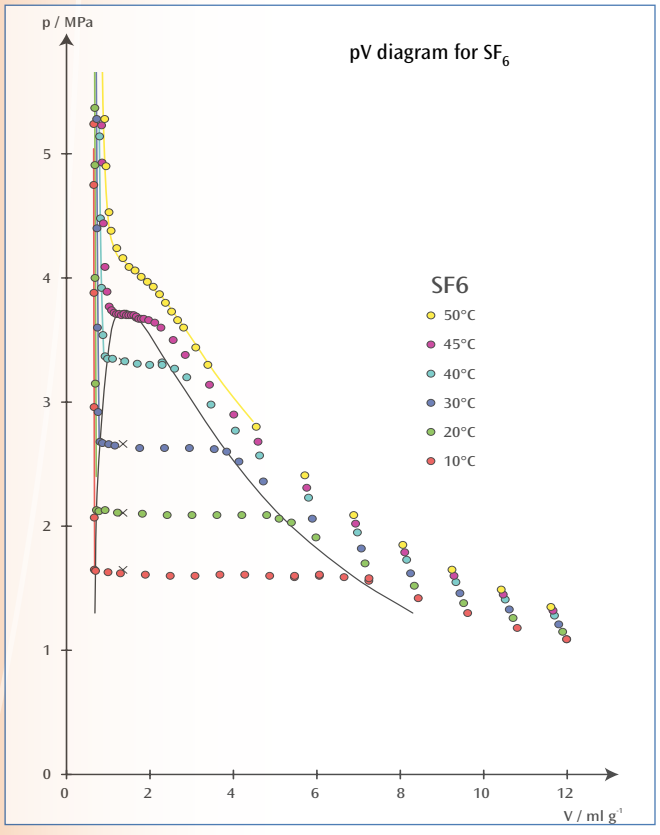
- Liquid and gaseous states
- Dynamic compression and expansion
- Critical opalescence
- Formation of the transition point at various temperatures

Quantitative measurements

- Display of the critical point and temperature
- Recording of isotherms in p-V (Clapeyron) diagrams
- Recording of isotherms in pV-p (Amegat) diagrams
- Pressure curves for a saturated vapour
- Differences between real gases and ideal gases



U10400



U10400

Critical Point Apparatus

A high-precision apparatus for studying the compression and liquefaction of a gas, determining the critical point and recording isotherms in p-V (Clapeyron) diagrams. The test gas is sulphur hexafluoride (SF_6), which has a critical temperature of 318.6 K (45.5°C) and a critical pressure of 3.76 MPa (37.6 bars), allowing for a simple experiment set-up.

The apparatus includes a transparent measuring cell that is highly resistant to leakage and compression. The volume inside the cell is changed via a finely adjustable handwheel, the change being indicated by a combination of a fixed and a rotary scale to an accuracy of 1/1000 of the maximum volume. The pressure is generated by a hydraulic system containing castor oil of medically approved quality. The measuring cell and hydraulic system are separated by a cap seal which rolls in as the volume increases. This design means the pressure gradient between the measuring cell and oil chamber is negligible. A manometer measures gas pressure instead of oil pressure without taking up any dead space inside the measuring cell.

During transitions from the gaseous to the liquid phases and vice versa, it is therefore possible to observe the formation of the first drops of liquid and disappearance of the last gas bubbles.

The measuring cell is enclosed in a transparent water chamber. A circulation thermostat allows the temperature to be maintained at a highly constant value, which can be monitored by means of a thermometer.

Practical indications of the volume, pressure and temperature permit easy recording of p-V or pV-p diagrams providing qualitatively correct results. Pressure and temperature-dependent volumetric corrections also provide quantitatively accurate results comparing favourably with standard reference values.

Critical temperature:	318.6 K (45.5°C)
Critical pressure:	3.76 MPa (37.6 bars)
Critical volume:	197.4 cm^3/mol
Critical density:	0.74 g/mol
Temperature range:	10 – 60°C
Maximum pressure:	6.0 MPa (60 bars)
Maximum volume:	15.7 cm^3
Manometer diameter:	160 mm
Bore for temperature sensor:	6 mm dia.
Temperature control connections:	7 mm dia.
Reducing valve connection:	1/8“dia.
Standard gas connection:	3.5 mm dia.
Dimensions:	380x200x400 mm^3
Weight:	7 kg approx.

Contents:

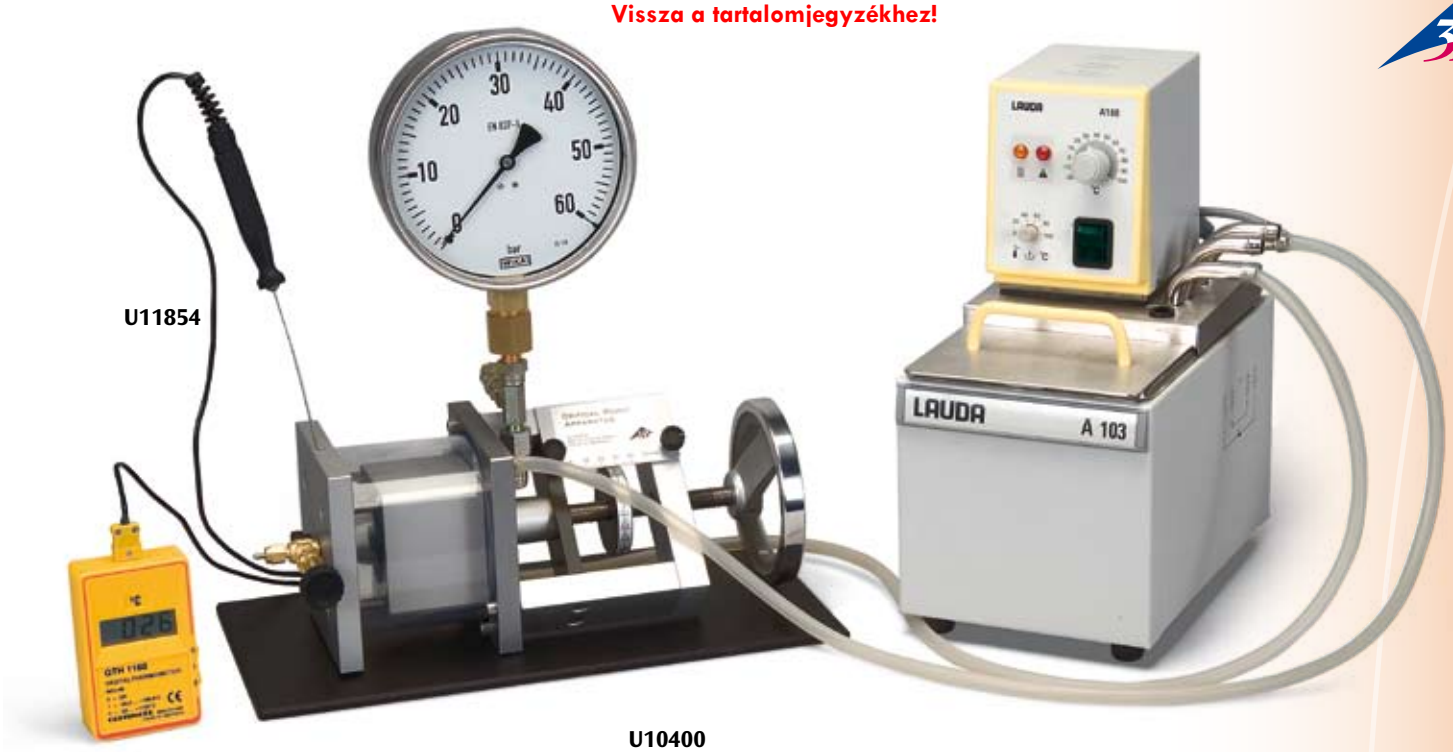
1 Critical point apparatus filled with hydraulic (castor) oil but without test gas (SF_6). Includes built-in safeguarded connection nozzle for MINICAN® gas canisters
1 Oil filling device
1 Angled 1.3-mm hexagonal spanner (for grub screw on rotary scale)
1 Plastic hose, 3 mm internal diameter
1 1/8“ pipe screw connection (SW 11)
1 Fluorescent lamp

Additionally required:

U14400 Immersion/Circulation Thermostat
U10146 Silicone Tubing, 1 m (2x)
U11853 Digital Quick-Response Pocket Thermometer
U11854 Immersion Sensor, NiCr-Ni, type K, -65°C – 550°C
Sulphur hexafluoride SF_6

Note:

In accordance with good laboratory practice, it is advisable to obtain gas via a fixed pipeline if the critical-point apparatus is used frequently. In case of occasional usage, it is more expedient to obtain the test gas from MINICAN® canisters. A MINICAN® gas connection is designed similarly to the valve on a common spray can, i.e. it is opened simply by fitting the MINICAN® on the gas connection nozzle.



U11854

U10400

U14400

U11853

Additionally required in case of degassing hydraulic oil:
U10401 Castor Oil
High-Power Vacuum Pump

U10401

Castor Oil (not illustrated)
250 ml of DAB approved castor oil for filling U10400 critical point apparatus.

U10402

Set of Seals (not illustrated)
Set of spare seals for critical point apparatus (U10400). Includes a rubber cap seal, round rubber seal, square rubber seal 78 x 78 mm, sealing ring and four copper sealing discs.

Immersion/Circulation Thermostat

This immersion/circulation thermostat has a closed bath for thermostatic control of water tanks or external apparatus with non-flammable liquids at temperatures of up to 100 °C. The fully electronic continuous controller and powerful circulation pump with a rotatable pump housing ensure ideal bath circulation and, therefore, a high degree of temperature constancy. The rotary knob is used for analogue setting of setpoint values. Actual values are indicated by a glass thermometer. Clearly visible indicator lights for heating functions and errors increase operational safety. Includes a connection for a continuous cooler, a cooling coil which makes use of tap water as the coolant, a thermometer with a display range of 0 - 100°C and a plug.

Operating-temperature range:	25°C – 100°C
Temperature constancy:	± 0.05°C
Heating power:	1.5 kW
Pump pressure:	max. 0.15 bar
Delivery rate:	max. 8 l/min
Bath volume:	2.5 l – 3.5 l
Bath area / depth:	135x105 mm / 150 mm³

U14400-230

Immersion / Circulation Thermostat (230 V, 50/60 Hz)

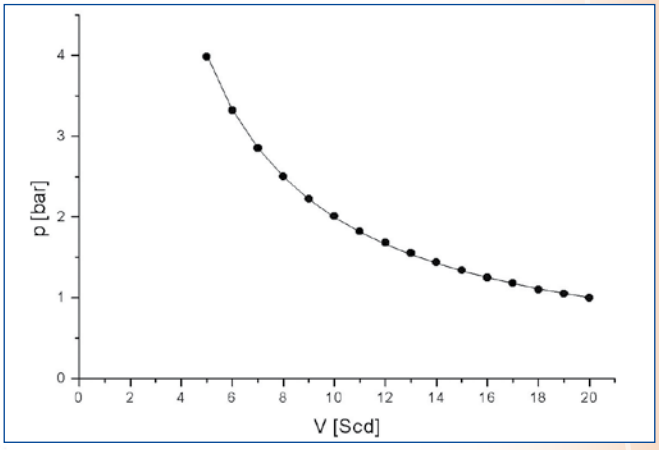
U14400-115

Immersion / Circulation Thermostat (115 V, 50/60 Hz)

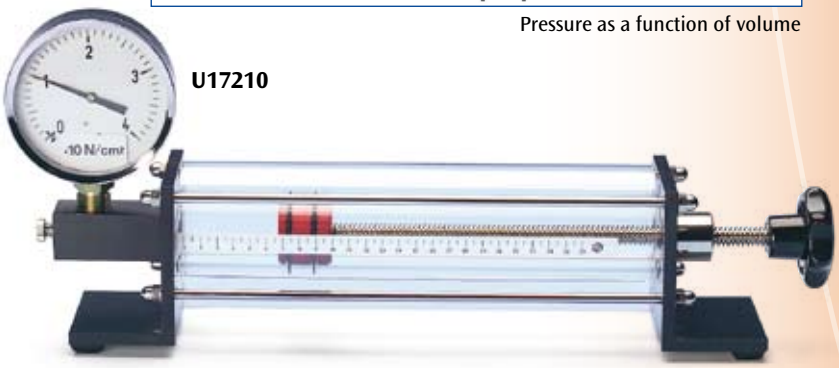
U17210

Boyle's Law Apparatus
Device for experiment based determinations of the dependence between the volume and pressure of a gas at constant temperature (Boyle's law). Consists of a plexiglass cylinder with graduations for volume measurement, piston, manometer and air inlet/outlet valves.
Turning the handle moves the piston via a thread in the plexiglass cylinder. This allows a generation of overpressures and underpressures. For safety reasons, the power cylinder is enclosed in another plexiglass cylinder.

Length:	300 mm
Internal diameter:	40 mm
Piston:	30 mm x 40 mm dia.
Piston seal:	2 O-rings
Manometer diameter:	100 mm
Pressure range:	0 N/cm² – 40 N/cm²



Pressure as a function of volume

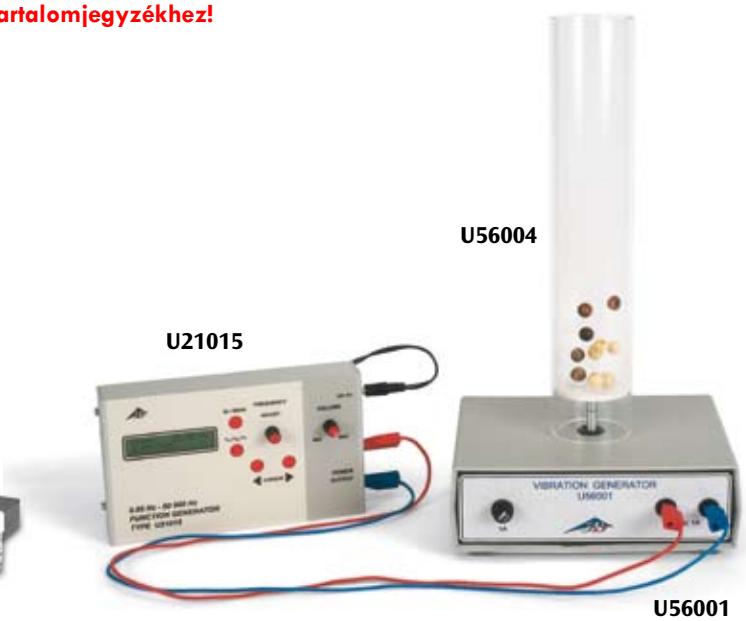


U17210



U14328

U8741180



U56004

U21015

U56001



U14327

U56004

Accessories for Kinetic Gas Theory

Accessories for vibrator for simulating particle motion in an ideal gas. Differently coloured spheres (gas model) are set in motion by mechanical vibrations.

Contents:

1 Plexiglas cylinder, length 300 mm
1 Circular disc
1 Set of spheres of different colours

Additionally required:
U56001 Vibration Generator
U21015-230 Function Generator (230 V, 50/60 Hz)
or
U21015-115 Function Generator (115 V, 50/60 Hz)

U8741180

Pneumatic Lighter

Device for demonstrating the ignition of diesel. By swiftly pressing down the piston, the compressed air in the transparent tube is heated so strongly that a piece of paper placed at the bottom of the tube very clearly ignites. Similarly, a cotton-wool pad soaked in ether also catches fire.
Length of
compression tube: approx. 150 mm

U8741185

Spare Glass Tube (not illustrated)
Spare glass tube for pneumatic lighter U8741180.

U14328

Oscillation Tube

For determining adiabatic exponent c_p/c_v of air by Rüchardt's method, used in conjunction with Mariotte flask U14327. Precision glass tube with precisely fitting aluminum cylinder. If the glass tube is placed vertically on a glass flask of 10 l volume and the aluminum cylinder is allowed to slide into the glass tube, it can be made to undergo harmonic oscillations on the air cushion resulting from the enclosed volume of air. c_p/c_v can then be calculated from the period.
Dimensions: 600 mm x 16 mm dia. internal
Aluminum cylinder: 15.2 g

Additionally required:
U14327 Mariotte Flask
U11902 Digital Stopwatch

Additionally recommended:
U20500 Vacuum Hand Pump

U14327

Mariotte Flask

Duran glass flask with discharge opening at base and two rubber stoppers with boreholes.
Volume: 10 l

Additionally recommended:
U14328 Oscillation Tube



U14328



U14327

U8440480

Wilke-type Stirling Engine

A functional model optimised for demonstrating to students the operation of a thermal engine and the conversion of thermal energy into mechanical energy, as well as investigating the Stirling cycle.
Because they are transparent, the displacement and power cylinders allow a clear view of their mutual interaction, particularly at low speed. The heat can be supplied in three different ways: by a heating plate mounted below the displacement cylinder, a candle or a standard incandescent lamp in combination with a concave mirror inserted underneath the displacement cylinder.

Flywheel rod:	520 mm
Dimensions without flywheel rod:	approx. 450x290x200 mm³
Weight:	approx. 4 kg



U8440480

U10050

Stirling Engine, Transparent

Transparent Stirling engine for quantitative investigations of the Stirling cycle. The Stirling engine can be operated in three different modes: as a heat engine, heat pump and refrigerating machine.
The displacement cylinder and displacement piston are made of heat-resistant glass; the power cylinder, flywheel and gearbox cover are made of acrylic glass. This allows very clear observation of the individual sequences of motion at all times. The crankshafts have ball bearings and are made of hardened steel. The connecting rods are made of wear-resistant plastic.
The glass of the displacement cylinder is also equipped with recessed temperature measurement sockets before and behind the displacement piston, to allow measurements of temperature differences during operation as a heat pump or refrigerating machine.
The large flywheel made of acrylic glass has imprinted markings to allow measurement of revolutions per unit of time using a light barrier.
For recording pV-diagrams, it is possible to measure the pressure in the power cylinder via a hose connection; the string included in the scope of delivery can be fastened to the power piston to measure the stroke in order to determine the volume.
The integrated engine – generator unit with a two-stage belt pulley allows a conversion of the produced mechanical energy into electrical energy. Equipped with a switchover option for operating an integrated lamp or external loads, or feeding electrical energy for operation as a heat pump or refrigerating machine, in accordance with the direction of rotation of the Stirling engine. Includes an alcohol burner (U10051)

Motor–generator unit:	max. 12 V DC
Two-stage belt pulley:	30 mm dia., 19 mm dia.
Power of the Stirling engine:	approx. 1 W
Dimensions:	approx. 300x220x160 mm³
Weight:	approx. 1.6 kg

Low Temperature Stirling Engine

A compact, transparent Stirling engine for demonstrating the operation and fundamental design of such engines.
A temperature difference of approximately 5ºC between the base and top plates is sufficient to set the motor in motion. This difference can be generated just by the warmth of a human hand. The top plate's matt, black coat also enables the device to be operated as a solar-powered engine.
The power cylinder is made of precision glass, while the displacement cylinder and flywheel are made of acrylic glass; this allows a clear observation of the movements of the power piston, displacement mechanism and crankshaft drive. The crankshaft and connecting rod have miniature precision ball bearings.

Speed:	approx. 80 rpm at ΔT=10 ºC
Flywheel:	110 mm dia.
Dimensions:	approx. 138 mm x 110 mm dia.

U10060

Low Temperature Stirling Engine

U10061

Low Temperature Stirling Engine, Assembly Kit



U10050



U10060

Heat Pump

Demonstration model for showing how refrigerators and heat pumps work. Electrical compression heat pump consisting of compressor with drive motor, vaporizer, condenser and expansion valve. The components are connected in a closed system by pipes and mounted on a base board. Evaporator and condenser are constructed as copper tubing spirals and each of them is submerged in water filled buckets serving as heat reservoirs for determining the energy absorbed or emitted. Two large manometers display the pressure ratios of the coolant in both heat exchangers. A protective overpressure switch disconnects the heat pump from the circuit when overpressure reaches 15 bars. In order to observe also the properties of liquids and gases (refrigerants) and the processes by which they are converted from one to another the heat pump is equipped with viewing ports. These allow you to see inside the pump and observe the state of the refrigerant immediately after the evaporator or condenser. May be used as an air-water or water-water heat pump.

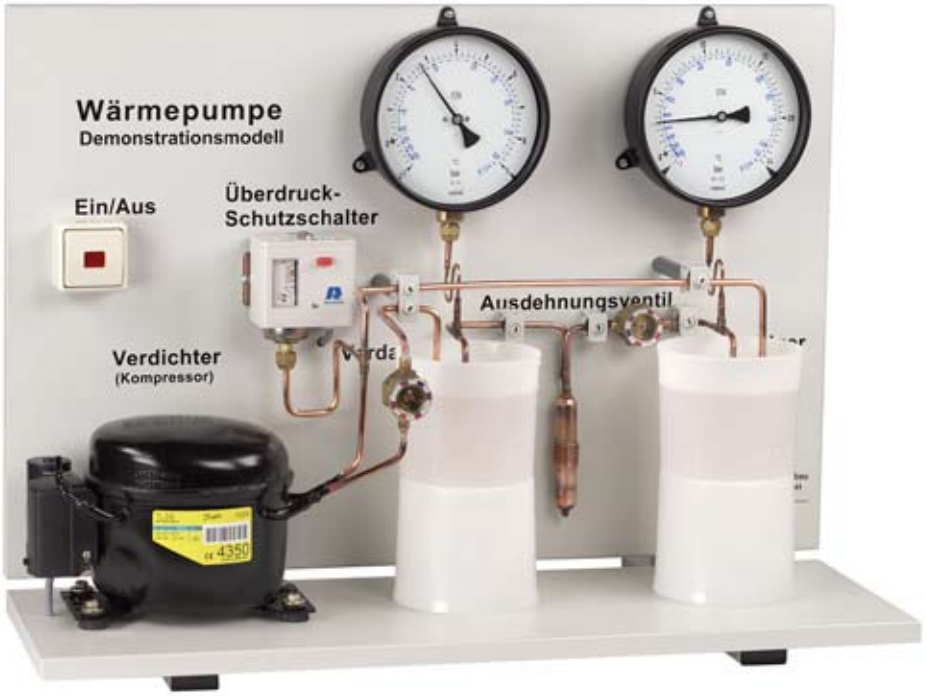
Compressor power:	120 W
Evaporator temperature:	-10 °C
Coolant:	R 134A, free of fluorochlorohydrocarbons
Manometer:	160 mm dia.
Dimensions:	750x350x540 mm³

U8440520-230

Heat Pump (230 V, 50/60 Hz)

U8440520-115

Heat Pump (115 V, 50/60 Hz)



U10055

U10055

Steam Engine, Transparent Housing

Transparent steam engine for demonstrate how an oscillating steam engine operates. In this engine the cylinder moves around a centre axis. This motion causes the inlet port and outlet port of the steam conduit to open and close.
The base plate and flywheel are made of plexiglass, the boiler and working cylinder are made of heat-proof quartz glass, making all of the moveable parts and actions very clearly visible. With a ball bearing supported crankshaft made of brass and a safety valve built into the boiler to prevent excessive pressure. Including alcohol burner.

Rotation speed	800 rpm.
Mech. power	1 W
Boiler volume	50 ml
Run time per load	20 – 25 min.
Max. operating pressure	0.5 bar



Function Models, Transparent
Movable, transparent, function cutaway models for demonstrating the operation of various engine types on a overhead projector.
The models are made of high-grade, transparent acrylic glass, 3 - 5 mm thick, and extremely robust and durable.
Dimensions: approx. 250x250 mm²



U15600
Wankel Engine, Transparent
Cutaway model for the overhead projector



U15601
Four-Stroke Engine, Transparent
Cutaway model for the overhead projector



U15602
Diesel Engine, Transparent
Cutaway model for the overhead projector



U15603
Steam Engine, Transparent
Cutaway model for the overhead projector



U15604
Two-Stroke Engine, Transparent
Cutaway model for the overhead projector



U15606
Stirling Engine, Transparent
Cutaway model for the overhead projector

U8621240
Spirit Lamp
Made of metal, with a knurled screw for feeding the wick and cap for extinguishing the flame.
Contents: 60 ml
Dimensions: 55mm x 65 mm dia.
Weight: 50 g approx.

U8621250
Wick
(not illustrated)
Spare wick for the U8621240 spirit lamp.
Length: 100 mm

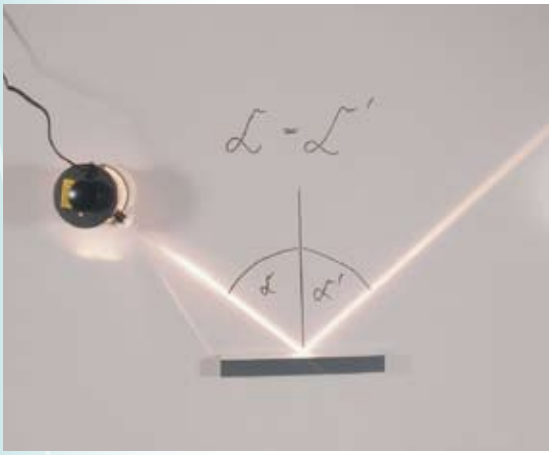
U8624110-230
Immersion Heater - 300 W
Immersion heater with protection against overheating (VDE-compliant).
Important: operates solely on a mains voltage of 230 V.



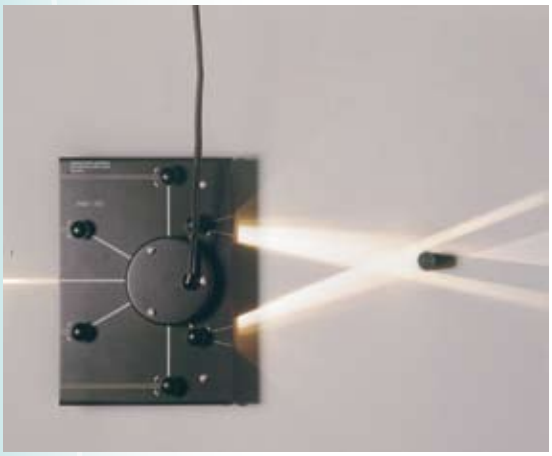
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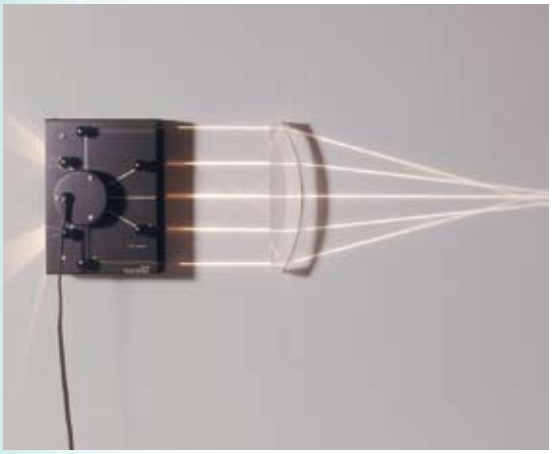
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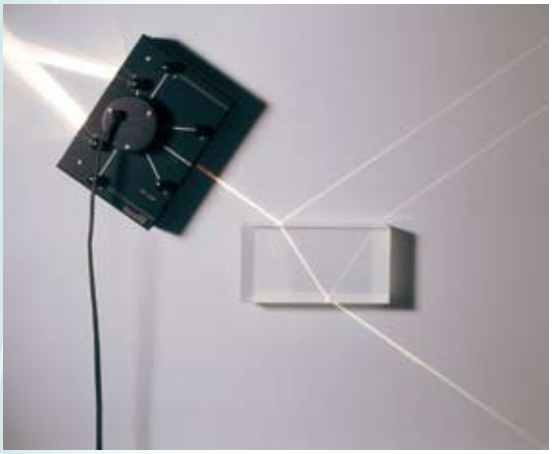
Reflection



Shadow projection



Lense errors



Refraction

Experiment topics:

- **Laws of reflection**
- **Laws of refraction**
- **Total reflection**
- **Minimum deflection angle for a prism**
- **Focal determination of mirrors and lenses**
- **Laws of lenses and image errors**
- **Shadow casting**



U40120

Single-Ray Projector

Light source for experiments demonstrating ray optics on a whiteboard (U10030 or U10031). With an adjustable aperture for producing a concentrated or divergent light beam.

Lamp:	12 V, 35 W
Connecting line:	1.5 m long with 4 mm plug
Dimensions:	approx. 120 mm x 70 mm dia.
Weight:	approx. 0.25 kg

Additionally required:

U40121 Magnetic Holder for Single-Ray Projector

U13900-230 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
U13900-115 Transformer 12 V, 60 VA (115 V, 50/60 Hz)

U40122

Halogen Lamp, 12 V, 35 W
(not illustrated)
Spare lamp for single-ray projector (U40120).

U40121

Magnetic Holder for Single-Ray Projector
Magnet holder for mounting single-ray projector (U40120) on a whiteboard (U10030 or U10031).

U14600



U14600

Optics Kit for Whiteboard

Set of optical components for use in conjunction with a single-beam lamp (U40120) or multiple-beam lamp (U40110) on a whiteboard (U10030 or U10031).

All components are lined with magnetic foil or furnished with a magnet holder and can be easily mounted and aligned on the whiteboard. This apparatus permits a wide range of experiments demonstrating ray optics without the need for a dark room; handwritten notes can be added to provide a clearer explanation.

Contents:

Mirror:

Art. Nr.	Designation	Dimensions
U15510	Plane mirror	200x35x35 mm³
U15511	Convex – concave mirror, f = ±100 mm	200x35x35 mm³

Transparent objects:

U15515	Plano-concave lens, f = -400 mm	200x40x35 mm³
U15516	Plano-convex lens, f = +400 mm	200x40x35 mm³
U15517	Plane-parallel plate	200x100x35 mm³
U51518	Semi-circular body, f = +200 mm	dia. 200x35 mm²
U15520	Right-angled prism	200x200x35 mm³

Shadow-casting bodies:

U15525	Cuboid	100x20x35 mm³
	Cylinder	dia. 5x35 mm²
	Cylinder	dia. 60x35 mm²

Additionally required:

U10030 Whiteboard 600 x 900 mm²

or

U10031 Whiteboard 600 x 900 mm²

U40120 Single-Ray Projector

U40121 Magnetic Holder for Single-Ray Projector

or

U40110 Multiple-Ray Projector

U40110



U40110

Multiple-Ray Projector, Magnetic

Light source for experiments demonstrating ray optics on a whiteboard (U10030 or U10031). In metal housing on magnetic foil.

Experiments on reflection, refraction and basic lens laws can be performed using five narrow light rays which emerge from the right-hand side. With the help of rotating mirrors, these rays can be directed to make parallel, divergent or convergent beams, or can be masked out individually. Highly demonstrative experiments on shadow casting can be conducted using the two divergent light rays emerging from the left-hand side. With the help of rotating mirrors, these rays can be directed or masked out individually.

Lamp:	12 V, 55 W
Connecting line:	1.5 m long with 4 mm plug
Dimensions:	approx. 150x200x50 mm³
Weight:	approx. 0.9 kg

Additionally required:

U13900-230 Transformer 12 V, 60 VA (230 V, 50/60 Hz)

or

U13900-115 Transformer 12 V, 60 VA (115 V, 50/60 Hz)



U10030 + U10031

Whiteboards

Steel boards with an enamelled surface for experiments with magnetic attachments. Scratch- and corrosion-proof, writeable with water-based felt pens. Can be suspended from a wall or mounted on holders (see page 205).

Art. Nr.	Designation	Dimensions
U10030	Whiteboard	600x900 mm²
U10031	Whiteboard	900x1200 mm²

U40113

Halogen Lamp, 12 V, 55 W

(not illustrated)

Spare halogen lamp for multiple-ray projector (U40110).

U17302-230

Laser Ray Box (230 V, 50/60Hz)

U17302-115

Laser Ray Box (115, 50/60 Hz)

Laser diode capable of producing up to five parallel rays, for use with related board (U17306). In metal housing with magnetic foil.
The number of emerging light beams can be selected electronically via switches. Power is supplied via a plug-in unit or batteries that are automatically disconnected after 60 minutes.

Diode laser:	5 beams, each max. 1 mW, Laser safety class II
Wavelength:	635 nm
Separation of laser beams:	18 mm
Plug-in power supply:	Primary 100 – 240 VAC, Secondary 3 V DC, 300 mA
Battery compartment:	for 2 x 1.5 V AA-batteries (batteries not included)
Dimensions:	approx. 110x60x20 mm³

Experiment topics:

- **Law of refraction**
- **Law of reflection**
- **Total reflection**
- **Determining the focal length of curved mirrors and lenses**
- **Lens laws**
- **Correction of spherical aberration**
- **Short-sightedness and long-sightedness of the human eye and the correction of such defects**
- **Beam paths in cameras, microscopes and telescopes**



U17302

BESTseller

U17300

U17306

U17306

Board for Laser Ray Box

Magnetic board for conducting experiments with laser ray box (U17302).
With a removable prop for inclining board.
Dimensions: approx. 600 x 450 mm²

U17300

Optics Equipment Set with Laser Ray Box

Set of optical components for use in combination with a laser ray box (U17302) and related board (U17306).
This equipment set is ideal for conducting a wide variety of experiments on ray optics. Equipped with magnetic foil, the components can be easily attached to the board and aligned. Six work templates with pre-defined positions facilitate experiment setup. The beam paths can be observed from a relatively long way away without any need for darkening the room.
Basic length: 100 mm each (in most cases)
Thickness: 15 mm each.

Contents:

- 1 Biconcave lens
- 4 Biconvex lenses
- 1 Plano-concave lens
- 1 Hemispherical body (45 mm)
- 1 Hemispherical body (75 mm)
- 1 Plane mirror
- 1 Concave mirror
- 1 Convex mirror
- 1 Flat parallel block (60x100 mm²)
- 1 Prism
- 1 Wave guide (20x200 mm²)
- 6 Foils (410x290 mm²)
- 1 Experiment guide

Additionally required:
U17302-230 Laser Ray Box (230 V, 50/60 Hz)
or
U17302-115 Laser Ray Box (115 V 50/60Hz)

U17306 Board for Laser Ray Box

U17301

Laser Optics Supplemental Set with Laser Ray Box

Supplementary kit to the demonstration laser optic set with laser ray box, consisting of 13 optical components for more advanced experiments on geometric optics, e.g. experiments using air lens that show why optical elements cause either negative or positive refraction. All components are coated with magnetic foil.
Base length: 100 mm each (in most cases)
Thickness: 15 mm each

Contents:

- 1 Biconcave glass lens
- 1 Biconvex glass lens
- 1 Equilateral glass prism
- 2 Rectangular glass prism
- 1 Flat parallel block (square)
- 2 Flat parallel blocks (rectangular)
- 2 Plane mirror
- 1 Biconcave 'air lens'
- 1 Biconvex 'air lens'
- 1 Air prism'



U17301

Experiment topics:

- **Focus of a convex lens**
- **Focal length**
- **Concave lens**
- **Prism**
- **Plan-parallel plate**



U21880

U21880

Five-Beam Optical Halogen Lamp 12 V, 55 W

Bright light source with five parallel light apertures for experiments involving ray optics to be conducted on a lab bench. In metal housing with integrated ventilation fan. Includes an adjustable reflecting mirror for setting the beam length. By lining its base plate with a magnetic foil, it is also possible to set up the lamp on magnetic boards.

Halogen lamp:	12 V, 50 W
Connection:	4-mm safety sockets
Slit width:	2 mm
Slit spacing:	18 mm
Housing dimensions:	approx. 210x118x85 mm³

U15530

Set of Optical Components

In conjunction with the five-beam optical lamp U21880, this equipment set is intended for experiments introducing students to geometric optics. The optical components are made of acrylic glass.

Height: 15 mm each

Contents:

1 Planar-convex lens
2 Bi-convex lenses
1 Bi-concave len
1 Equilateral prism
1 Rectangular prism
1 Irregular prism
1 Plane-parallel plate
1 Semicircular element
1 Cylindrical lens



U15530

Additionally required:

U13900-230 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
U13900-115 Transformer 12 V, 60 VA (115 V, 50/60 Hz)

U15530 Set of Optical Components

Experiment topics:

- **Demonstration of various light beams**
- **Reflection of a light ray by a plane mirror**
- **Reflection of a beam of rays by a plane mirror**
- **Reflection of a beam of rays by a concave / convex mirror**
- **Snell's law of refraction**
- **Refraction by a plane-parallel plate**
- **Refraction by a prism**
- **Inverting prism**
- **Concave and convex lenses**



U17128

U17145

Basic Optics Equipment Set

Complete set of apparatus for performing experiments with optical disc (U17128).

Contents:

Art. Nr.	Description	Quantity
U17150	Optical bench U, 120 cm	1
U17160	Optical rider U, 75 mm	3
U17161	Optical rider U, 30 mm	1
U17140	Experiment lamp, halogen	1
U13735	Spare lamp, Halogen 12 V, 50 W	1
U17000	Object holder on a stem	1
U17105	Convex lens, f = + 150 mm (75 mm dia.)	1
U17040	Set of slits and apertures	1
U17128	Optical disc with accessories	1
U17120	Storage strip	1

Additionally required:

U13900-230 Transformer 12 V, 60 VA (230 V, 50/60 Hz)
or
U13900-115 Transformer 12 V, 60 VA (115 V, 50/60 Hz)

U17128

Optical Disc with Accessories

This equipment set introduces the fundamentals of geometric optics. It consists of a base plate with an angular scale possessing 1° divisions, a block scale and two bore holes for mounting clamps for optical components (lenses, prisms, mirrors). An adjustable holder and tripod permit horizontal as well as vertical installation.

Delivered with a storage case, this equipment set comprises the following items:

1 Optical disc with a holding stem and 2 clamps, 240 mm dia.
1 Bi-concave lens, 90 mm
1 Bi-convex lens, 90 mm
1 Semi-circular element, 90 mm
1 Trapezoid element, 45° and 60°
1 1 Prism, rectangular, leg length 50 mm
1 Combined mirror (planar, convex, concave)

With a dependability that has been proven over the course of decades, the Kröncke optical system provides the precision necessary for student exercises and practical experiments in a wide range of experiments on ray optics and wave optics.

All optical components are mounted in diaphragms with no stem and can easily be moved up and down on an optical rider, perpendicular to the optical axis for the purpose of precise adjustment. The optical riders can be freely moved along the optical bench's U-shaped profile and secured by means of a simple clamping mechanism.

Optical Bench K

Optical bench comprising an aluminium U-shaped profile with a printed millimetre scale.
Cross-section: 72 x 30 mm approx.

Art. Nr.	Length	Weight
U8475337	1000 mm	1,2 kg
U8475336	450 mm	0,6 kg







U8475410

Halogen Lamp 12 V/20 W
(not illustrated)
Special substitute lamp for the optical lamp K (U8475400).

U8475400

Optical Lamp K
Halogen lamp in cylindrical housing attached to diaphragm screen (100x100 mm²) for mounting on K-model optical riders (U8475350).
The filament can be aligned horizontally or vertically.
Halogen lamp: 12 V, 20 W
Terminals: 4 mm safety sockets
Dimensions: approx. 60x100x100 mm³
Weight: approx. 130 g

Additionally required:
U8475430-230 Transformer 12 V, 25 VA (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 VA (115 V, 50/60 Hz)

U8475350

Optical Rider K
Optical rider for K-model optical benches (U8475337 and U8475336).
With two clamps for diaphragms from the Kröncke optical system or for plates up to 2 mm thick.
Dimensions: approx. 40x50x35 mm³
Weight: approx. 70 g



U8476110

Prism Table K
Prism table with clip for clamping prisms. Holder fits K-model optical riders (U8475350).

U8476630

Micrometer Screw K
Micrometer screw with fine tip for measuring diffraction and interference lines. Holder fits the optical saddle K (U8475350).
Dimensions: approx. 80x30x60 mm³
Weight: approx. 120 g

U8475180

Plane Mirror K
Simple plane mirror, glass.
Dimensions: 100x100 mm²
Weight: approx. 70 g

U8475200

Concave Mirror K
Concave mirror on diaphragm 100x100 mm².
Focal length: 180 mm
Mirror diameter: 50 mm
Dimensions: 100x100 mm²

U8472345

Iris Diaphragm K
Continuously adjustable iris on diaphragm screen 100 x 100 mm².
Aperture: 2 – 18 mm
Dimensions: 100x100 mm²



U8476630



U8475180



U8475200



U8472345

Optical Lenses K

Lenses made of high-grade optical glass. Shock-proof and crack-proof installation in optical diaphragm (100x100 mm²). With focal length specification.
Dimensions: 100x100 mm²
Lens diameter: 50 mm.



U8475900 - U8475940



U8475950 - U8475960

Art. Nr.	Designation
U8475900	Convex Lens K, f = 50 mm
U8475910	Convex Lens K, f = 100 mm
U8475920	Convex Lens K, f = 150 mm
U8475930	Convex Lens K, f = 300 mm
U8475940	Convex Lens K, f = 500 mm
U8475950	Concave Lens K, f = -100 mm
U8475960	Concave Lens K, f = -500 mm



U8776140

U8476510

Fresnel Mirror K

Fresnel mirror for use on K-model optical benches (U8475337 and U8475336).
Two mutually inclined surface-coated mirrors are bonded to a common metal plate. A knurled screw at the rear can be used to adjust the angle between the mirrors. The wave nature of light can be demonstrated by interference following reflection at both mirrors.
Dimensions: approx. 50x160x83 mm³
Weight: approx. 240 g



U8476510

U8776140

Storage Box

Box made from smoked beech, varnished, with 20 compartments for lenses and optical elements of width 100 mm.
Dimensions: 400x130x90 mm³
Weight: approx. 1,000 g

Projection Screens K (not illustrated)
Plastic projection screens for mounting on K-model optical riders (U8475350).
Dimensions: 200x150 mm²

U8476310

Projection Screen K, transparent

U8476320

Projection Screen K, white

U8475540

Clamp K

Clamp for diaphragms, filters, diffraction objects and other objects in a slide frame (see as of page 116). On diaphragm screen (100 x 100 mm²).
Clamping range: 0, 2 – 10 mm
Dimensions: approx. 100x100 mm²
Round opening: 38 mm dia.

U8476690

Adjustable Slit K

Continuously adjustable slit on diaphragm screen (100x100 mm²). The slit width can be adjusted by means of a micrometer screw.
Slit width: 0 – 4 mm
Slit height: 20 mm
Dimensions: approx. 100x100 mm²
Weight: approx. 190 g

U8476520

Pair of Polarsation Filters K

Two polarising filters on a diaphragm screen (100 x 100 mm²) for producing and analysing polarised light. In a rotating frame with a pointer and protractor scale.
Scale: 0 – 180°
Scale division: 5°
Dimensions: approx. 100x100 mm²
Filter diameter: 35 mm



U8475540



U8476690



U8476520

U10304

Support for Optical Bench D

A pair of base rails with contact points and screws for adjusting optical bench. Made of black, anodised aluminium.

Length of supports: 270 mm



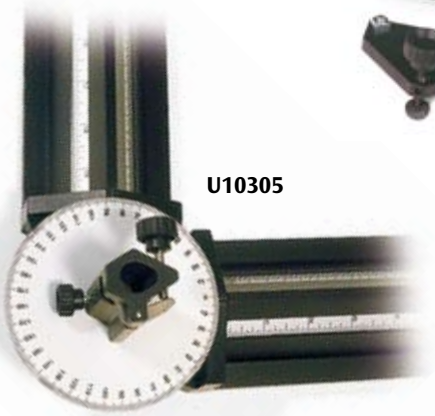
U10304

U10305

Swivel Joint for Optical Bench D

For experiments where light is deflected and where the highest precision requirements prevail. Black anodized aluminum with adjustable protactor scale ±180° in 1° divisions. Sleeve for holding optical elements shaft mounted.

Protractor scale: ± 90°
Sleeve height: 60 mm
Clamping width for rods: 10 – 14 mm



U10305

Optical bench U

Comprising a solid aluminium profile, anodised with natural finish, robust and resistant to twisting, with mm scale along the full length. For experiments with optical attachments on a stem.

Cross-section: approx.100x40 mm²

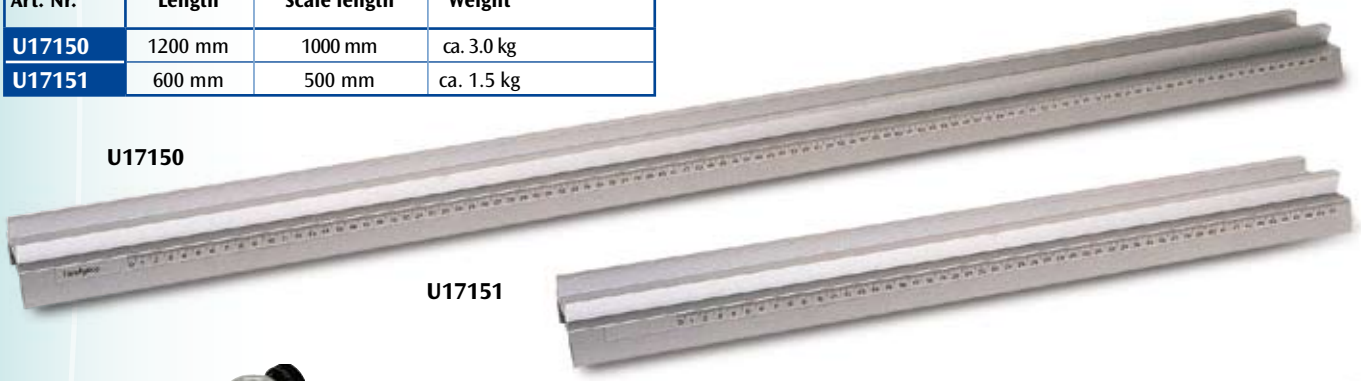
Art. Nr.	Length	Scale length	Weight
U17150	1200 mm	1000 mm	ca. 3.0 kg
U17151	600 mm	500 mm	ca. 1.5 kg

U171661

Pair of Rail Supports

Two support feet made of natural-finish, anodised aluminium for U-model optical benches (U17150 und U17151).

Dimensions: 220x20x15 mm³



U17150

U17151



U17165



U17160, U17161



U171661

U17165

Swivel Joint with Scale

Connecting piece for articulated linking of two U-model optical benches (U17150 and U17151). Profile rails. 90° articulation angle in both directions. Natural-finish, anodised aluminium. With a mounting for optical attachments on a stem at the axis of rotation.

Clamping width for stems: 10 mm
Scale division: 5°
Dimensions: 180x82x100 mm³

Optical Rider U

Optical rider for U-model optical benches (U17150 and U17151) for mounting optical attachments on a stem. A smooth base ensures easy movement on the optical bench.

Art. Nr.	Sleeve height
U17160	70 mm
U17161	35 mm

Optical Precision Bench D

Optical precision bench with a triangular profile for research and demonstration experiments requiring maximum accuracy. Made of black, anodised aluminium. Tilt-proof, slip-proof, resistant to bending and twisting, equipped with a full-length scale with cm/mm divisions. Bore holes on front end for securing connecting elements for additional rails or swivel joint (U10305). Available in three designs. On request, also available in any length up to 2000 mm (inquire about price).
Cross-section: approx. 90x60 mm³

Art. Nr.	Length	Weight
U10302	500 mm	ca. 1.75 kg
U10300	1000 mm	ca. 3.5 kg
U10301	2000 mm	ca. 7 kg

U10302



BESTseller

U103201

Sliding Rider D

Optical rider with a mounting for optical attachments on a stem, adjustable vertically with respect to the optical axis.
Sliding range: ±50 mm
Sleeve height: 90 mm
Base width: 50 mm
Clamping width for rods: 10 – 14 mm



U103201

U10331

Extension Arm D

Extension Arm to clamp on an optical rider D, for positioning optical elements out of the optical axis.
Extension arm: 100 mm
Clamping width for rods: 10 – 14 mm



U10331

U10330

Tilting Rider D

Optical rider for tilting optical elements out of the optical axis.
Sleeve height: 90 mm
Base width: 50 mm
Clamping width for rods: 10 – 14 mm
Tilting range: 90°

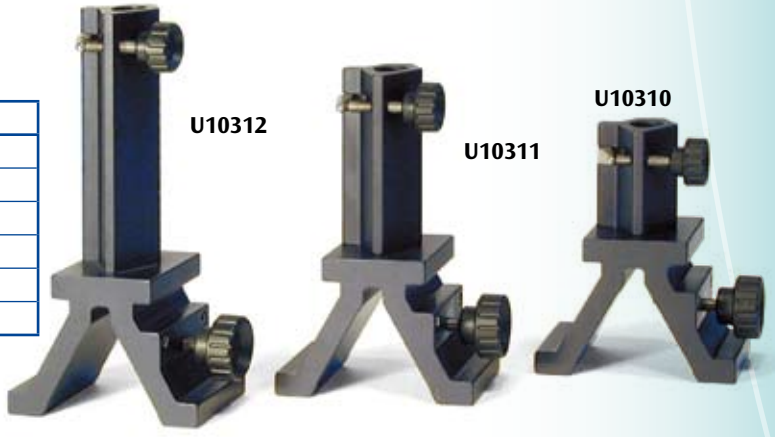


U10330

Optical Rider D

Optical rider for D-model precision optical benches (U10300, U10301 and U10302) for mounting optical attachments on a stem. For research and demonstration experiments requiring maximum accuracy. Made of black anodized aluminum.
Clamping width for rods: 10 – 14 mm

Art. Nr.	Sleeve height	Base width
U10310	60 mm	50 mm
U10311	90 mm	50 mm
U10312	120 mm	50 mm
U10315	60 mm	36 mm
U10316	90 mm	36 mm
U10317	120 mm	36 mm



U10312

U10311

U10310

U21881

Optical Lamp, Halogen

Ultra-bright light source for experi ments on optical bench and for projection. It consists of a metal housing with a condenser, a movable element for axial light adjustment, a holding stem with a screw mounting and an integrated fan.

Halogen lamp:	12 V, 50 W
Connection:	via 4-mm safety sockets
Light aperture:	40 mm dia.
Shaft diameter:	10 mm
Dimensions:	approx. 80x80x105 mm³

Additionally required:
U13900-230 Transformer 12 V, 60 W (230 V, 50/60 Hz)
or
U13900-115 Transformer 12 V, 60 W (115 V, 50/60 Hz)



U21881

U17140

U17140

Experimental Lamp, Halogen

Light source with low-divergence beam for optical experiments. Black-painted metal housing on a stem, with fixture for vertical or horizontal set-up.

Halogen lamp:	12 V, 50 W
Connection:	via 4-mm safety sockets
Light aperture:	40 mm dia.
Shaft diameter:	10 mm
Dimensions:	approx. 80x80x105 mm³

Additionally required:
U13900-230 Transformer 12 V, 60 W (230 V, 50/60 Hz)
or
U13900-115 Transformer 12 V, 60 W (115 V, 50/60 Hz)

U13735

Spare Halogen Lamp, 12 V, 50 W (not illustrated)
Spare halogen lamp for optical lamps (U17140 and U21881).

U21840

He-Ne Laser

Monochromatic, coherent light source for optical experiments, e.g. on diffraction, interference, and hologram reconstitution. Anodised metal housing with key switch, neutral filter for attenuating beam, handle and power supply unit. To widen the beam, microscope objectives (e.g. W30614) can be screwed to the beam aperture.

Laser protection class:	II
Output power:	<0.2 mW (with neutral grey filter) <1 mW (without neutral grey filter)
Wavelength:	633 nm
Beam diameter:	0.48 mm
Radiation divergence:	1.7 mrad
Mode:	TEMoo
Polarisation:	Random
Service life:	> 12000 hours
Plug-in power supply:	12 V DC, 1 A
Dimensions:	approx. 200x60x50 mm³
Weight:	approx. 0.6 kg

Contents:
1 He-Ne Laser
2 Keys
1 Long stand rod
1 Short stand rod
1 Transformer 12 V



U21840

W30614

Achromatic Objective - 10x / 0.25

Microscope objective for diverging beam in conjunction with He-Ne laser U21840.



Divergence of laser beam by a microscope objective.

Diode Laser

Extremely compact light source for experiment set-ups in geometrical and wave optics. Due to its compact design, sophisticated and space-saving configurations can be set up. A laser with all the safety features for both school and practical training applications:

- Instruction laser of safety class 2 with key-operated switch
- Clearly visible LED operating mode indicator
- Potentiometer to adjust output power
- Power supply provided by plug-in power supply is included.

Laser protection class:	II
Output power:	0.5 mW up to < 1 mW, Adjustable with potentiometer
Wavelength:	650 nm ± 3 nm
Beam diameter:	2.5 mm, ±10%
Stability of the output power:	± 5% in 24 h
Beam divergence:	< 2 mrad
Polarization:	random
Supply voltage:	12 V from a power supply unit
Shaft:	130 mm x dia. 10 mm
Dimensions:	approx. 50x72x54 mm³



U16040

U16040-230

Diode Laser (230 V, 50/60 Hz)

U16040-115

Diode Laser (115 V, 50/60 Hz)

BESTseller

Lenses on Stem

Lenses in black frame on stem. With a lens protection ring for preventing damage to the lens.
Holder: 130 mm dia.
Shaft: 10 mm dia.

Note:
All the components on stems illustrated on the following pages are supplied without an optical rider.



U10347



U17107



U17108

Art. Nr.	Designation	Focal length	Diaphragm diameter
U10347	Convex lens on stem	+5 mm	4,4 mm
U17101	Convex lens on stem	+50 mm	50 mm
U17102	Convex lens on stem	+100 mm	50 mm
U17103	Convex lens on stem	+150 mm	50 mm
U17104	Convex lens on stem	+200 mm	50 mm
U17105	Convex lens on stem	+300 mm	50 mm
U17108	Convex lens on stem	+150 mm	75 mm
U17106	Concave lens on stem	-100 mm	50 mm
U17107	Concave lens on stem	-200 mm	50 mm

Mirrors on Stem

Mirrors in black metal frame on stem. With protective ring for prevent damage to mirror.
Holder 130 mm dia.
Diaphragm: 50 mm dia.
Shaft: 10 mm dia.

Art. Nr.	Designation	Focal length
U17110	Concave mirror, on stem	+75 mm
U17111	Convex mirror, on stem	-75 mm
U17112	Plane mirror, on stem	–



U17110

U17111

U17112



U17109

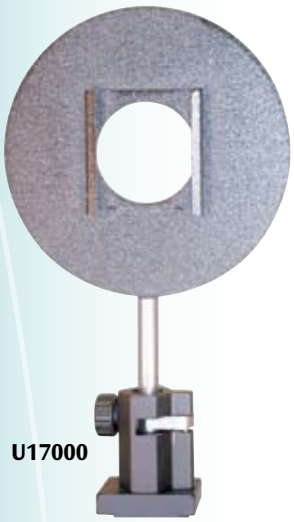
U17109

Variable Focus Lens

Transparent silicone lens, on stem. The radius of curvature of the soft silicone lens can be adjusted via the water pressure in the lens using a plastic syringe, e.g. for demonstrating the accommodation capacity of the eye.
Includes plastic syringe and connecting tube.
Holder: 130 mm dia.
Lens: 65 mm dia.
Shaft: 10 mm dia.

Vissza a tartalomjegyzékhez!

Optical Components on Stem



U17000



U17001



U17010



U17015

U17000

Object Holder on Stem

Object holder in black metal frame on stem. With plug-in frame for diaphragms, filters, diffraction gratings and other objects in slide frame (see as of page 116).

Metal frame:	130 mm dia.
Plug-in socket:	50x50 mm²
Shaft diameter:	10 mm dia.

U17001

Rotating Object Holder on Stem

Object holder in black metal frame on stem. With rotating, plug-in frame for diaphragms, filters, diffraction gratings and other objects in slide frame (see as of page 116) with protractor scale.

Holder:	130 mm
Plug-in frame:	50 x 50 mm
Angular scale:	± 90°
Divisions:	5°
Stem:	10 mm

U17010

Iris on Stem

Iris diaphragm in black metal frame, shaft-mounted. Continuously adjustable diaphragm diameter.

Holder:	130 mm dia.
Iris diameter:	3 – 29 mm
Shaft:	10 mm dia.

U17015

Adjustable Slit on Stem

Slit with symmetric aperture, in black metal frame on stem. With adjusting screw.

Holder:	130 mm dia.
Slit width:	0 – 3 mm
Slit height:	18 mm.
Shaft:	10 mm dia.



U17125

U17125

Projection Screen

Translucent screen, on stem, for all projection purposes on optical bench.

Dimensions:	250x250 mm²
Shaft:	10 mm dia.



U17120

U17120

Storing Base for Lenses

Wooden strip with ten bore holes for storing instruments with 10 mm-shaft.



U17025



U21835

U17030

Total Reflection Apparatus on Stem

Plexiglas rod with bend in black metal frame on stem. Parallel light shone through the rod undergoes total internal reflection and is guided around the bent end.

Metall holder: 130 mm dia.
Shaft: 10 mm dia.



U17030

U17025

Holder on Stem for Direct-Vision Prism

Holder with rotating mounting for direct-vision prism (U14020). In black metal frame on stem.

Holder: 130 mm dia.
Shaft: 10 mm

U21835

Holder on Stem for Lenses without Frame

Holder with a clamp for mounting frameless lenses. In black metal frame on stem.

Holder : 130 mm dia.
Aperture: 40 mm dia.
Shaft: 10 mm dia.

U10345

Fresnel Mirror on Stem

This device is used to demonstrate the wave nature of light by observing interference caused by reflection at two mirrors and can be used to calculate the wavelength of light. It consists of two mutually inclined, front-coated mirrors made of black acrylic glass and fitted in black, anodized aluminum holders with firmly mounted mirror protection elements on a tripod made of high-grade steel. The angle of inclination can be finely adjusted from the rear.

Total mirror area: 30x95 mm²
Adjustment range: -0.3° – +0.7°
Shaft: 10 mm dia.



U10345



U8473210



U8473200

U8473200-230

E14 Lamp Socket on Stem

E14 lamp socket on stem, with mains connection cable and Euro-plug conforming to CEE 7/16.

Shaft: 113 mm x10 mm dia.
Weight: approx. 135 g

U8473210-230

E27 Lamp Socket on Stem

E14 lamp socket on stem, with mains connection cable and Earthed plug conforming to CEE 7/4.

Shaft: 113 mm x10 mm dia.
Weight: approx. 240 g

U17020

Prism Table on Stem

Round prism table with a height-adjustable clamp, e.g. for fixing prisms. On stem for mounting on optical rider.

Table: 60 mm dia.
Shaft: 10 mm dia.



U17020

Diaphragms, Diffraction Objects and Filters

For fitting on an object holder on stem (U17000), in a rotatable object holder on stem (U17001) or in a clamping holder K (U8475540).



U17040

U17040

Set of 5 Slit and Hole Diaphragms

Five slit and hole diaphragms in a slide frame.

Dimensions: 50 x 50 mm²

Contents:

1 Slit, Slit width 1 mm
1 Threefold slit, Slit width 1 mm, Slit spacing 5 mm
1 Fivefold slit, Slit width 1 mm, Slit spacing 5 mm
1 Apertured diaphragm, dia. 8 mm
1 „F-diaphragm“

U14107

Diaphragm with a Single Slit and Rib

Photographic diffraction object in a slide frame.

Slit and rib width: 0.5 mm each

Dimensions: 50 x 50 mm²



U14107



U8470800

U8476600

Diaphragm with 3 Single Slits and 1 Double Slit

Photographic diffraction object in a slide frame.

Single slit widths: 0.075 / 0.15 / 0.4 mm

Double slit width: 0.1

Double slit spacing: 0.5 mm

Dimensions: 50x50 mm²



U8476600



U8470790

U8470800

Set of 5 Hole Diaphragms

Five hole diaphragms of different diameters in a slide frame.

Hole diameter: 1/ 3/ 6/ 10/ 15 mm

Dimensions: 50x50 mm²

U8470790

Set of 5 Single Slits

Five single slits of different widths in a slide frame.

Slit widths: 0.1/ 0.2/ 0.4/ 0.8/ 1.6 mm

Dimensions: 50x50 mm²

U8476605

Set of 4 Image Objects

Set of four image objects in a slide frame.

Dimensions: 50x50 mm²

Contents:

1 Scale, 15 mm with scale divisions of 0.1 mm
1 Photograph
1 F diaphragm
1 Number 1 diaphragm

U8476605



U14424

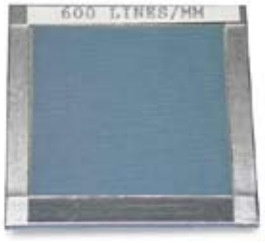
Copy of a Rowland Grating

This copy of a Rowland grating is supplied on a collodion foil between two glass plates in a metal frame for the purpose of projecting diffraction spectra, measuring wavelengths and observing spectra with spectrum lamps.

Number of lines: 600 Lines/mm

Dimensions: 50x50 mm²

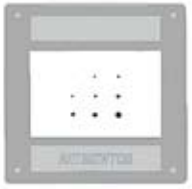
U14424



U8476650



U8476660



U14108



Diaphragms with Circular Holes and Discs

Photographic diffraction objects in a slide frame.
Dimensions: 50x50 mm²

Art. Nr.	Description	Diameter
U14108	Diaphragm with 3 Circular Hole and Disc Paires	1.0/1.5/2.0 mm
U8476650	Diaphragm with 9 Circular Discs	0.1 – 1.8 mm
U8476660	Diaphragm with 9 Circular Holes	0.1 – 1.8 mm

U14100



U14101



U14102

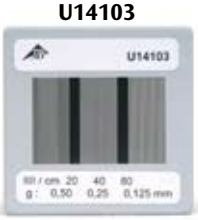


Diaphragms with Double and Multiple Slits

Photographic diffraction objects in a slide frame.
Dimensions: 50x50 mm²

Art. Nr.	Description	Slit spacing	Slit width	No. of slits
U14100	Diaphragm with 3 Double Slits of Different Widths	0.3 mm	0.10/0.15/0.20 mm	2
U14101	Diaphragm with 4 Double Slits of Different Spacings	0.25/0.50/0.75/ 1.00 mm	0.15 mm	2
U14102	Diaphragm with 4 Multiple Slits and Gratings	0.25 mm	0.15 mm	2/3/4/5/40

U14103



U14104



U14106



Diaphragms with Gratings

Photographic diffraction objects in a slide frame.
Dimensions: 50x50 mm²

Art. Nr.	Description	Grating constant	Slit width	No. of lines
U14103	Diaphragm with 3 Ruled Gratings	0.5/0.25/0.125 mm	0.25/0.125/ 0.063 mm	2/4/8 Lines/mm
U14104	Ruled Gratings	0.125 mm	0.063 mm	8 Lines/mm
U14106	Diaphragm with 2 Cross Gratings	0.25 mm	0.125 mm	4 Lines/mm

Gratings

Wire mesh grating in slide frames. For students and demonstration experiments.
Dimensions: 50x50 mm²



U21871



U21872



U21873



U21874

Cat. No.	Description	Lines/mm
U21871	Grating	140
U21872	Grating	530
U21873	Grating	600
U21874	Grating	1000



U19515

U19515

Set of 4 Gratings

Four line gratings mounted in slide frame with protective glass plates.
For student and demonstration experiments.
Number of lines: 80/100/ 300/ 600 Lines/mm
Dimensions: 50x50 mm²

Transmission Grating

Transmission grating for spectroscopic examinations and for experiments on diffraction and interference. Suitable to resolve the Na-D lines.
Mounted on glass carrier.
Dimensions: 38x50 mm²

Art. Nr.	Description	Lines/mm
U19512	Transmission Grating	300
U19511	Transmission Grating	600

U19512

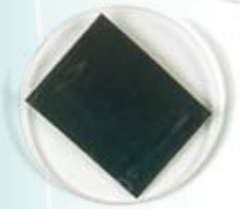


U19511





U21870



U19525



U40129

U19520

Demonstration Gratings

Three diffraction gratings on a frame for demonstrating the relationship between line spacing and diffraction angle.
Number of lines: 100/ 300/ 600 lines/mm.
Dimensions: 90x30 mm²



U19520

U19525

Reflection Grating

Reflection grating for demonstrating visible spectra and UV-spectra of 1st and 2nd order and when inclined, of up to 5th order. Mounted on round, concave glass carrier
Curveature radius: 500 mm
Number of lines: 530 lines/mm
Grating dimensions: 40x30 mm²
Glass carrier: 50 mm dia.

U21870

Hologram

Transmission hologram in slide holder.
Dimensions: 50x50 mm²

U40129

Polarisation Filter

Set of two polarisation filters in a slide frame.
Dimensions: 50x50 mm²

U19530

Set of 7 Colour Filters

Set of 7 colour filters for experiments on additive and subtractive colour combination.
Colored plastic transparencies fitted in slide frame between glass plates.
Primary colours: Red, blue, green
Secondary colours: Cyan, magenta, yellow and violet
Dimensions: 50x50 mm²



U21878



U21879



U19530

U21878

Set of 3 Colour Filters, Primary Colours

Set of 3 colour filters, primary colours, in slide frames.
Colours: Red, green, blue
Dimensions: 50x50 mm²

U21879

Set of 3 Colour Filters, Secondary Colours

Set of 3 colour filters, secondary colours, in slide frames.
Colours: Cyan, yellow, magenta.
Dimensions: 50x50 mm²



U21821



U218221



U218241



U21820

U21821

Polarisation Filter (Glass)

High-grade glass filter for producing and studying linearly polarised light. In a rotatable frame with pointer. With a thread for mounting on holder for polarisation filters (U21820).

Degree of polarisation:	99.9 %
Holder diameter:	50 mm
Filter diameter:	45 mm
Thread:	M49

Additionally required:
U21820 Holder for Polarisation Filters

U21820

Holder for Polarisation Filters

Holder on a stem with two threads for mounting polarisation filters (U21821), quarter wavelength filters (U218221) or half wavelength filters (U218241). Including a 360° scale with 1° divisions on both sides.

Holder diameter:	100 mm
Angle scale:	0° to 360°
Scale division:	1°
Aperture diameter:	50 mm
Thread:	M49 on both sides
Shaft:	150 mm x 10 mm

U218221

Quarter Wavelength Filter

High-grade glass filter for producing elliptically or circularly polarised light. In a rotatable frame with a pointer. With a thread for mounting on holder for polarisation filters (U21820).

Wavelength range:	560 – 630 nm
Holder diameter:	50 mm
Filter diameter:	33 mm
Thread:	M49

Additionally required:
U21820 Holder for Polarisation Filters

U218241

Half Wavelength Filter

High-grade glass filter for producing elliptically or circularly polarised light. In a rotatable frame with a pointer. With a thread for mounting on holder for polarisation filters (U21820).

Wavelength range:	560 – 630 nm
Holder diameter:	50 mm
Filter diameter:	33 mm
Thread:	M49

Additionally required:
U21820 Holder for Polarisation Filters



U21811



U21810

U21811

Young's Slits Diaphragm

Made of stainless steel with etched, calibrated slits for quantitative diffraction experiments. Including exact technical specifications on the storage case.

Diffraction objects:	1 single slit, 2 double slits
Double slit spacing:	500 µm, 900 µm
Slit width:	70 µm

Additionally required:
U21810 Component Holder

U21810

Component Holder

Two-piece holder on a stem for mounting optical components. The components are fastened by means of a metal ring furnished with two retaining screws.

Holder:	80 mm dia.
Aperture:	36 mm dia.
Components:	max. 61 mm dia.
Shaft:	150 mm x 10 mm dia.



U21826

U21826

Polarisation Equipment Set

Equipment list:

Cat. No.	Description	Number
U21820	Holder for Polarisation Filter	2
U21821	Polarisation Filter	2
U218221	Quarter Wavelength filter	1
U218241	Half Wavelength filter	1

60° Prisms

Equilateral prisms for use on the prism table on shaft (U17020) or prism table K (U8476110).

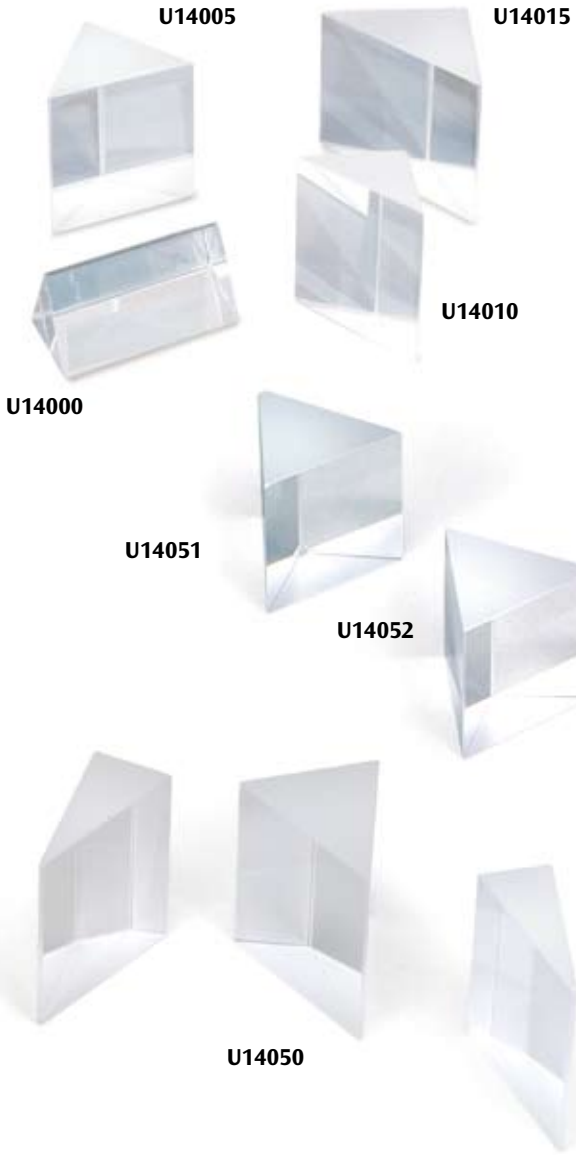
	U14000	U14005
Material	Crown glass	Crown glass
Refractive index	1.515	1.515
Side length	30 mm	45 mm
Height	50 mm	50 mm

	U14051	U14052
Material	Crown glass	Flint glass
Refractive index	1.515	1.608
Average dispersion	0.008	0.017
Side length	30 mm	30 mm
Height	30 mm	30 mm

90° Prisms

Rectangular prisms for use on the prism table on shaft (U17020) or prism table K (U8476110).

	U14010	U14015
Material	Crown glass	Crown glass
Refractive index	1.515	1.515
Side length	30 mm	45 mm
Height	30 mm	30 mm



U14050

Set of 3 Prisms

Set of prisms for demonstrating the design of an achromatic prism and a direct vision prism. Consists of a thin flint glass prism, as well as thin and thick crown glass equilateral prisms.
The two thin prisms deflect a light beam equally strongly but with different dispersions. Moving them closer together in the light path results in a direct vision prism which decomposes light into its spectral components without deflecting it. The thick crown glass prism has the same dispersion as the flint glass prism, but deflects the light beam twice the distance. This permits configuration of an achromatic prism which deflects light without splitting it into a spectrum.



Material	Flint glass	Crown glass	Crown glass
Refractive index	1.608	1.515	1.515
Average dispersion	0.017	0.008	0.008
Base	15 mm	30 mm	18 mm
Side length	40 mm	40 mm	40 mm
Height	40 mm	40 mm	40 mm



U14020

Amici Direct Vision Prism

A combined prism for splitting light beams into a spectrum without deflecting them. Comprises an alternating combination of two crown glass prisms and one flint glass prism; blackened on the outside.
Dispersion angle: 4.2°
Dimensions: approx. 105x20x20 mm³

Additionally recommended:
U17025 Holder for Direct-Vision Prism on Stem



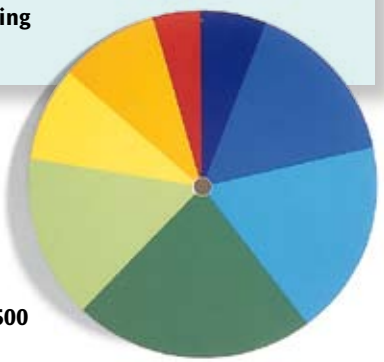
U8476730

Inverting Spectacles

Spectacles with two fully rotatable inverting prisms in a shielded spectacle frame. The inverting prisms reverse incoming light rays, turning the world upside down, so to speak, and making it unexpectedly difficult for the wearer to perform even the simplest of daily tasks such as reaching for objects, drawing, moving about in a room etc.

Experiment topics:

- Additive colour mixing
- Subtractive colour mixing



U15500

U15500

Newton's Colour Disc

Plastic, circular disc with segments coloured red, orange, yellow, light green, dark green, light blue, dark blue and violet for demonstrating additive combination of colours. When the disc is turned rapidly, its colours merge to produce white.

Diameter: 170 mm

Additionally required:
U11040 Motor with Drive Control
Stand equipment



U21883



U11040

U11040

Motor with Drive Control

Controllable motor for spinning the colour disc fast (U15500). With disc holder and clamp for attachment to a stand rod. Including plug-in power supply.

Control range:	0 – 25 rev/s
Rotation direction:	reversible
Dimensions:	approx. 110x70x45 mm³
Weight:	approx. 0.2 kg

U21883

Equipment Set for Colour Mixing

Equipment set for demonstrating how colours combine (with the aid of an overhead projector). This equipment set is designed to permit quick setting up and safe, simple operation. The clear configuration facilitates understanding of the experiments and allows direct viewing of results.

The projection plate, along with its three holders for mirrors and lenses, is placed onto the projection surface of the overhead projector. Depending on the projection distance, three large circles with diameters of 30 to 80 cm appear on the projection screen. By turning the holders and mirrors, it is possible to project colours so that they are separated or so that they partially overlap. Such adjustments can be performed easily and precisely. The large colour filters can be simply inserted into the lens holders, or placed directly on the overhead projector.

Contents:

1 Projection plate with three mirror and lens holders
3 Colour filters; red, green, blue (120 x 50 mm²)
3 Colour filters; cyan, yellow, magenta (120x50 mm²)

Additionally required:
U30150 Overhead Projector

Experiment topics:

Spectrometer

Investigations of
- Emission and absorption spectra
- Transmission curves of filters
- Spectral resolution of white light

Wave Optics

Display and measurement of diffraction and interference spectra, for example, diffraction at a slit, pinhole, grating, Newton's rings, Fresnel mirrors; comparison of measured spectra with theoretical calculations.

Geometric Optics

For example, measurement of focal lengths, enlargements and divergence of a light beam.

Time-Dependent Data Acquisition

For measuring light modulation on a pixel, for instance, oscillations of monochromatic light sources, measurement of doublets in emission and absorption spectra (e.g. sodium, mercury).
Fast Fourier transformation allows wavelengths to be determined.

CCD Linear Camera
Intended for investigating all optical phenomena in real time, this precision CCD linear camera consists of a measuring head with a CCD linear array and data acquisition accessories.
Includes user-friendly software, neutral grey filters, a USB cable, a plug-in power supply and a storage case.

Measurement Head with a CCD Linear Array

Resolution:	2048 pixel (14x200 µm)
Sensitive length:	30 mm
Neutral-grey filter:	density factor 3.0: black/white
Integration time (remote or direct control):	5 ms to 42.5 ms – step 2.5 ms
Rod:	170 mm x 10 mm dia.
Computer Connection:	USB interface
Refresh rate:	20 fps @ P233 MMX – RAM 16 Mo

System Requirements

Operating system:	Windows
Computer:	at least PC486 DX33 with 8 MB RAM
2 MB of free hard-disk space	
Screen resolution:	at least 640x480 pixels with 256 colors

Software
The multi-lingual software offers a wide range of functions:
Real-time displays for observing time-dependent phenomena, for example, during experiment adjustments
- Adjustable sensitivity of the measuring head in accordance with the intensity of the light source
- Representation of the intensity distribution of interference spectra in diagrams and grey stages, as well as coloured display of measured emission and absorption spectra
- Measurement functions such as adjustable axis scaling, grids, vertical and horizontal cursor with corresponding displays, peak-search routine with display of intensity and position, zoom
- Signal processing functions such as smoothing, averaging and inversion of spectra, Fast-Fourier Transformation
- Simulations for comparing theoretically calculated interference and diffraction intensity distributions with experimental data
- Storage, printing, online help and export of data and graphics (in the form of word processing, spreadsheet and bitmap files)

Contents:
CCD linear camera
Plug-in power supply
Neutral-grey filter
Manual with experiment descriptions
Software for data recording and evaluation
USB cable
Transport case

U218001-230
CCD Linear Camera (230 V, 50/60 Hz)

U218001-115
CCD Linear Camera (115 V, 50/60 Hz)

Additionally required:
U21821 Polarisation Filter (2x)

Additionally recommended:
U16040-230 Diode Laser (230 V, 50/60 Hz)
or
U16040-115 Diode Laser (115 V, 50/60 Hz)

U21811 Young's Slit Diaphragms
U21810 Multi-Component Holder



U218001



U218001

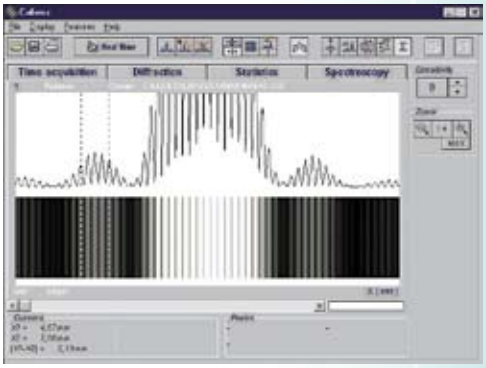


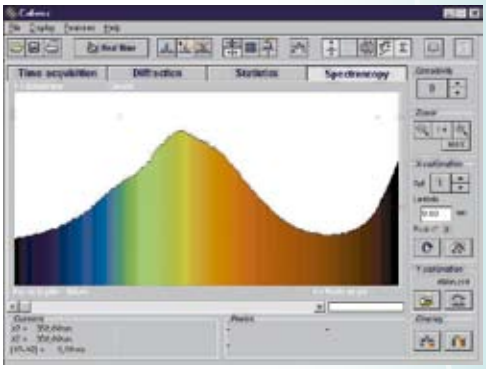


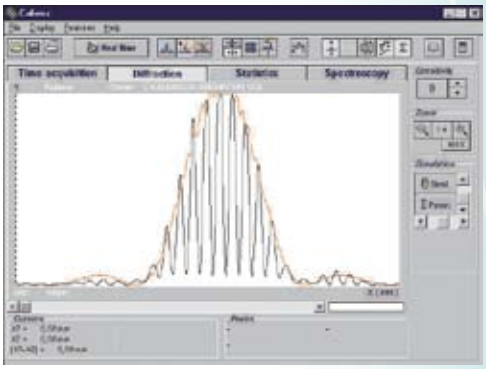


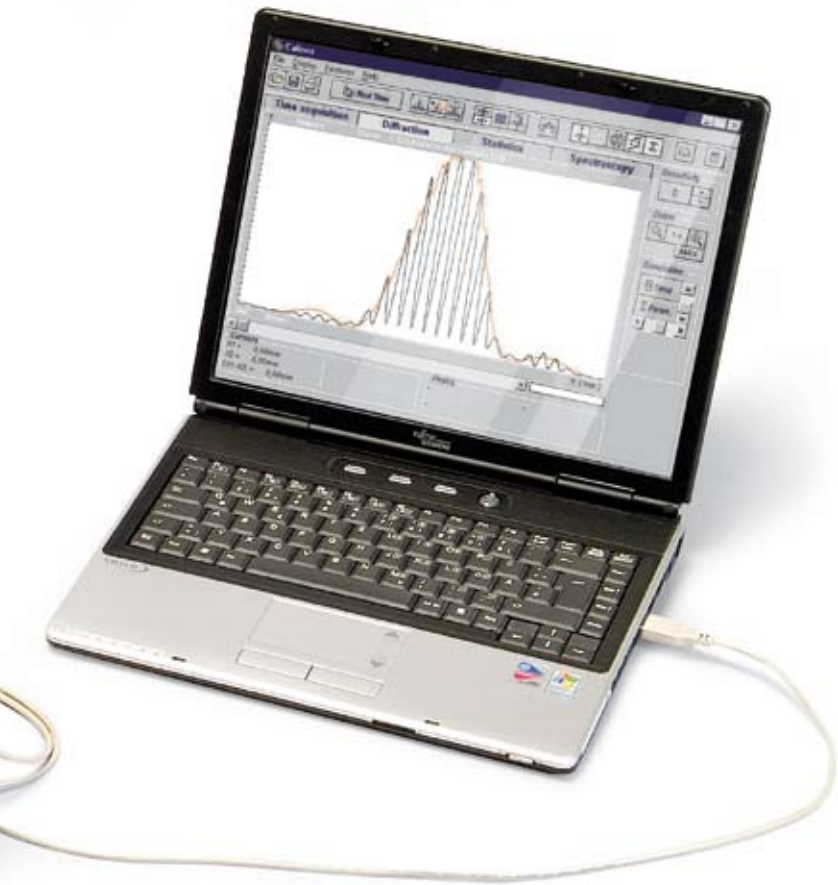














U14390

U14390

Demonstration Polarimeter

Device for use on an overhead projector to demonstrate optical activity and determine specific angles of rotation and concentrations at known specific angles of rotation.
A yellow filter (for more precise measurement accuracy) and a polarizer are embedded in a black plastic base plate. A cell containing a solution of the substance to be investigated with 50 mm and 100 mm markings is inserted into the holder. The analyzer is situated above this set-up in a holder with rotary handle and pointer. By turning the analyser, it is possible to ascer-tain the angle of rotation and read it off a transparent angle scale.

Cuvette:	Markings at 50 mm and 100 mm
Angle scale:	-40° – +40°
Scale divisions:	1°
Dimensions:	approx. 370x330x190 mm³

Additionally required:
U30150 Overhead Projector

U8472580

Demonstration Polariscope

Apparatus for use on an overhead projector to demonstrate a photo-elastic image in samples subjected to stress and strain.
The polarising filter is incorporated into the base plate of the frame; the analyser is embedded in the laterally swivelling upper base plate. Via the spindle drive, a tensile or pressure load can be exerted on the test body.

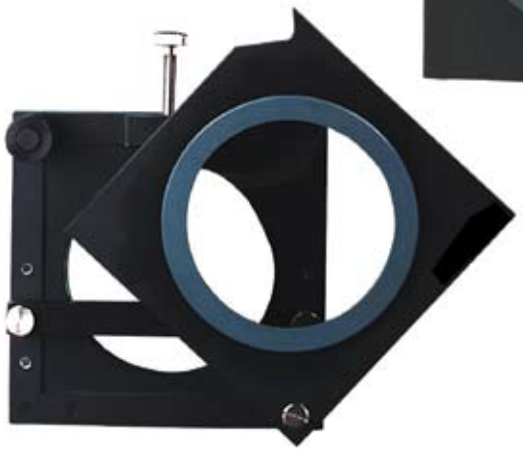
Samples:	Epoxy-resin
Dimensions:	approx. 150x150x45 mm³
Total weight:	approx. 820 g

Contents:
1 Basic apparatus
2 Metal clamps for applying tension
1 Ring, 60 mm dia.
1 Block, 60x10x10 mm³
2 Blocks, 20x10x8 mm³
3 Triangles to lay on surface

Additionally required:
U30150 Overhead Projector



U8472580





U8761160

Polarimeter with 4 LEDs

Polarimeter with a lighting unit comprising four monochromatic LEDs for determining the angle and direction of rotation of polarised light as a function of wavelength as well as sample thickness and concentration with the help of an optically active substance.
The light emerging from those LEDs that are lit is polarised linearly and transmitted through a fitted sample cylinder filled with the optically active substance. The analyser in the cover is used to identify the direction of polarisation which can be read on the cover's angle scale.

Wavelength of LEDs:	560 nm (green), 590 nm (yellow) 630 nm (orange) 650 nm (red)
Dimensions:	approx. 110x190x320 mm³
Weight:	approx. 1 kg

U8761160-230

Polarimeter with 4 LEDs (230 V, 50/60 Hz)

U8761160-115

Polarimeter with 4 LEDs (115 V, 50/60 Hz)



Determination of the angle of rotation of optically active substances



U11112



U14313

U14314

Round Cells
Duran glass cells with bonded optical discs and GL threads. E.g. for experiments on the determination of the angle of rotation of optically active substances on the optical bench.
Diameter: 35 mm
Thread: GL-14

U14313
Round Cell, 100 mm

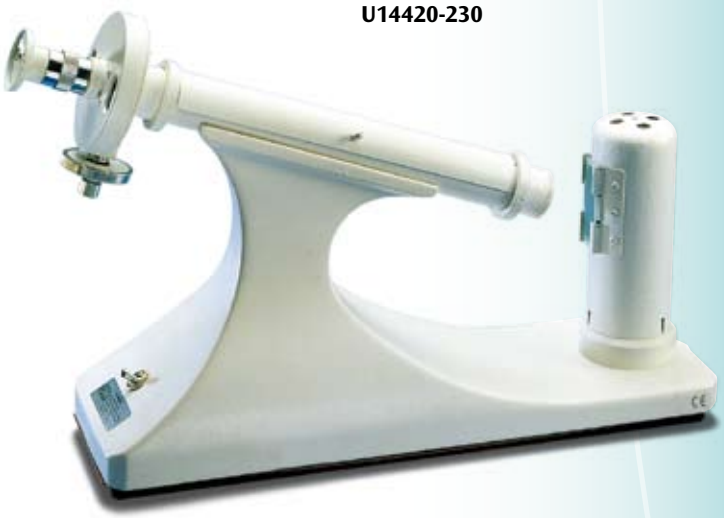
U14314
Round Cell, 200 mm

U11112
Cell Holder on a Stem
Plastic holder for round cells (U14313) and (U14314).
Holder: 36 mm dia.
Stem: 90 mm x 10 mm dia.

U14420-230
Polarimeter
Polarimeter with a sodium lamp as the light source for the measurement of the rotation and the rotation direction of the polarization plane of polarized light through optically active substances as well the determination of the concentration of liquids.
Robust metal stand with slightly tilted shaft for tubes with lengths up to 220 mm. With swivel cover, analyzer and polarizer. A sodium lamp with filter holder is used as a light source. Includes polarimeter tubes 100 mm, 200 mm and spare sodium lamp.

Measurement range:	2 semi-circles (0 – 180°)
Glass tubes:	100 and 200 mm, 15 mm dia.
Scale division:	1°
Readability:	0.05° (with Vernier scale)
Dimensions:	200x360x450 mm³
Weight:	10 kg
Light source:	Sodium lamp (589 nm)
Mains voltage:	230 V, 50/60 Hz

U14420-230



U14421
Polarimeter Tube 100 mm
(not illustrated)
Spare glass tube for polarimeter (U14420-230).
Length: 100 mm, 15 mm dia.

U14422
Polarimeter Tube 200 mm
(not illustrated)
Spare glass tube for polarimeter (U14420-230).
Length: 200 mm, 15 mm dia.

U14423
Spare Sodium Lamp (not illustrated)
Spare lamp for polarimeter (U14420-230).

Control Unit for Spectrum Lamps

Control unit for operating spectral lamps (U8476800 – U8476875), including a lamp housing on a stand rod.
Lamp housings can be clamped to a stand rod and connected on the rear of the robust metal housing. A switch on the front can be used to change over between the right-hand and left-hand spectral lamps.
Maximum output current: 1 A

Lamp housing:	180 mm x 50 mm dia.
Tripod rod:	300 mm x 10 mm dia.
Lamp socket:	Pico 9
Dimensions:	approx. 255x175x135 mm³
Weight:	approx. 5.3 kg

Contents:
1 Control unit
1 Lamp housing on a stand rod with a 7-pole connection cable

U21905-230

Control Unit for Spectrum Lamps (230 V, 50/60 Hz)

U21905-115

Control Unit for Spectrum Lamps (115 V, 50/60 Hz)

Additionally recommended:
U21906 Lamp Housing on a Stand Rod

U21906

Lamp Housing on a Stand Rod (not illustrated)
Additional lamp housing with a cable for connecting to a spectral lamp ballast coil (U21905-230 or U21905-115).

Spectrum Tube Power Supply

Control unit for stable operation of spectral tubes (U41810 – U41825). The integrated current limiter ensures a long service life of the tubes. Spring-contacts in fully insulated fixtures guarantee secure mounting and reliable operation.

Voltage:	5000 V
Maximum current:	10 mA
Dimensions:	approx. 370x120x90 mm³

U41800-230

Spectrum Tube Power Supply (230 V, 50/60 Hz)

U41800-115

Spectrum Tube Power Supply (115 V, 50/60 Hz)

Spectrum Tubes

High luminance spectral tubes emitting the line or band spectrum of a gas or mercury vapour. Partly evacuated capillary glass tubes filled with gas or mercury vapour are furnished with electrodes for the application of a voltage to generate the electrical field that provides the necessary energy.

Capillary length:	100 mm
Total length:	approx. 260 mm

Spectral Lamps

Gas discharge lamps for emitting line spectra of inert gases and metal vapours with high luminance and spectral purity.

Socket:	Pico 9
Operating current:	max. 1A
Weight:	approx. 350 g

Additionally required:
U21905-230 Control Unit for Spectrum Lamps (230 V, 50/60 Hz)
or
U21905-115 Control Unit for Spectrum Lamps (115 V, 50/60 Hz)



U8476800 - U8476875

Art. Nr.	Filling
U8476800	Cd
U8476805	Cs
U8476810	He
U8476830	K
U8476840	Na
U8476845	Rb
U8476850	Ne
U8476855	Tl
U8476870	Hg 100
U8476875	Hg/Cd



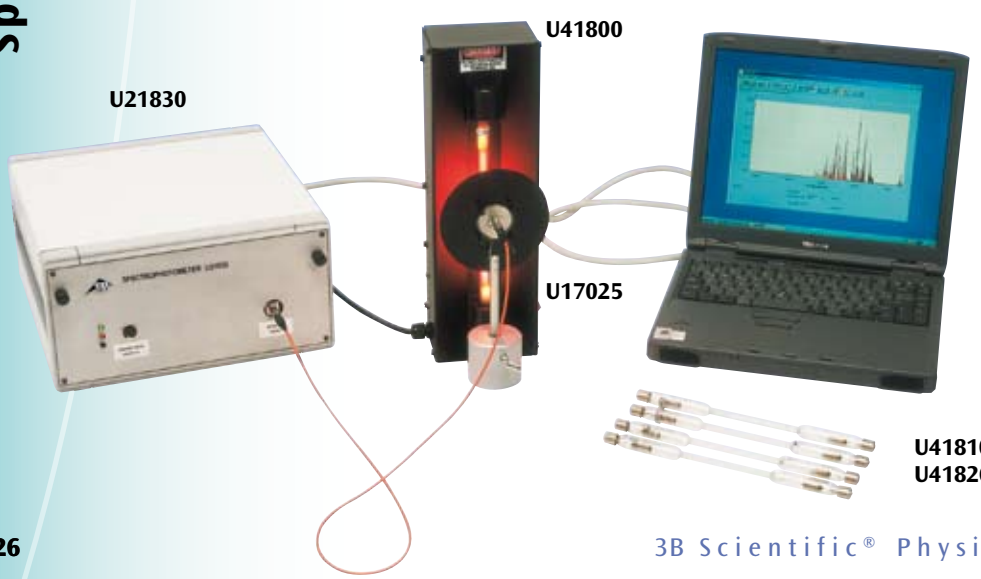
U21905



U41800

Additionally required:
U41800-230 Spectrum Tube Power Supply (230 V, 50/60 Hz)
or
U41800-115 Spectrum Tube Power Supply (115 V, 50/60 Hz)

Art. Nr.	Filling
U41810	Air
U41811	Argon
U41812	Bromine
U41813	Carbon dioxide
U41814	Chlorine
U41815	Deuterium
U41816	Helium
U41817	Hydrogen
U41818	Iodine
U41819	Krypton
U41826	Krypton 86
U41820	Mercury
U41821	Neon
U41822	Nitrogen
U41823	Oxygen
U41824	Water vapor
U41825	Xenon



U41800

U21830

U17025

U41810 - U41826

U21827-230

High-Pressure Mercury Spectral Lamp Equipment (230 V, 50/60 Hz)
Gas discharge lamp for observing high-intensity mercury spectral lines at high vapour pressures. Lines in the ultra-violet range are suppressed by the glass body.
Includes a black metal housing with integrated power supply unit, a light aperture with a fine thread for direct screw-mounting of filters and a threaded stand rod. Includes a stand rod with thread.

Luminance:	1800 lm
Operating current:	0,6 A
Power:	50 W
Base:	E27
Service life:	approx. 24000 h
Threaded light aperture:	40 mm dia.
Fine thread for filter:	M49
Dimensions:	approx. 242x153x80 mm³
Weight:	approx. 2,4 kg

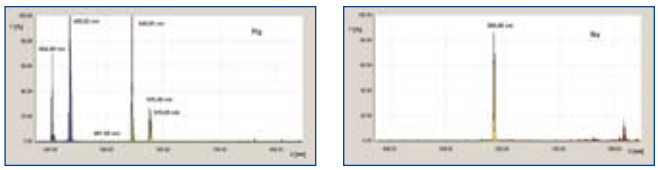
U21828-230

Low-Pressure Mercury Spectral Lamp Equipment (230 V, 50/60 Hz)
Gas discharge lamp for observing mercury spectral lines at low vapour pressures with optimal line widths. The body is made of quartz glass to allow detection of lines in the ultra-violet range too. Includes a black metal housing with integrated power supply unit, a light aperture with a fine thread for direct screw-mounting of filters and a threaded stand rod. Includes a threaded stand rod and UV filter with M49 thread.

Operating current:	0,16 A
Power:	6 W
Base:	G5
Service life:	approx. 3000 h
Threaded light aperture:	40 mm dia.
Fine thread for filter:	M49
Dimensions:	approx. 242x153x80 mm³
Weight:	approx. 2,2 kg

U21828-230 **U21827-230** **U21829-230**





Line spectra of deuterium, helium and neon, recorded with the spectrophotometer U21830

U21829-230

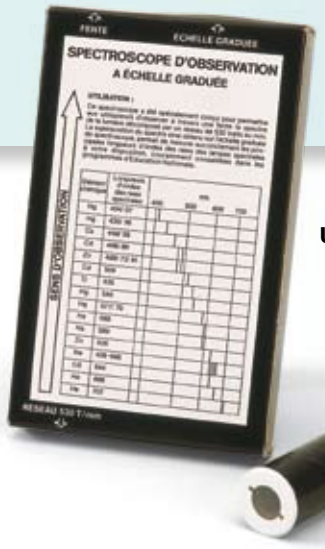
Low-Pressure Sodium Spectral Lamp Equipment (230 V, 50/60 Hz)
Gas discharge lamp for observing Na D lines and investigating of the doublet.
Includes a black metal housing with integrated power supply unit, a light aperture with a fine thread for direct screw-mounting of filters and a threaded stand rod. Includes a stand rod with thread.

Luminance:	1800 lm
Operating current:	0,35 A
Power:	18 W
Base:	BY22d
Service life:	approx. 10000 h
Threaded light aperture:	40 mm dia.
Fine thread for filter:	M49
Dimensions:	approx. 242x153x80 mm³
Weight:	approx. 2,5 kg

Spare Lamps:
(not illustrated)
U21831-230 Hg High-Pressure Spectral Lamp for U21827-230
U21832-230 Hg Low-Pressure Spectral Lamp for U21828-230
U21833-230 Na Low-Pressure Spectral Lamp for U21829-230

Handheld Spectroscope

Device for observing absorption and emission spectra, e.g. to observe the Fraunhofer line spectrum in sunlight for the observation of absorption spectra through liquids, the emission spectra of gas discharge tubes or for chemical analysis during flame tests.



U21876

U21875

U21875

Hand Spectroscope
Simple spectroscope for observing spectra and spectral lines.
Made of cardboard and plastic with built-in grid.
Dimensions: approx. 145 mm x 28 mm Ø

U21876

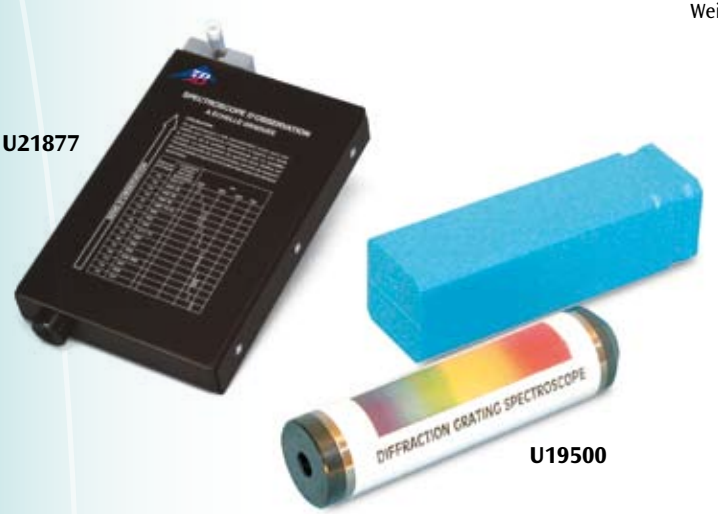
Spectroscope in Cardboard Box
Hand spectroscope in a flat cardboard box with printed wavelength scale for easy reading of spectral lines and spectra.
Dimensions: approx. 180x115x25 mm³

U19500

Pocket Spectroscope

High quality optical system with centered visible spectrum, which is linear with respect to the wavelength. In metal sleeve. With fixed slit and prism system with grating

Slit width:	0.2 mm
Number of grating lines:	600 lines/mm
Dimensions:	approx. 115 mm x 25 mm dia.
Weight:	approx. 62 g



U21877

U19500

U8472660

Hand Spectroscope with an Amici Prism

Precise optical system with a visible spectrum that is linear in terms of wavelength around the centre point. In a metal housing with an adjustable slit and high-grade Amici prism. Delivery in hinged case for protective and dust-free storage.

Angular dispersion:	7° (C-F)
Linear dispersion:	60 mm
Slit width:	0 – 1 mm
Folding case:	approx. 150x70x30 mm³
Weight:	approx. 150 g



U8472660

U21877

Spectroscope in Metal Case

Hand spectroscope in a flat metal case with printed wavelength scale for easy reading of spectral lines and spectra. With holder for mounting a probe in a glass vessel.

Dimensions:	approx. 180x115x25 mm³

U14416

Spectrometer-Goniometer

High-precision device for the precise determination of the optical data of prisms. Can also be used as a spectroscope for the observation and measurement of emission and absorption spectra. Diverse accessories.

Spectral telescope:	continuously adjustable, eyepiece cross-wires
Objective:	f = 160 mm, 18 mm dia.
Slit tube:	symmetrical precision slit, hardened steel
Eyepiece:	f = 160 mm, 18 mm dia.
Prism:	Flint glass (60°), Dispersion (nF – nC): 0.017
Length of base:	33 mm, height: 22 mm
Angular scale:	0° up to 360°
Scale division:	0.5°
Vernier reading accuracy:	1 angular minute
Weight:	approx. 7.9 kg



U14416

U14415

Kirchhoff-Bunsen Spectroscope

Desktop spectroscope for the observation and measurement of emission and absorption spectra. With adjustable slit, condensor, flint glass prism as well as an observation telescope with sliding ocular. Scale tube with reference division, which is superimposed on the image plane of the spectrum due to reflection at the front surface of the prism. Includes removable prism hood. Ideal for schools and universities.

Observation tube:	moveable, with locking screw, slideable eyepiece
Objective:	f = 160 mm, 18 mm dia.
Slit tube:	stationary, with symmetrical slit
Objective:	f = 160 mm, 18 mm dia.
Scale tube:	stationary, 200-division scale
Eyepiece:	f = 90 mm, 18 mm dia.
Scale:	can be calibrated in wavelengths
Prism:	Flint glass (60°), Dispersion (nF – nC): 0.017
Length of base:	20 mm, height: 30 mm
Weight:	4.8 kg



U14415

U21830

Digital Spectrophotometer

This digital spectrophotometer is used for quantitative investigations of emission and absorption spectra and transmission curves, and for measurements related to calorimetry and chemical kinetics.
Based on the Czerny-Turner principle, this device permits simultaneous, real-time recording and analysis of the entire visible range from 380 nm – 830 nm in conjunction with the user-friendly measurement and evaluation software. Light recorded by means of an optical fibre and projected on a CCD detector via two mirrors and a reflection grating.
Includes an absorption module with cell and slide holders for disposable cells and colour filters, a software program and various connecting cables.

Spectral range:	380 – 830 nm
Wavelength accuracy:	0.25 nm
Resolution:	1 nm
Transmission:	0% – 100%
Resolution:	0.1%
Absorption:	0% – 100%
Resolution	0.1%
Optical configuration:	Czerny Turner
CCD detector:	2048 pixels
Absorption module:	
Quartz halogen lamp:	12 V/20 W
Optical connection:	via optical fibre
Mains voltage:	115 V/230 V, 50/60 Hz
Dimensions:	approx. 315x175x322 mm³
Weight:	approx. 6.6 kg

System requirements:

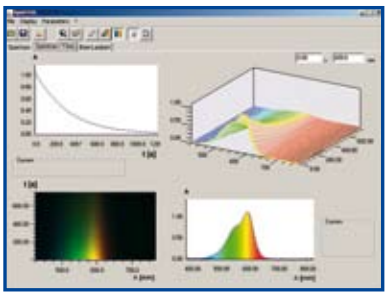
Operating system:	WINDOWS
PC:	Pentium 133 or higher, 32 MB RAM, CD-ROM drive
Free disk space:	at least 15 MB
Screen resolution:	at least 800x600 pixels (16 bit)
Computer connection :	USB interface

Contents:

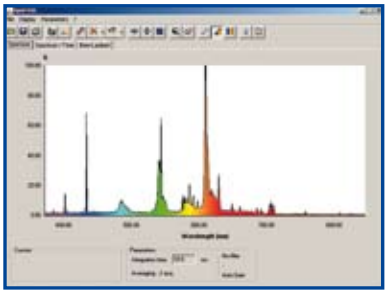
1 Spectrophotometer
1 Absorption module
1 CD with software
1 Optical fibre, 1 m
1 PC connection cable (USB)
1 DIN cable for connecting the absorption module
1 Mains connection cable
100 Disposable cells
1 Operating manual

Software:

- Real-time recording of emission and absorption spectra as well as transmission curves
- Simultaneous recording of spectra over the entire wavelength range (recording time per spectrum less than 2 ms)
- Recording of spectra as a function of time (chemical kinetics)
- 3D display; functional relationship between absorption, time and wavelength
- Display of spectra in authentic colours
- Display of several spectra in one diagram
- Manual calibration option
- Wavelength measurements
- Recording and evaluation of concentration measurements (Beer-Lambert law)
- Zoom and cursor function
- Storage of recorded spectra
- Export of measured data to standard text and bitmap formats, as well as Regressi and Excel formats
- Colour printout of spectra



Decolourization of dissolved potassium permanganate ($KMnO_4$) with oxalic acid ($COOH_2$)



Line spectrum of a fluorescent lamp



U21830

Vissza a tartalomjegyzékhez!

BESTseller

Experiment topics:

- Michelson interferometer
- Fabry-Perot interferometer
- Determination of the refractive index of glass*
- Determination of the refractive index of air*
- Twyman-Green test for optical components (qualitative)*

* U10351 Accessory set required



U10350

U10350

Interferometer

This complete equipment set comprises high grade optical components mounted on a heavy, rigid base plate for precise and reproducible measurements. The large optical components permit a generation of clear and well defined interference patterns in daylight. The reflective observation screen has an adjustable inclination.
Pre-defined component positions allow quick rearrangement to ensure extremely rapid preparation for the various experiments. The equipment set includes a stable plastic box for storing the mounted and adjusted interferometer as well as the base plate for laser.

Beam splitter:
- Diameter: 40 mm
- Evenness: λ/10 (front side), λ/4 (rear side)

Surface-coated mirror:
- Dimensions: 40x40 mm²
- Evenness: <λ/2

Mirror adjustment:
- Eccentric reduction: approx. 1:1000 (individual calibration specified on eccentric base)

Base plate:
- Weight: 5, 5 kg
- Dimensions: 245x330x25 mm³

Additionally required:
U21840 He-Ne Laser



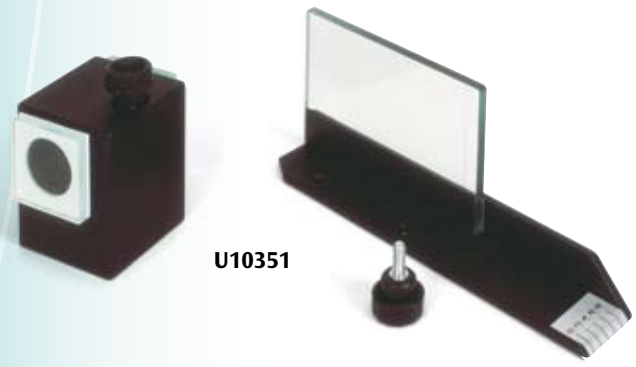
Glass plate in the beam path of the Michelson interferometer

U10351

Accessory Set for the Interferometer

This accessory set for the interferometer (U10350) consists of a vacuum cell for determining the refractive index of air and a glass plate on a rotatable holder for determining the refractive index of glass and investigating the surface quality of optical components (Twyman-Green interferometer).

Additionally required:
U20500 Vacuum Hand Pump
U10146 Silicone Tube



U10351



Vacuum chamber in the beam path of the Michelson interferometer

Light Speed Meter

Equipment set for determining the speed of light thanks to electronic run-time measurement.
Comprises a compact housing containing a transmitter emitting short LED pulses, a photo receiver and a calibrated, oscillating quartz generator producing chronologically precise square-wave pulses. Emitted light pulses are returned by an internal reflector and by a triple-prism reflector placed a long distance from the light source. The returning light signals are then superimposed on the original signal. A dual-channel oscilloscope is used to measure the time difference between the two signals. The speed of light can be calculated from this difference and the distance to the triple-prism reflector.
The triple-prism reflector can be installed by eye without the need for complex adjustments

Contents:

1 Control unit with a transmitter, receiver and integrated power supply unit
1 Fresnel lense on shaft
1 Triple-prism reflector on shaft
3 HF cables, 1 m



U8476460

U8476460-230

Light Speed Meter (230 V, 50/60 Hz)

U8476460-115

Light Speed Meter (115 V, 50/60 Hz)

Additionally required:
U11177 Oscilloscope, 150 MHz
Optical Bench
Optical Rider (2x)
Stand Equipment



Experiment Topics:

- **Adaptation (accommodation) of the eye's lens**
- **Short-sightedness**
- **Long-sightedness**
- **Presbyopia**
- **Correction by means of spectacles**

W16003

Functional Model of the Eye

Model for demonstrating the functions of the human eye, including inverted display of images on the retina. The curvature of the silicone lens can be changed by means of water pressure in order to demonstrate the process of accommodation. A holder serves to position corrective glass lenses in front of the eye's lens.
The set is mounted on a wooden base and includes an optical object, glass lenses (-0.5 D, +1.0 D) and English operating instructions.

Dimensions: approx. 320 x 180 mm²
Weight: approx. 1.5 kg



W16003

Experiment Topics:

- **Refraction and interference at the surfaces of a glass block, apertured diaphragm, square diaphragm, grating with slits, cross grating.**
- **Michelson interferometer**
- **Investigation of linearly polarised light**
- **Absorption of light**
- **Reconstruction of a hologram**



U17303

U17303

Equipment Set for Wave Optics with Laser

Equipment set for demonstrating fundamental phenomena in wave optics by means of practical experiments.
The light source is provided by a partially polarised diode laser with adjustable mount. Power is supplied from a plug-in power supply (included) or from batteries. The components are magnetic and can be placed horizontally or vertically on the included metal board, according to the set-up required for the various experiments. All components are stored in a case with shaped foam inlay.

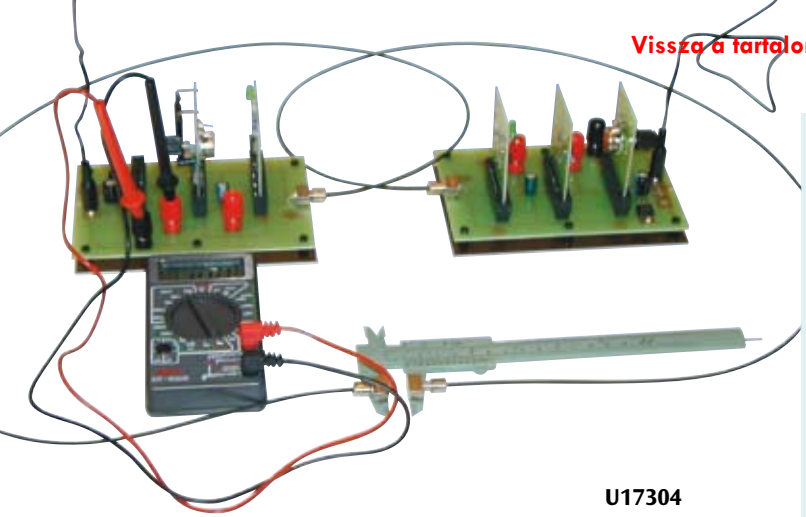
Diode laser:	max. 1 mW, laser safety class II
Wavelength:	635 nm
Plug-in power supply:	primary 100 V AC – 240 V AC secondary 3 V DC, 300 mA
Battery holder:	for 2 x 1.5 V AA batteries (batteries not included)

Contents:

1 Diode laser with adjustable mounting
1 Plug-in power supply
1 Battery holder (without batteries)
2 Mirrors with adjustable mounting
1 Half-silvered mirror
1 Screen, white
1 Screen, frosted glass
1 Convex lens
1 Polarisation filter
1 Holder for lens and filter
3 Colour filters in slide frames (red, green, blue)
2 Apertured diaphragms in slide frames
2 Square diaphragms in slide frames
3 Gratings with slits in slide frames
1 Cross grating in slide frame
1 Glass plate in slide frame
1 Holder for slide frames
1 Hologram
1 Metal board (60x45 cm²) with removable strut
4 Rubber feet for metal board
1 Storage case
1 Experiment guide







U17304

Experiment Topics:

- Tyndall's light guide experiment
- Attenuation in curved optical waveguides
- Attenuation in liquids
- Attenuation at optical transitions
- Setup for force measurement
- Setup of light barrier
- Setup for proximity sensor
- Transmission of audio signals
- Data transmission between two computers



U17304

Equipment Set for Waveguide Optics

Complete modular experiment set for examining optical waveguide phenomena and their applications. Consisting of one base PCB for use as a transmitting and receiving module, one analog transmitting and receiving unit, one digital transmitting and receiving unit, one microphone amplifier and low-frequency generator, one low-frequency amplifier with integrated loudspeaker, RS232 interface for transmitter and receiver, one digital multimeter, sheathed and unsheathed optical fibres of different lengths and all connecting cables. Including universal plug-in power supplies and storage case.

Wall power supply units: 100–240 V AC (primary)
9 V DC (secondary)

Additional recommended:
U11175 Analog Oscilloscope
U11257 High-Frequency Patch Cord, BNC / 4-mm Plug

U17305

Equipment Set for Laser Communication

Experiment system for transmitting audio and video signals with a laser beam. Consisting of power supply for laser diode with variable output power and with audio and video input for modulation of laser beam, receiver unit with integrated amplifier and connectors (CINCH) for loudspeakers and TV set, microphone and loudspeaker. Audio signals are frequency modulated and video signals amplitude modulated. For trans-mitting video signals, any PAL or NTSC video camera (refer to p. 148) can be connected (not included in scope of delivery). Including universal plug-in power supplies and storage case.

Laser diode:	Laser protection class II
Wavelength:	635 nm
Laser power:	0.2 – 1mW continuously variable
Plug-in power supply:	100 – 240 V AC 50/60 Hz (primary), 12 V DC (secondary)



U17305





U15310

BESTseller



U15300

U15310

Wimshurst Machine

Historical experiment set-up for the generation of safe, high DC potentials for numerous experiments in the area of electrostatics. Hand crank operation and belt drive, adjustable spark gap, two high-voltage capacitors (Leyden jars).

Diameter:	310 mm
Spark gap:	max. 120 mm
Dimensions:	approx. 360x250x400 mm³
Weight:	approx. 3.4 kg

U8491500

Electrostatic Equipment Set

Using this equipment a whole set of, in part, historical experiments can be performed to investigate electrostatic phenomena. The components are equipped with 4-mm connector pins thus providing for rapid and easy interchangeability of assembly on an insulated stand. Connection chains are included for connection to the charge source, but experiment cables with 4 mm plugs can also be used. We recommend that the Wimshurst machine (U15310) be used as a charge source in these experiments.

Contents:

1 Standbase
1 Stand rod, insulated, with retaining and connection socket
1 Conductor sphere 30 mm dia., with pin
1 Rolling sphere race
1 Elder-pith double pendulum with hook stand
10 Pieces of elder-pith (in box)
1 Box with spherical electrode
1 Box with pointed electrode
1 Triskelion wheel on needle bearing
1 Bundle of tissue paper strips on rod
1 Luminous pane
1 Chimes with bells
1 Friction rod, plastic, with 4 mm socket
2 Connection chains
1 Experiment instructions

Additionally required:
U15310 Wimshurst Machine

Van de Graaff Generator with Discharge Electrode

Generator for the generation of DC potentials with low current for multiple experiments in electrostatics. Detachable conductor sphere, drive motor with controllable speed, including small discharge sphere on rod.

Voltage:	up to approx. 100 kV
Conductor sphere:	190 mm dia.
Sphere on rod:	460 mm, dia. 90 mm
Dimensions:	approx. 240x190x620 mm³

U15300-230

Van de Graaff Generator with Discharge Electrode (230 V, 50/60 Hz)

U15300-115

Van de Graaff Generator with Discharge Electrode (115 V, 50/60 Hz)



U15301

Rubber Belt for Van de Graaff Generator

(not illustrated)

Spare rubber belt for Van de Graaff generator (U15300-230 and U15300-115 respectively).

Length:	930 mm
Width:	50 mm



U8491500



U41005

U17250



U8532130

U17250

Electroscope

Pointer instrument for the detection of electrical charges and voltages. Shielding ring with 4 mm earthing sleeve. Suitable for shadow projection. Includes sphere, capacitor plate on 4 mm plug and capacitor plate on insulating rod.

Diameter: approx. 130 mm

U8532130

Kolbe's Electroscope

Pointer instrument for the detection of electrical charges and voltages with high sensitivity. Metal housing with 4 mm earthing sleeve, glass front and rear, needle with pivot bearing, scale, suitable for shadow projection.

Measuring range: 0 – 6 kV

Dimensions: approx. 170x100x210 mm³

U8490210

Piezoelectric Charge Source

Hand-held unit used for the simple generation of safe voltages needed in electrostatic experiments. Featuring the functional principle of a piezoelectric gas lighter. With shortened earthing sleeve and 4-mm cable plug.

Charge: approx. 2 µC

Crystal capacitance: 100 pF

Voltage: max. 12 – 15 kV

Dimensions: approx. 250x25x33 mm³

Weight: approx. 130 g

U41005

Rotating Arm Electroscope

Apparatus for demonstrating the effect of electric fields. The apparatus consists of a metal rod with offset ends, freely pivoted on insulated needle. When a charged friction rod is brought near to the electroscope the rotating arm moves.

Length of arms: 150 mm approx.

Height: 160 mm approx.

U8490210



U11051

U11053

U11052



U11053

Friction Rods

Two rods for experiments on frictional electricity, made of PVC and acrylic.

Length: approx. 250 mm

Diameter: approx. 10 mm

Charge Spoon

Metal plate on insulating rod for charge transport and for experiments on electrostatic induction.

Art. Nr.	Designation	Length	Plate	Rod
U11051	Charge Spoon, small	205 mm	40x35 mm²	10 mm dia.
U11052	Charge Spoon, large	265 mm	40x70 mm²	10 mm dia.



U8531407



U8496460



U8492350



U8532126

U8496460

Faraday Cup

Faraday pail with 4 mm plug, e.g. for mounting on an electroscope (U17520 or U8532130) or electrometer amplifier (U8532130).

Dimensions: 115 mm x 70 mm dia. approx.

U8531407

Electrometer

Impedance converter with high-resistance input for measuring extremely small charges and currents. The input signal is converted into a proportional voltage, which can then be measured with an external voltmeter. During the measurement the potentials of the electrometer and the experimenter must be matched by using a metal rod connected to earth.

The electrometer can also be configured for use as a differential amplifier.

Electrometer gain factor:	1
Frequency range:	0 – 20 kHz (differential gain 1 – 10)
	0 – 2 kHz (differential gain 100)
Input resistance:	5 GΩ approx. (electrometer mode)
	1.5 GΩ approx. (differential amplifier mode)
Max. input voltage:	±100 V
Max. output voltage:	±6 V (electrometer)
	±10 V (differential amplifier)
Permitted load resistance:	Ω10 kΩ (electrometer)
	Ω2 kΩ (differential amplifier)
Supply voltage:	12 V AC
Dimensions:	165x165x50 mm³ approx.
Weight:	1.14 kg approx.

Additionally required:
U17450 Analogue Multimeter AM50
U8475430-230 Transformer 12 V, 25 W (230 V, 50/60Hz)
or
U8475430-115 Transformer 12 V, 25 W (115 V, 50/60Hz)

Additionally recommended:
U8496460 Faraday Cup

Conducting Spheres with 4 mm Plugs

Nickel-plated hollow brass spheres for electrostatics experiments, e.g. for determining the capacity of a sphere or for experiments on the influence of nearby objects.

U8492350

Conducting Sphere, dia. = 85 mm, with 4 mm Plug

U8532126

Conducting Sphere, dia. = 30 mm, with 4 mm Plug

Additionally recommended:
U11055 Drilled Rod

U51001

Electrolytic Trough

Equipment set for recording equipotential lines of electric fields. Electrodes of different shapes can be used to measure equipotential lines for a plate capacitor, dipole, induced surface charge and a Faraday beaker.

Trough dimensions: 160x105x65 mm³ approx.

Contents:

1 Plastic trough
1 Stand with measurement electrode
2 Bar electrodes
2 Round disc electrodes
1 Ring electrode
20 Sheets of millimetre-grid paper

Additionally required:
U17450 Analogue Multimeter AM50
U117601-230 AC/DC Power Supply Unit 0 – 12 V, 3 A (230 V, 50/60 Hz)
or
U117601-115 AC/DC Power Supply Unit 0 – 12 V, 3 A (115 V, 50/60 Hz)

U51015

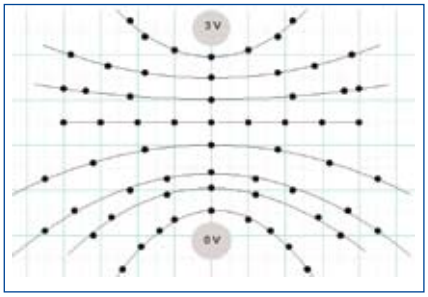
Pack of Millimetre Paper Sheets (not illustrated)
20 sheets of millimetre-grid paper for setting up an electrolytic trough (U51001).



U117601

U51001

U17450



Equipotential lines of point charges

U8492310



U8611200

U8492320



U8611200

U8492330



U8611200

Pair of Capacitor Plates
Pair of capacitor plates consisting of light metal castings with electrically isolated handling rod and 4 mm socket connector for constructing a capacitor. The distance between the plates is determined by the plexiglas spacers that are provided.

U8492310
Pair of Capacitor Plates 500 cm²

U8492320
Pair of Capacitor Plates 250 cm²

U8492330
Pair of Capacitor Plates 125 cm²

Additionally required:
U8611200 Barrel Foot, 0.9 kg

Additionally recommended:
U8492340 Plastic Dielectric Plate
U8476371 Plexiglas Dielectric Plate

Dielectric Plates
Dielectric plates for experiments with plate capacitors.

U8492340
Plastic Dielectric Plate
Dimensions: 300x300x3 mm³ approx.

U8476371
Plexiglas Dielectric Plate
Dimensions: 300x300x2 mm³ approx.

U8492340

U8476371



U8492345
Plate Capacitor D
Plate capacitor used to investigate the relationship between electric charge and voltage, quantify capacitance as a function of plate spacing, measure the dielectric constant ε and precisely determine the electric field constant ε_0. The plate spacing is finely adjustable via a spindle and can be read on a vernier scale with 1/10 mm divisions.
Plate spacing: 0 – 65 mm
Plate thickness: 3 mm
Plate area: 500 cm²
Weight: 4 kg approx.

Additionally recommended:
U8492340 Plastic Dielectric Plate
U8476371 Plexiglas Dielectric Plate

BESTseller

U30040
Plate Capacitor S
Plate capacitor used to investigate the relationship between charge, voltage and capacitance, as well as determine the dielectric and electric field constants.
It consists of a fixed and a movable plate on a guide rail. A centimeter scale is used to read the plate spacing. The device comes with four dielectric sample plates made of acrylic, bakelite, plywood and cardboard.
Plate spacing: 0 – 150 mm
Plate diameter: approx. 149 mm
Plate area: 175 cm²
Connection: Via 4-mm safety jacks

U30040





U8492345

BESTseller

Experiment topics:

- Introductory experiments on the functioning of the apparatus
- Electrostatic tests
- Measurement of static electric field strength
- Capacitor tests
- Measurements of potential with an electrostatic meter

U8533015



Electric Field Meter

Instrument for static measurements of electric field strength or electrical potential.
A star-shaped modulation vane-wheel connected to earth is mounted a short distance in front of a measurement electrode, also star-shaped. Influenced by the electric field, the charges generate an alternating current proportional to the field strength. This alternating current is measured via a selective amplifier without the electric field experiencing any average energy loss over time. When used in conjunction with voltage measurement plates, the instrument can be used as an electrostatic voltmeter. The device is protected against excess voltage. A standard DC voltmeter can be used for display.

Max. output voltage:	10 V
Measurement ranges:	1 V output can correspond to: 100 V/cm, 300 V/cm, 1000 V/cm 10 V, 30V, 100 V (with 1x voltage measurement plate) 100 V, 300 V, 1000 V (with 10x voltage measurement plate)
Dimensions:	140x110x70 mm³ approx.
Weight:	1 kg approx.

Contents:
1 Electric field meter
1 Voltage measurement plate, measuring range 1x
1 Voltage measurement plate, measuring range 10x
1 Capacitor measurement plate, 250 cm^2
Set of plexiglas spacers

U8533015-230
Electric Field Meter (230 V, 50/60 Hz)

U8533015-115
Electric Field Meter (115 V, 50/60 Hz)

Additionally required:
U17450 Analogue Multimeter AM50

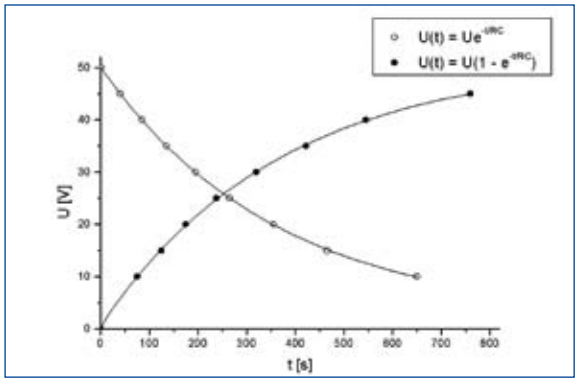
Additionally recommended:
U8533050 Accessories for the Electric Field Meter
U8496410 Drip Cup with Basin



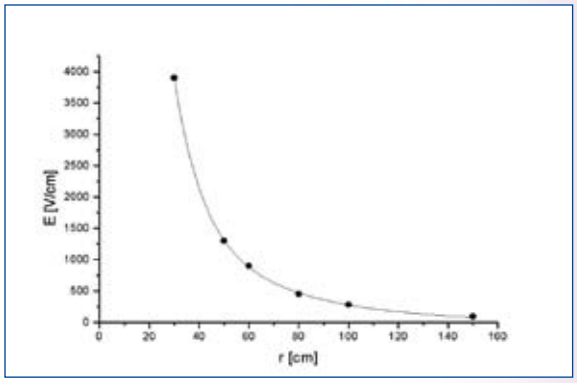
Static voltage measurements



Measuring the electric field strength of a plate capacitor as a function of the capacitor voltage



Charge and discharge curves of a capacitor



Electric field strength of a Van de Graaff generator as a function of the distance to the generator

U8533050



U8533050

Accessories for the Electric Field Meter

Comprehensive set of accessories for electric field meter U8533015.

Contents:

- 2 Insulated slot-clips
- 1 Alligator clip
- 1 Alligator clip with a lateral contact pin
- 1 Ball with a conductive surface
- 1 Conductor ball, 100 mm dia.
- 1 Charge ball, 30 mm dia.
- 2 Plexiglass insulating bars
- 2 Electrostatic plates, 100 mm dia.
- 1 Rotary capacitor, 500 pF
- 1 Piezoelectric ceramic disc
- 2 Capacitors, 10 nF, 630 V
- 1 Capacitor, 3.3 nF
- 1 Capacitor,100 nF
- 1 Flame probe
- 1 Protective resistor, 10 MΩ
- 1 Zinc plate, 70 mm dia.
- 1 Capacitor plate, aluminum, 70 mm dia.
- 1 Dipole bar, 500 mm x 3.8 mm dia.

Additionally required:

U8533015-230 Electric Field Meter (230 V, 50/60 Hz)

or

U8533015-115 Electric Field Meter (115 V, 50/60 Hz)

U8496410



U8496410

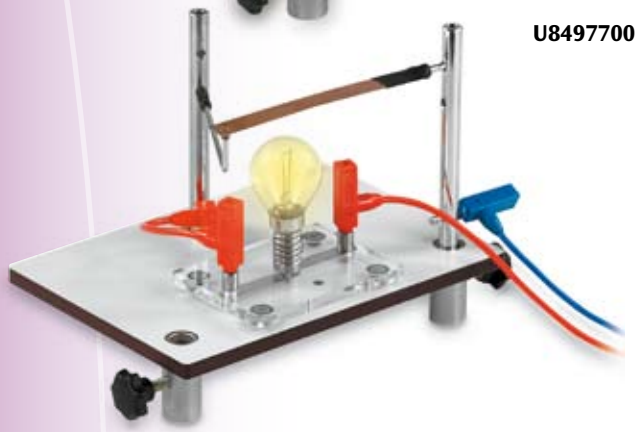
Drip Cup with Basin

Set for experiments involving electrostatic charging of fluids e.g. for charge separation when performing water separation in connection with the E-field meter (U8533015-230 or U8533015-115). Drip cup with side mounted holder and glass stopcock for precise regulation of the drip speed. Basin with 4-mm connector plug.

Dimensions: 70 mm x75 mm dia. approx.
Weight: approx. 150 g



U8497700



U8497700

Assembly Kit “Bell, Relay and Bimetallic Switch”

Equipment kit comprising materials to assemble electromagnetic switches and bimetallic switches.

Base plate:	approx. 200x140x40 mm³
Weight:	approx. 1.6 kg

Contents:

1 Stand plate with 3 clamps
1 Bell, 70 mm in diameter
2 Contact rod with three 4 mm cross holes
1 Leaf spring with connector
1 Bimetallic strips with connector
1 Armature with connector
1 Contact pin with connector
1 U-core, 20x20 mm²
1 Coil, 500 turns

Additionally required:
Bulb, 12 V, 25 W, Type E14, to replace blown components
U8495320 Lamp Socket E14
U33300-230 Transformer with Rectifier (230 V, 50/60 Hz)
or
U33300-115 Transformer with Rectifier (115 V, 50/60 Hz)



U8495350

U8495350

Set of Conductors and Non-Conductors

Samples of eight materials for experiments to investigate the electrical conductivities of different materials. In a storage container.

Materials:	Iron, aluminium, copper, steel, wood, glass, plastic, cotton
Sample length:	approx. 200 mm
Weight:	approx. 200 g



U8495320

U8495310

U8495310

Lamp Socket E10

Lamp socket on transparent acrylic base with screw connection for ordinary commercial filament bulbs for E10 sockets. Sockets for 4 mm safety plugs.

U8495320

Lamp Socket E14

Lamp socket on transparent acrylic base with screw connection for ordinary commercial filament bulbs for E14 sockets. Sockets for 4 mm safety plugs.



U8495910

U8495920

U8495930

U8495910

Toggle Switch

Switch mounted on a transparent acrylic base for the alternate opening and closing of two electric circuits. Sockets for 4 mm safety plugs.

U8495920

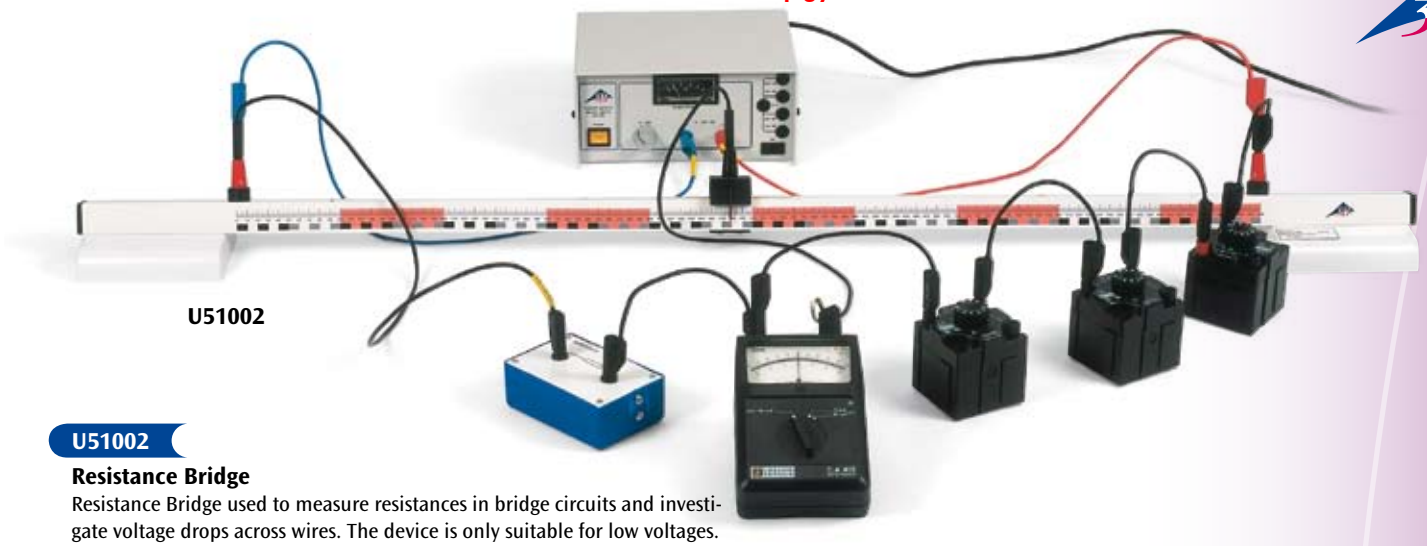
Single-Throw Switch

Switch mounted on a transparent acrylic base for the alternate opening and closing of a circuit. Sockets for 4 mm safety plugs.

U8495930

Momentary Contact Switch

Switch mounted on a transparent acrylic base for the momentary closing of circuits. Sockets for 4 mm safety plugs.



U51002

U51002

Resistance Bridge

Resistance Bridge used to measure resistances in bridge circuits and investigate voltage drops across wires. The device is only suitable for low voltages. It consists of a rail with a scale mounted at two points and a resistance wire stretched between two connecting sockets. A sliding contact on the resistance wire is used to set the resistance of the resultant two wire sections. A Wheatstone bridge circuit is configured to determine unknown resistances.

Dimensions:	approx. 1300x100x90 mm³
Rail:	approx. 30x30 mm²
Scale:	0 – 1000 mm
Scale divisions:	mm
Resistance wire:	1 m, 0.5 mm dia.
Material:	NiCr
Resistance:	5.4 Ω
Connection:	4 mm safety jacks
Maximum permissible voltage:	8 V
Maximum permissible current:	1.5 A

Additionally recommended:

U11170 Zero Galvanometer CA 403
U11180 Resistance Decade 1 Ω
U11181 Resistance Decade 10 Ω
U11182 Resistance Decade 100 Ω
U51004 High-Precision Resistor 1 Ω
U51005 High-Precision Resistor 10 Ω
U117601-230 AC/DC Power Supply 0 – 12 V, 3 A (230 V, 50/60 Hz)
or
U117601-115 AC/DC Power Supply 0 – 12 V, 3 A (115 V, 50/60 Hz)

U15321

Insulator with Clamp

Metal stem with knurled screw and 4 mm bore hole on acrylic rod, as insulated holder for wires, e.g. when conducting experiments on the optical bench are performed.

Diameter:	approx. 10 mm
Length:	approx. 100 mm

U15320

Insulated Slider

Insulated slider for measuring the electrical resistance as a function of the length, cross section and material. The slider is mounted with two insulated contacts as voltage dividers on riders on the optical bench. Acrylic rod with metal stud and 4 mm bore hole.

Diameter:	approx. 10 mm
Length:	approx. 100 mm

U8713100

Rod Clamp with Insulator

Clamp for the insulated securing of electrical components with 4-mm connectors. A PVC isolator is used to isolate sections from each other. Upper section features two 4 mm cross bore holes and one 6-mm hole with clamping screw. Lower section with two 4 mm cross holes.

Total length:	approx. 205 mm
Stem diameter:	approx. 10 mm
Weight:	approx. 135 g

U8497740

Contact Stand with Terminal Sockets

Connection rod on insulated base with three 4-mm cross holes and one axial 4 mm bore hole used to secure components with 4-mm connectors or to plug in 4 mm cables. At the top end spring-loaded terminal socket used as a wire clamp.

Height:	approx. 130 mm
Shaft:	approx. 105x10 mm²
Base:	approx. 25x70 mm²
Weight:	approx. 210 g



U15321

U15320

U8713100

U8497740

U8492020

Resistance Apparatus

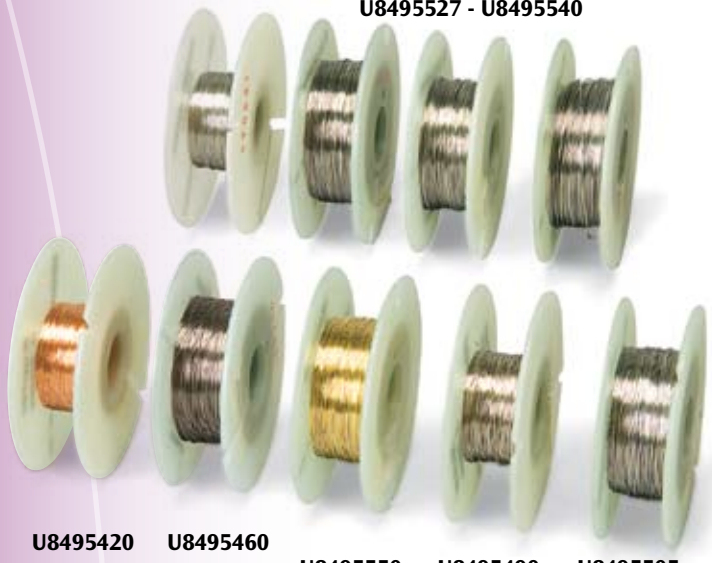
Apparatus to investigate the dependency of electrical resistance on conductor length, conductor cross-section and material. Six wires are laid out side by side on a block of wood and both ends connect to 4 mm sockets.

Wire specimens:	Constantan 1.0 mm dia., Constantan 0.7 mm dia. (2x), Constantan 0.5 mm dia., Constantan 0.35 mm dia., Brass 0.5 mm dia.
Wire lengths:	1000 mm
Dimensions:	approx. 1085x70x55 mm³
Weight:	approx. 1.5 kg



U8492020

U8495527 - U8495540



U8495420 U8495460 U8495550 U8495490 U8495505

Resistance Wires

Metal wires on bobbins, e.g. for experiments to investigate how resistance depends on the material, cross-sectional area and length of the wire.

Art. Nr.	Material	Length	Diameter
U8495420	Copper	100 m	0.3 mm
U8495460	Iron	100 m	0.3 mm
U8495550	Brass	50 m	0.3 mm
U8495490	Nickel	50 m	0.3 mm
U8495505	Chrome-Nickel	100 m	0.3 mm
U8495527	Constantan	100 m	0.2 mm
U8495532	Constantan	100 m	0.3 mm
U8495537	Constantan	50 m	0.4 mm
U8495540	Constantan	50 m	0.5 mm



U51009

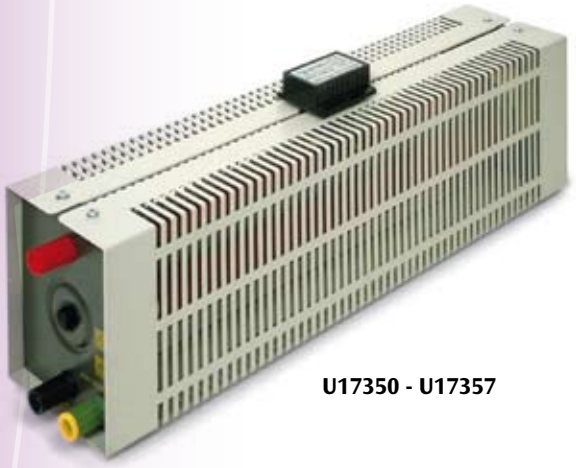
High Precision Resistors

High precision resistors in plastic housing with 4 mm safety plugs.
Dimensions: approx. 122x70x30 mm³

Art. Nr.	Resistance	Tolerance	Load rating
U51004	1 Ω	1%	4 W
U51005	10 Ω	1%	4 W
U51006	100 Ω	1%	4 W
U51007	1 kΩ	1%	4 W
U51008	10 kΩ	1%	4 W
U51009	100 kΩ	1%	1 W
U51010	1 MΩ	1%	1 W
U51011	10 MΩ	1%	1 W



U11190 – U11191



U17350 - U17357

Capacitance Decades

Capacitance decades which can be mechanically connected to one another. With color-coded safety sockets and control knob for setting capacitances in 10 steps. Includes 25 cm safety patch cord.
Nominal voltage: 350 V DC
Connections: 4 mm safety sockets
Dimensions: approx. 72x72x90 mm³
Weight approx. 220 g

Art. Nr.	Measurement range	Step size	Accuracy
U11190	0.01 µF – 0,1 µF	0.01 µF	2%
U11191	0.1 µF – 1 µF	0.1 µF	2%

Rheostats

Slide-contact resistors of high current-bearing capacity in housings that are safe to touch, for experiments with safety low voltage circuits, to be used as continuously variable resistors or voltage dividers. With built-in earth sockets.
Resistance tolerance: 10% from nominal value
Max. permissible power: 320 W (continuous operation), 640 W (max. 15min)
Max. permissible voltage: 600 V
Terminals: 4 mm safety sockets
Dimensions: approx. 446x93x150 mm³
Weight: approx. 2.85 kg to 3.25 kg

Art. Nr.	Resistance	Max. current rating (continuous)	Max. current rating (15 min)
U17350	1 Ω	18 A	25 A
U17351	3.3 Ω	10 A	12 A
U17352	10 Ω	5.7 A	12 A
U17353	33 Ω	3.1 A	4.4 A
U17354	100 Ω	1.8 A	2.5 A
U17355	330 Ω	1 A	1.4 A
U17356	1000 Ω	0.57 A	0.8 A
U17357	3300 Ω	0.31 A	0.44 A

U11185

Resistance Decade, 1 Ω– 10 kΩ

Four resistance decades in a single housing, can be used individually or in combination, e.g. for setting up a Wheatstone bridge. Can be set using control knob, with decade scale.

Output:	via 4 mm safety sockets
Max. current:	700 mA (1 Ω– 10 Ω) 200 mA (10 Ω– 100 Ω) 70 mA (100 Ω– 1 kΩ) 20 mA (1 kΩ– 10 kΩ)
Accuracy:	1%
Dimensions:	approx. 310x90x80 mm³
Weight:	approx. 1 kg



U11185

U51012

Capacitor 2200 µF

Capacitor in plastic housing with 4-mm safety plugs.

Capacitance:	2200 µF
Tolerance:	20%
Maximum permissible voltage:	40 V
Dimensions:	approx. 122x70x30 mm³



U51012

U11820

Inductance Decade

Variable inductance decade in impact-resistant plastic housing. This series incorporates mechanically stable components, a slide switch for setting measurement ranges and coloured 4 mm sockets with clips for connecting wires.

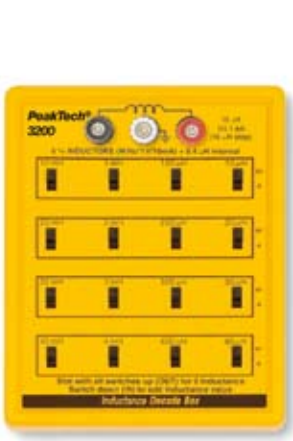
Measuring range:	10 µH – 111.1 mH
Increment:	10 µH
Accuracy:	5%
Number of decades:	4
Limiting values:	max. 1 V / 10 mA
Dimensions:	approx. 147x117x33 mm³
Weight:	approx. 310 g

U11821

Capacitance Decade

Capacitance decade in impact-resistant plastic housing. This series incorporates mechanically stable components, a slide switch for setting measurement ranges and coloured, 4-mm sockets with clips for connecting wires.

Measuring range:	100 pF – 11.111 µF
Increment:	100 pF
Accuracy:	5%
Number of decades:	5
Limiting values:	max. 50 V DC
Dimensions:	approx. 147x117x33 mm³
Weight:	approx. 310 g



U11820



U11821

Resistance Decades

Resistance decades which can be mechanically connected to one another, e.g. in order to assemble a Wheatstone bridge. With colour-coded safety sockets and control knob for setting measurement resistances in 10 steps. Includes 25 cm safety patch cord.

Connections:	4 mm safety sockets
Dimensions:	approx. 72x72x90 mm
Weight:	approx. 220 g



U11180 - U11184

Art. Nr.	Measurement range	Step size	Max. current	Accuracy
U11180	0.1 Ω – 1 Ω	0.1 Ω	1 A	1 % ±5 mΩ
U11181	1 Ω – 10 Ω	1 Ω	750 mA	1 % ±5 mΩ
U11182	10 Ω – 100 Ω	10 Ω	250 mA	0,5 %
U11183	100 Ω – 1 kΩ	100 Ω	75 mA	0,5 %
U11184	1 kΩ – 10 kΩ	1 kΩ	25 mA	0,5 %

Experiment topics:

- Voltage measurement of galvanic elements
- Standard potentials of different pairs of metals/metal cations
- Standard potentials of different pairs of non metals/non metal cations
- Voltage measurement of concentration chains
- Electrochemical corrosion of iron
- Measurement of pH values of different electrolyte solutions
- Daniell cell
- Leclanché cell
- Fuel cells

BESTseller



U11110

U11111

pH Combined Electrode

pH combined electrode with shaft made of plastic with a BNC plug and highly flexible cable.

Length of cable: approx. 1 m
Dimensions: approx. 120 mm x 12 mm dia.



U11111

U11110

Electrochemistry Case

A complete equipment set in a case for basic experiments on electrochemistry. 2 cell blocks made of resistant plastic, each with 4 half-cells, allowing a simultaneous configuration of 4 galvanic elements. These elements are connected electrically to each other via strips of filter paper acting as membranes. Includes a handy measurement device with an LCD display for pH values and practically zero-current measurement of voltages, as well as a pH combined electrode with a highly flexible cable. Automatic accumulator charging during mains operation with overload protection. Enclosed in a robust console housing with labelling on a resistant SKF inscription foil with a scratch proof coating.

Electrodes:	approx. 42x28 mm²
Measurement device:	
7 segment display:	3 digit
Height:	13 mm
Voltage ranges:	2 V DC and 20 V DC
Resolution:	1 mV
Input resistance:	200 MΩ
Accumulator operation:	approx. 10 hours of operation after charging
Dimensions:	approx. 175x105x55 mm³

Contents:

1 foam lined case
1 measurement device
1 pH combined electrode with BNC plug
1 adapter 12 V AC/ 3V DC 500 mA
1 plug-in power unit 12 V AC / 580 mA for 115/230 V AC mains voltage
2 cell blocks, each with 4 half cells
2 Ag- electrodes
4 Zn- electrodes
2 Fe- electrodes
2 C- electrodes
2 Al- electrodes
2 Ni- electrodes
4 Cu- electrodes
1 Pt gauze electrode
1 magnesium strip
1 plastic plate
1 set of filter papers (50 units)
1 emery stick
3 experiment cables with 2 mm plug, 20 cm, red
3 experiment cables with 2 mm plug, 20 cm, blue
1 experiment cable with 2 mm plug, 30 cm, red
1 experiment cable with 2 mm plug, 30 cm, blue
6 tapping clips
2 plastic beakers, 25 ml
2 drip pipettes with rubber caps
1 operating instructions

Additionally required:
Chemicals

U11100

Equipment Set for Electrochemistry

Set for measuring electrochemical potentials of various metals in experiments intended for students. Includes digital multimeter.

Trough: approx. 85x70x45 mm³
Elecrodes: approx. 76x40 mm²

Contents:

1 flat trough
1 copper plate
1 zinc plate
1 iron plate
2 nickel plates
1 aluminum plate
2 electrolyte-carbon plates
1 digital multimeter with 2 cables with crocodile clamps



U11100

U14332

Hofmann Water Decomposition Apparatus

Apparatus for electrolysis of water, the quantitative determination of the gases formed and establishing Faraday's laws. Consists of two scaled gas collection tubes connected by flexible plastic hose with leveling bulb for pressure compensation and hence for the exact measurement of gas volumes, on stand with retaining plate. GL threads provide secure mounting for electrodes.

Dimensions: approx. 800x150 mm²
Baseplate area: approx. 250x160 mm²
Rod: approx. 750 mm x 12 mm dia.
Retaining plate: approx. 120x110 mm²

BESTseller

Contents:

1 gas collection tubes
2 platinum electrodes with 4 mm sockets
1 plastic hose with leveling bulb
1 stand ring for holding leveling bulb
1 universal bosshead
1 stand baseplate with rod and retaining plate

Additionally recommended:

U33020-230 DC Power Supply 0–20 V, 0–5 A (230 V, 50/60 Hz)
or
U33020-230 DC Power Supply 0–20 V, 0–5 A (115 V, 50/60 Hz)

U21020-230 Power and Energy Meter (230 V, 50/60 Hz)
or
U21020-115 Power and Energy Meter (115 V, 50/60 Hz)



U14330

U14332

U14331

U14330

Leclanché Cell

This model of a dry battery was invented by the French chemist Georges Leclanché in the 1860s. It consists of a cylindrical zinc electrode, a rod shaped carbon electrode, a clay vessel and a battery glass. Filled with cell electrolyte, the Leclanché cell supplies a voltage of approximately 1.5 volts. The cell is delivered empty.

Connections: 4 mm jacks
Dimensions: approx. 175 mm x 65 mm dia.
Suitable filling: Ammonium chloride solution (NH_4Cl), approx. 20% concentration

U14331

Daniell Cell

Galvanic cell (Daniell cell) named after John Frederic Daniell for studying the properties of an electrochemical cell. The Daniell cell consists of a cylindric zinc and copper electrode, a clay vessel and a battery glass. Filled with cell electrolyte the Daniell cell supplies a voltage of approx. 1.1 volts. The cell is delivered empty.

Connections: 4 mm jacks
Dimensions: approx. 105 mm x 65 mm dia.
Suitable filling: Copper sulfate solution ($CuSO_4$), 10% concentration, Zinc sulfate solution ($ZnSO_4$), 10% concentration

Electrode plates (not ill.)

Spare electrodes for the electrochemistry equipment set (U11100).
Dimensions: approx. 76x40 mm²

Art. Nr.	Material
U11101	Set of 10 Copper Plates
U11102	Set of 10 Zinc Plates
U11103	Set of 10 Iron Plates
U11104	Set of 5 Nickel Plates
U11105	Set of 10 Aluminum Plates
U11106	Set of 5 Carbon Plates



U19555

BESTseller

U19555

Magnetic Equipment Set

A selection of various magnets for introducing the subject of magnetism. Complete with a specially molded storage tray.

Contents:

3 AlNiCo round magnets: 12 mm, 19 mm, 24 mm dia.
1 AlNiCo horseshoe magnet, 25 mm long
1 Chromium-steel horseshoe magnet, 100 mm long
2 Chromium-steel bar magnets, 100 mm x 6 mm dia.
2 Bar magnets in a protective plastic case, 80 mm long
5 Iron ring magnets, 25 mm dia.
5 Iron magnets, 19x19x5 mm³
1 Natural magnet
4 Colored magnetic foils, 50x50 mm²
2 Drawing compasses, 19 mm dia.
2 Drawing compasses, 16 mm dia.



U8491820

U19553

U8491820

Bar Magnet, Alnico, 70 mm

Alnico bar magnet with poles marked red and green.

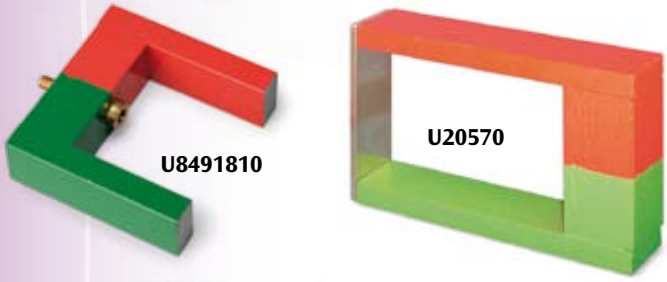
Dimensions: approx 70x20x8 mm³
Weight: approx. 80 g

U19553

Horseshoe Magnet 140 mm, with Yoke

Horseshoe shaped chromium steel magnet with yoke, poles coloured red and silver.

Dimensions: approx. 140x20x10 mm³



U8491810

U20570

U8491810

Horseshoe Magnet, 70 mm

Horseshoe shaped AlNiCo magnet with screw. Poles marked red and green.

Pole area: approx. 20x10 mm²
Distance between poles: approx. 50 mm
Length of shank: approx. 70 mm
Weight: approx. 400 g

U20570

Horseshoe Magnet 130 mm, with Yoke

Horseshoe shaped magnet with yoke. Poles coloured red/green.

Pull-off force of yoke: 250 N
Pole spacing: approx. 60 mm
Length: approx. 130 mm



U19551

U8495210

U19550

U20550

U19551

Pair of Bar Magnets, AlNiCo, 60 mm, with Two Iron Yokes

Pair of AlNiCo bar magnets, red, with north pole marked. Including two iron yokes.

Dimensions: approx. 60x15x5 mm³

U19550

Pair of Bar Magnets, 80 mm

Pair of bar magnets with poles marked red and blue. In plastic protective cover.

Dimensions: approx. 80x22x10 mm³

U8495210

Cylindrical Bar Magnet 50x20

Round bar magnet with poles marked red and green.

Dimensions: approx. 50 mm x 20 mm dia.

U20550

Cylindrical Bar Magnet 200x10

Round bar magnet with poles marked red and green.

Dimensions: approx. 200 mm x 10 mm dia.



U8495225

U19552

U8495225

Suspended Magnet

Apparatus for demonstrating repulsion forces between magnets. Two ring magnets facing each other with identical poles are slid on a rod.

Base: approx. 100 mm dia.
Rod: approx. 100 mm x 30 mm dia.
Weight: approx. 410 g

Contents:

1 Rod with Base
2 Ring magnets

U19552

Pair of Bar Magnets 150 mm with Two Iron Yokes

Pair of chromium-steel magnets, poles identified in red and silver. Including two iron yokes.

Dimensions: approx. 150x19x6 mm³

U8496112

Equipment Kit "Hysteresis Curve"

Apparatus for recording the magnetic flux density as a function of the magnetic field strength in different iron specimens.

Dimensions of the iron samples: approx. 140 mm x 10 mm dia.

Number of turns:	600
Internal resistance:	1.5 Ω
Inductance without core:	3.5 mH
Dimensions:	approx. 200x145x65 mm³
Total weight:	approx. 950 g

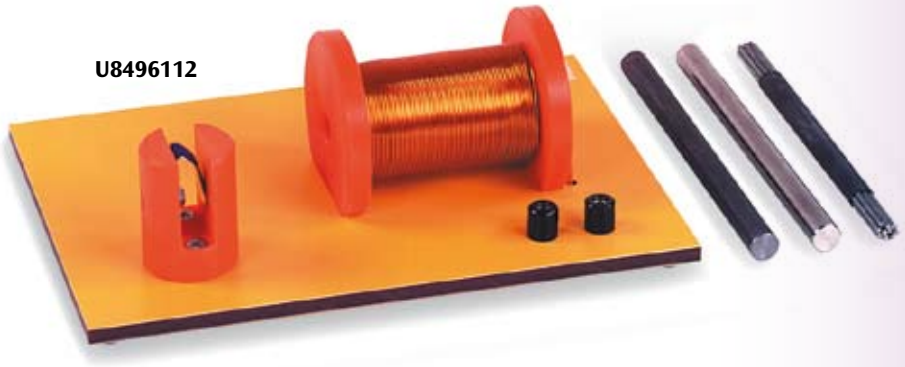
Contents:

Base plate with coil and holder for Hall sensors
3 iron samples as coil cores (stainless steel, hard metal and iron)

Additionally recommended:

U8533510-230 Power Function Generator (230 V, 50/60 Hz)
or
U8533510-115 Power Function Generator (115 V, 50/60 Hz)
U11360 Magnetic Field Sensor

U11300-230 3B NET*log*™ (230 V, 50/60 Hz)
or
U11300-115 3B NET*log*™ (115 V, 50/60 Hz)
U11310 3B NET*lab*™



U8496112

U45051

Diamagnetic Levitation Apparatus

The physicist S. Earnshaw proposed the following theorem in 1848: „It is not possible for charges or magnets to be placed in a stable levitated state in a static field obeying an inverse square law." He further stated, however, that it would be possible to achieve this with the help of diamagnetic materials.

The availability of very powerful rare-earth metal magnets has made it possible to design a cheap levitation apparatus such as this using graphite as the diamagnet. Diamagnetic materials are repelled from both magnetic poles.

A gold-coated NdFeB magnet is allowed to levitate freely between two graphite plates in a space enclosed by transparent acrylic. The gravitational force acting on the magnet is almost entirely counteracted by the force of attraction from a ring magnet located above the plastic covering.

Two diamagnetic graphite plates, one above and one below the NdFeB magnet, compel it into a stable equilibrium since both poles of the magnet are repelled by the graphite plates (diamagnetism).

Dimensions:

Base plate:	approx. 95x95x135 mm³

Contents:

1 Levitation apparatus
2 Transparent acrylic plates
1 Socket wrench



U45051

U19556

Soft-Iron Bars

Set of 5, non-magnetic soft-iron bars for magnetic induction experiments.

Dimensions: approx. 155 mm x 10 mm dia.



U19556

Vissza a tartalomjegyzékhez!



U21900

U21900

Inclination Instrument

Instrument for measuring the inclination of the Earth's magnetic field and also for mapping the magnetic field of a current-carrying conductor.
An aluminum conductor loop with 4 mm safety sockets, a magnetic needle with a pointed axle rotates on bearings above a full circle in transparent material with an angle scale, rotating about the horizontal axis and mounted on acrylic base.

Diameter of circle:	approx. 110 mm
Length of magnetic needle:	approx. 100 mm
Strap length:	approx. 150 mm
Terminal:	4 mm safety sockets
Base dimensions:	approx. 100x90x185 mm³

Additionally recommended:
U33020-230 DC-Power-Supply 0 – 20 V, 0-5 A (230 V, 50/60 Hz)
or
U33020-115 DC-Power-Supply 0 – 20 V, 0-5 A (115 V, 50/60 Hz)



U8495255

U8495255

Inclination and Declination Instrument

Instrument for measuring the inclination and declination of the Earth's magnetic field and also for mapping the magnetic field of a current-carrying conductor. The bearings are of agate upon which the magnetic needle is mounted in a frame with reference circle. The frame is equipped with an additional reference circle. There are two 4 mm sockets included for power supply.

Length of magnetic needle:	approx. 100 mm
Dimensions:	approx. 180x100x220 mm³
Weight:	approx. 620 g

Additionally recommended:
U33020-230 DC-Power-Supply 0-20 V, 0-5 A (230 V, 50/60 Hz)
or
U33020-115 DC- Power-Supply 0-20 V, 0-5 A (115 V, 50/60 Hz)



U8495243

U8495243

Globe with Bar Magnet

Globe of the world with bar magnet along the axis of the poles, for demonstrating the shape of the Earth's magnetic field.
A compass (U19561) or a magnetic field sensor (U8491900) can be seen to align at the surface of the globe in accordance with a magnetic field parallel to the lines of longitude. The inclination can also be determined using the magnetic field sensor.

Diameter:	approx. 150 mm
Weight:	approx. 150 g

Additionally recommended:
U8491900 Magnetic Field Sensor
U19561 Compass



U8491900

U8491900

Magnetic Field Indicator

Bar magnet, with poles identified by colour and free to turn in space, for three-dimensional mapping of magnetic fields. On agate gimbal bearings pivot allowing free rotation in space, small bar magnet with color pole coding. Handle and cardanic suspension made of plastic to alleviate any adverse effects on magnetic field.

Magnet:	approx. 25x3x3 mm³
Handle length:	approx. 95 mm



U21603



U19561

U21603

Magnetic Needle

Magnetic needle mounted on base with pivot point.

Length:	approx. 80 mm
Height:	approx. 110 mm

U19561

Compass

Compass in a stable housing, low friction needle bearing, including a compass card and angle scale.

Scale division:	2°
Diameter:	approx. 55 mm



U8491920



U11451



U11452

U8491920

Magnetic Field Lines Device, Three-Dimensional

Instrument for three-dimensional mapping of the magnetic field lines of a cylindrical bar magnet. The plexiglas housing is filled with a special, highly viscous liquid and iron filings. After the magnet has been inserted into the central hole, the iron filings, which had previously been distributed randomly in the liquid, align themselves according to the direction of the field. An enclosed air bubble ensures that a good shake of the device causes the iron shavings to be evenly distributed.

Diameter of the hole:	approx. 21 mm
Dimensions:	approx. 115x115x120 mm³
Weight:	approx. 0.8 kg

Additionally required:
U8495210 Cylindrical Bar Magnet 50x20 mm

U19560

Magnetic Field Line Apparatus, Two-Dimensional

Demonstration apparatus for two-dimensional display of magnetic field lines in combination with an overhead projector. It consists of a transparent plastic vessel filled with a liquid containing magnetic powder. Magnets and an experiment manual in English are included.

Dimensions:	approx. 280x180x9 mm³

Additionally required:
U30150 Overhead projector

U19560



U11451

Iron Filings

250 g of iron filings for displaying magnetic field lines.
In a storage flask.

Additionally recommended:
U11452 Shaker

U11452

Shaker

Plastic flask with a fine hole for scattering iron filings evenly.

U15350

Hexagonal Magnet Model

Demonstration apparatus for the properties of the crystal lattice of ferromagnetic materials, particularly Weiss domains, Barkhausen jumps, saturation, hysteresis and Curie temperature.
117 freely moving magnetic needles are supported in a hexagonal arrangement between two connected transparent acrylic plates.
For projection on the overhead projector.

Length of magnetic needles:	approx. 17 mm
Dimensions of plate:	approx. 150x150 mm²

Additionally recommended:
U30150 Overhead Projector
U8495185 Pair of Flat Coils

U19562

Set of 10 Tracing Compasses

Set of 10 compasses for tracing field lines. Aluminum housing, glazed on both sides. Markings for indicating compass directions.

Diameter:	approx. 19 mm

U8495185

Pair of Flat Coils

Pair of coils for generating a near-uniform magnetic field for the hexagonal and cubic magnet models (U15350 and U15351). This makes it possible to observe changes in the magnetic flux when the magnetisation is changed.

Number of turns:	125
Resistance:	7 Ω. approx.
Permitted current:	1 A
Dimensions:	150x30x18 mm³ approx.
Weight:	85 g approx.

U15351

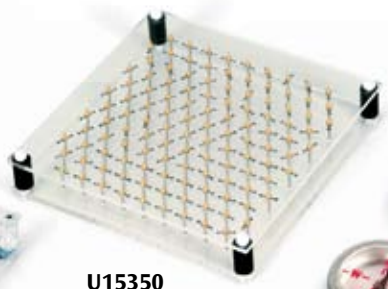
Magnet Model, Cubic

Like U15350, but with magnets in a square arrangement.

Additionally recommended:
U30150 Overhead Projector
U8495185 Pair of Flat Coils

U15351





U15350



U19562

U8495185



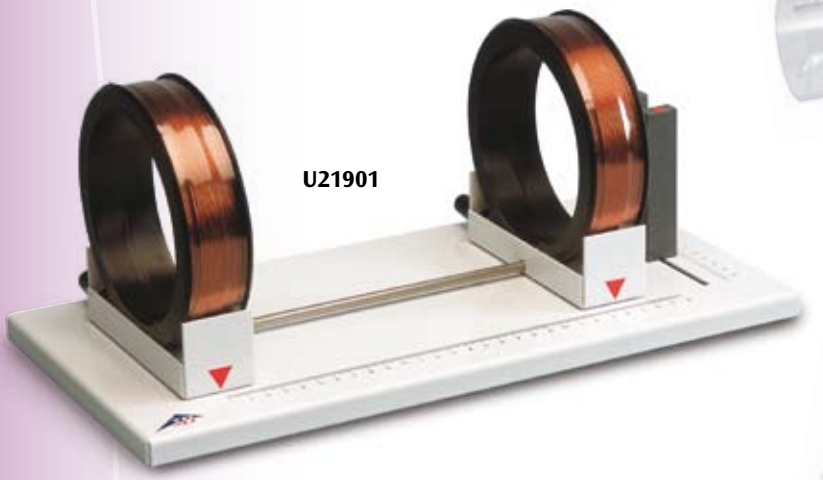
U21901

Pair of Helmholtz Coils on Mounting Plate

Pair of coils with variable separation for determining the optimum Helmholtz configuration and for quantitative testing of the uniformity of the magnetic field. The apparatus comprises a coil pair arranged parallel to each other mounted on a robust metal base plate with a holder for a magnetic field meter to measure the magnetic field. One coil and its holder are moveable. There are two scales printed on the base plate to allow coil separation to be read off and to determine how far the measurement probe's position deviates laterally from the coil axis respectively.

Average coil diameter:	125 mm
Number of turns:	100 each
Max. coil separation:	240 mm
Max. permissible current:	5 A
Terminals:	4 mm safety sockets
Base plate:	approx. 400x200 mm²

Additionally recommended:
U11360 Magnetic Field Sensor



U21901

U8496175

Coil with Variable Number of Turns per Unit Length

Cylindrical coil of variable length for investigating the magnetic field strength as a function of the closeness of the turns.

Coil diameter:	100 mm
Number of turns:	30
Coil length:	490 mm
Max. Current:	10 A, for short periods 20 A
Terminal:	4 mm safety sockets

Additionally recommended:
U8496150 Stand for Cylindrical Coils
U11360 Magnetic Field Sensor



U8496175



U12253

U12252

Field Coils

Cylindrical coils for experiments investigating magnetic field intensity as a function of the current and the number of turns, for demonstrating that the field intensity is independent of the coil cross section. Coil bobbins made of acrylic.

Number of turns:	120
Coil length:	490 mm
Max. current:	10 A, for short periods 20 A
Terminal:	4 mm safety sockets

U12252

Field Coil 100 mm dia.

U12253

Field Coil 120 mm dia.

Additionally recommended:
U8496150 Stand for Cylindrical Coils
U11360 Magnetic field sensor



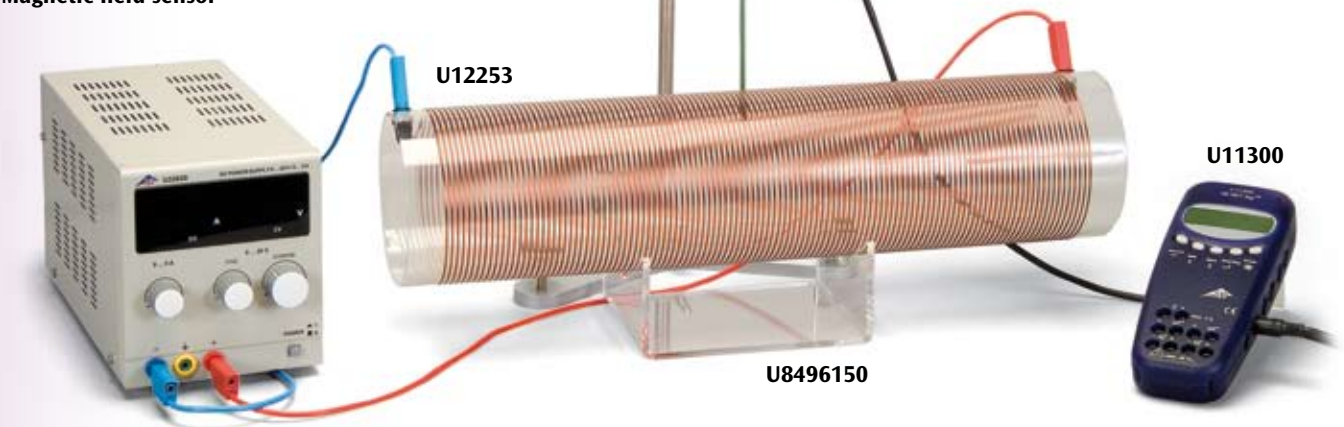
U11360

U8496150

Stand for Cylindrical Coils

Made of plexiglass.

Dimensions:	approx. 165x120x75 mm³
Weight:	approx. 185 g



U12253

U11300

U8496150

BESTseller

Experiment topics:

- **Magnetic flux lines of bar and horseshoe magnets**
- **Magnetic screening**
- **Magnetic induction**
- **To display the shapes adopted by magnetic field lines around a straight conductor, a conductor loop, a cylindrical coil, and an electromagnet**



U8491790

U8491790

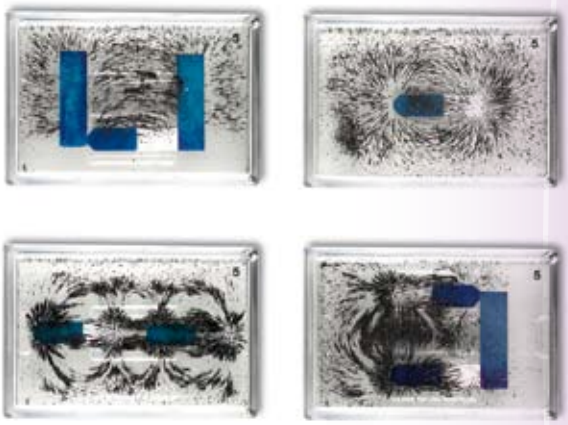
Set of Apparatus for Displaying Magnetic Fields

Equipment set for demonstration experiments designed to make visible the magnetic field distribution of permanent magnets and current carrying conductors. Also compatible for use with a daylight projector. The acrylic glass boxes containing iron filings are equipped with a pouring lip so that the used fillings can easily be refilled into the storage bottle.

Acrylic glass boxes:	approx. 185x125x40 mm³
Storage tray:	approx. 430x380x25 mm³
Weight:	approx. 1.5 kg

Contents:

1 Straight conductor mounted on box made of transparent acrylic
1 Ring-shaped conductor mounted on box made of transparent acrylic
1 Cylindrical coil mounted on box made of transparent acrylic
1 Magnetic overlay with guide studs on acrylic box
1 Acrylic plastic box with smooth surface for scattering materials
2 Soft iron bars
1 Flat soft iron bar
2 Permanent flat bar magnets
1 Soft iron ring
1 Magnetic needle with holder
1 Scattering bottle with iron filings
1 Pre-molded storage tray



Additionally required:
U117361-230 DC-Power Supply, 0 – 16 V, 0 – 20 A (230 V, 50/60 Hz)
or
U117361-115 DC-Power Supply, 0 – 16 V, 0 – 20 A (115 V, 50/60 Hz)

Additionally recommended:
U30150 Overhead projector



Current Conductor on Acrylic Base

Current Conductor for demonstrating the magnetic fields of current-carrying conductors. The magnetic field can be made visible with iron powder. Acrylic glass base with two 4 mm safety sockets. For projection on the overhead projector.

Dimensions of acrylic glass base:	approx. 185x150x30 mm³
Number of turns:	7
Coil diameter:	approx. 35 mm
Coil length:	approx. 65 mm



U8491792

U8491791

U8491793

U8491791

Straight Conductor on Acrylic Base

U8491792

Loop-Shaped Conductor on Acrylic Base

U8491793

Coil on Acrylic Base



Experiment topics

- **Diamagnetism and paramagnetism**
- **Waltenhofen's pendulum**
- **Force on a conductor in a magnetic field in parallel and transverse configurations**
- **Measuring currents with a current balance**

U10371

Equipment Set for Electromagnetic Experiments

This equipment consists of a stable, firm, anodized-aluminum tripod with pre-defined magnet positions and accessory mountings. The deflection of the conductor swing can be adjusted in steps of 0, 15, 30 and 45 mm for current balance experiments.

Contents:

1 Aluminum tripod, anodized
1 Conductor swing with 4 mm safety jacks
2 Waltenhofen pendulums (solid and slotted)
1 Glass rod and polyester thread with hook
1 Aluminum rod and polyester thread with hook
1 Knurled screw

Additionally required:
U10370 Permanent Magnet with Adjustable Pole Spacing
U33020-230 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

U10372

Lorentz Motor

Comprising a motor armature without an iron core, this device is intended for installation inside the permanent magnet with adjustable pole spacing (U10370). The coil is rotated purely by the Lorentz force, its direction of rotation depending on the direction of the current.

Additionally required:
U10370 Permanent Magnet with Adjustable Pole Spacing
U33020-230 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

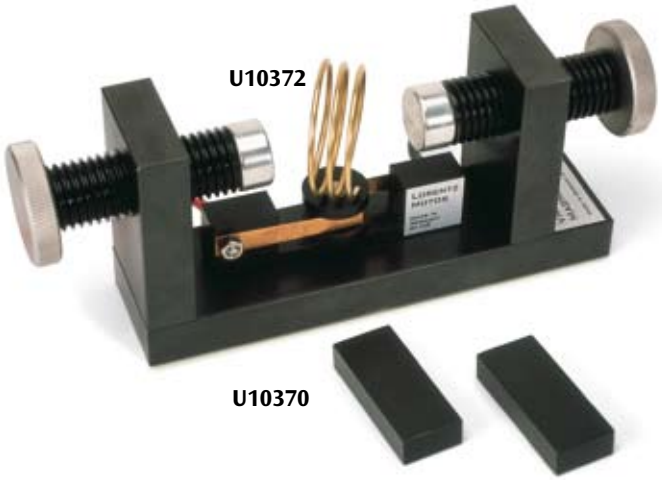
U10370

Permanent Magnet with Adjustable Pole Spacing

This permanent magnet has an adjustable pole spacing and a high field strength arising from a use of two neodymium magnet elements. It comes with a black-finished iron yoke, knurled handles made of high-grade steel and attachable pole shoes. This magnet system can be installed horizontally or vertically.

Magnet:	20x10 mm²
Pole shoes:	20x50 mm²
Pole spacing:	2 – 80 mm
Field strength at centre of gap:	20 mT – 1000 mT







U8496800

Experiment topics:

- Effect of force acting on a current-carrying conductor in a magnetic field
- Measurement of the magnetic flux density
- Effect of induction acting on a single conductor in the magnetic field
- Force between two parallel linear conductors
- Definition of ampere

U8496800

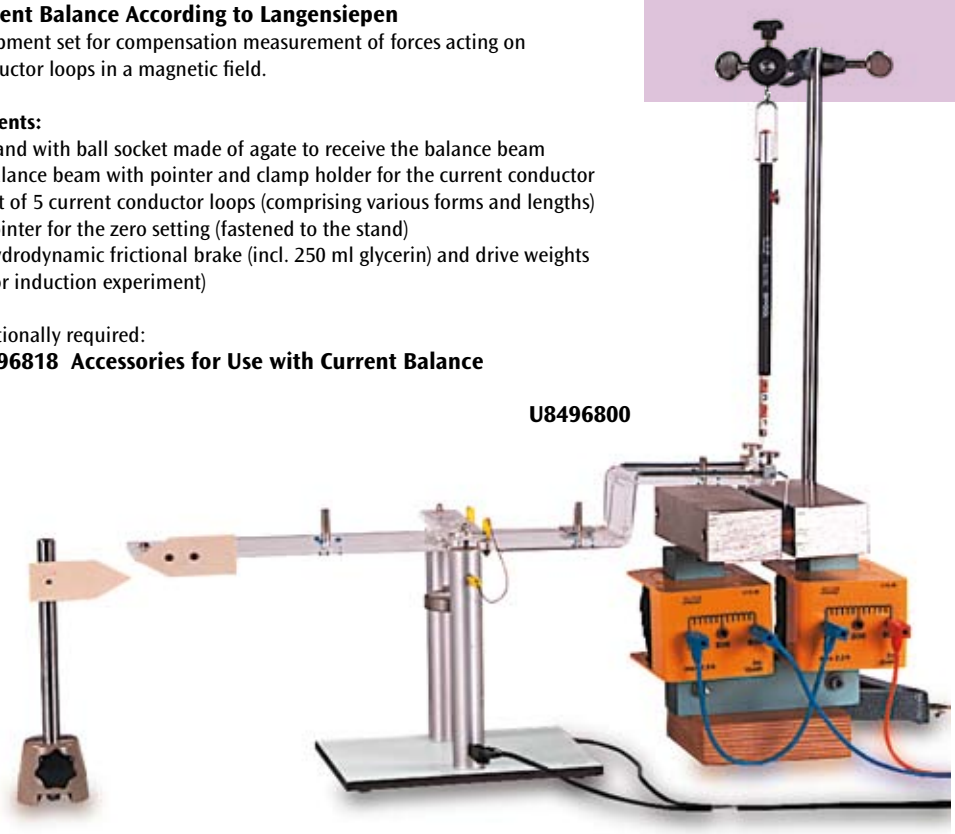
Current Balance According to Langensiepen

Equipment set for compensation measurement of forces acting on conductor loops in a magnetic field.

Contents:

1 Stand with ball socket made of agate to receive the balance beam
1 Balance beam with pointer and clamp holder for the current conductor
1 Set of 5 current conductor loops (comprising various forms and lengths)
1 Pointer for the zero setting (fastened to the stand)
1 Hydrodynamic frictional brake (incl. 250 ml glycerin) and drive weights (for induction experiment)

Additionally required:
U8496818 Accessories for Use with Current Balance



U8496800

U8496818

Accessories for Use with Current Balance

Accessories for use with current balance (U8496800).

Contents:

1 Transformer core with yoke and clamp
1 Pole piece set
2 Coils, 600 turns
1 Base block
1 Dynamometer 0.1 N
2 Weight 100 g
1 Weight 200 g
10 Spacer rings

Additionally required:
Stand Equipment

U8496270

Induction Apparatus

Apparatus for demonstrating the induced voltage in a frame coil that is moved through the magnetic field produced by a magnet plate of limited area or by the rotation of a current-carrying conductor in the magnetic field of the magnet plate. By varying the speed of motion of the frame coil, the direction of motion and the number of turns in the coil, the induction law can be derived experimentally and quantitatively.
The transparent design of the magnetic plate and coils means that they can be demonstrated on the overhead projector. An unfoldable support permits inclined set-up.

Operating voltage:	2 – 12 V DC
Frame coil:	approx. 185x125 mm²
Total dimensions:	approx. 585x200x55 mm³
Weight:	approx. 3 kg

Contents:

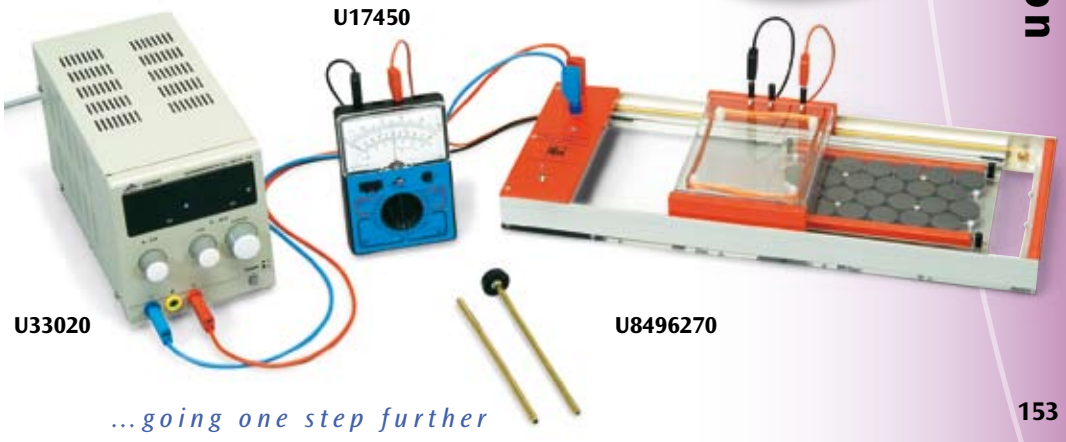
1 Induction apparatus with retractable magnetic plate
1 Frame coil
1 Rolling conductor loop

Additionally required:
U33020-230 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)
U17450 Analogue Multimeter AM50

Additionally recommended:
U30150 Overhead Projector

BESTseller

U17450



U33020

U8496270

Vissza a tartalomjegyzékhez!



U8497500

Waltenhofen's Pendulum

Equipment set for the demonstration of the effects of eddy currents and braking. A pendulum object composed of a solid steel plate swings back and forth between the poles of an electromagnet with the power switched off. When the magnet is switched on, the pendulum motion of the object comes to an almost immediate halt. If the plate contains slots more time elapses before the plate stops moving, i.e. the braking effect is severely reduced. The equipment set consists of a pendulum rod and four aluminium pendulum plates with various shapes:
rectangle, rectangle with slits, circular disk, ring and ring with slits.

Rectangular:	approx. 100x60 mm²
Ring:	approx. 30 mm dia. (interior), approx. 60 mm dia. (exterior)

Additionally required:
U8497180 Transformer Core D
U8497200 Pair of Pole Pieces
U8497440 Coil with 1200 Turns (2x)
U33020-230 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)



U122501

Set of 3 Induction Coils

Coils for experiments on induction in combination with the 120 mm diameter field coil (U12253) and for experiments on resonant electric circuits. The coils are only designed for safety extra low voltage (SELV). The spools are made of transparent acrylic plastic.

Connection:	4 mm safety sockets
Coil length:	170 mm
Coil 1	
Number of turns:	300 with taps at 100 and 200 turns
Coil cross section:	50x50 mm²
Coil 2	
Number of turns:	300
Coil cross section:	50x30 mm²
Coil 3	
Number of turns:	300
Coil cross section:	50x20 mm²

Additionally recommended:
U12253 Field Coil 120 mm dia.

U21903

Variable Inductance Coil

Coils for measuring inductance and self-inductance of a current-carrying coil depending on the insertion of an iron core and for investigating AC circuits. Coil of copper wire in a shock-resistant plastic casing with lifting handles. A coated iron core is mounted on a worm screw for moving in and out of the coil. With printed scale in cm for reading the length of core inserted into the coil.

Number of windings:	3000
Max. permissible voltage:	30 V AC, 60 V DC
Max. permissible current:	2 A
Inductance at 1 A:	approx. 0.15 –1.4 H, continuously adjustable
Resistance:	12.5 Ω
Terminals:	4 mm safety plugs
Dimensions:	approx. 265x145x130 mm³
Weight:	approx. 6.2 kg



U21602

Lenz's Law Apparatus

Instrument for demonstrating Lenz's Law qualitatively by bringing a magnet close to it. One closed and one open conductor loop, with point bearing on base.

Length:	approx. 195 mm
Height:	approx. 110 mm

Additionally required:
U20550 Cylindrical Bar Magnet 200x10

U8481510

Flat Coil in a Rotatable Frame

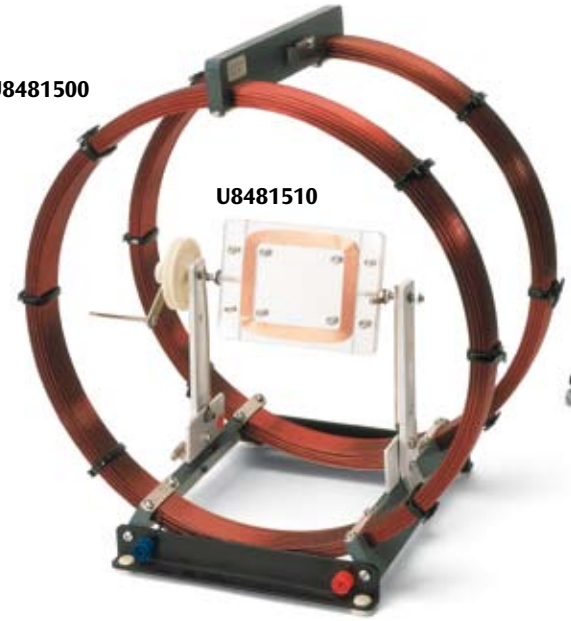
Flat coil in a plexiglas frame, mounted so that it can be rotated, for use in combination with 300 mm Helmholtz coils (U8481500). When the flat coil is rotated in the magnetic field of the Helmholtz coils, an alternating voltage is induced.
The electrical connection to the coil is established via sliding contacts. A hand crank and pulley on the rotary frame's axle are used to drive the coil.

Number of turns:	4000
Effective area:	41.7 cm^2
Dimensions:	approx. 110x80x11 mm^3
Weight:	approx. 360 g

Additionally required:
U8481500 Helmholtz Coils, 300 mm
U17450 Analogue Multimeter AM50
U33020-230 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

U8481500

U8481510



U8481500

Helmholtz Coils 300 mm

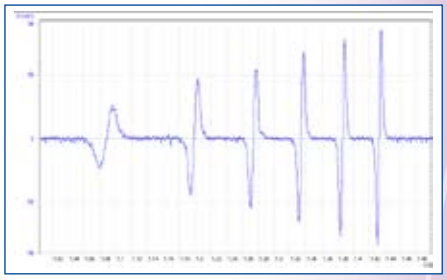
Pair of coils with large diameter in Helmholtz configuration used to produce a homogeneous magnetic field. The coils can be switched in parallel or in series. A spring clip on the top crossbar is used to mount the Hall sensor during measurements of the magnetic field.

Coil diameter:	approx. 300 mm
Number of turns per coil:	124 each
DC resistance:	1.2 Ω each
Maximum coil current:	5 A each
Terminals:	4 mm safety sockets
Weight:	4.1 kg approx.

Additionally recommended:
Magnetic Field Sensor

U8511100





The induced voltage as a function of time.

U8511100

Tube with Six Induction Coils

Plastic tube with six identical induction coils connected in series. When the bar magnet provided is allowed to fall through the tube, a voltage is induced in each of the coils in turn. As the velocity of the magnet increases with time during its fall, the amplitudes of the voltage peaks also increase, and their width decreases. The area under each voltage peak remains constant.

Coil width:	10 mm
Distance between coils:	190 mm
Dimensions:	approx. 1500 mm x 20 mm dia.
Weight:	approx. 500 g

Additionally required:
Stand Equipment

U11300



U8496300

Electromotor and Generator

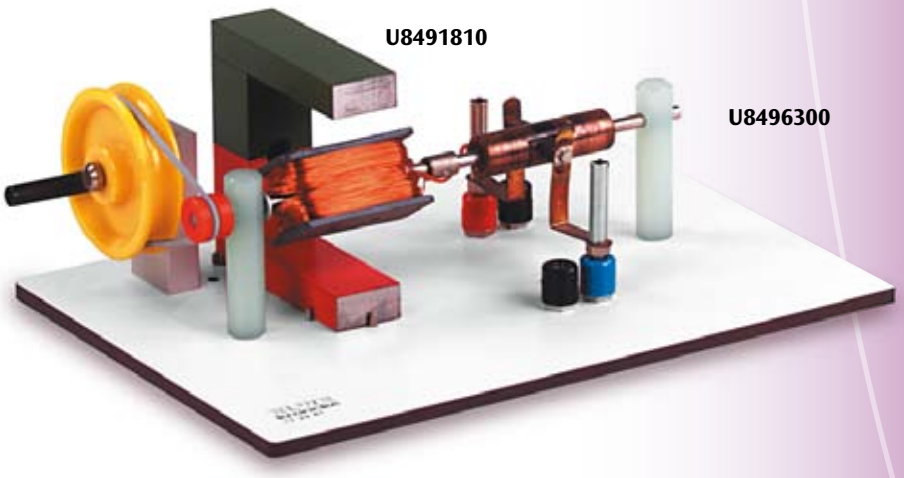
Functioning model to demonstrate how a direct current motor and a direct or alternating current generator operate. The model is equipped with a commutator and slip rings and mounted on a melamine coated cardboard plate with connection sockets, drive pulley and rubber belt.

Dimensions:	approx. 200x140x60 mm^3
Weight:	approx. 370 g

Additionally required:
U8491810 Horseshoe Magnet 70 mm

U8491810

U8496300



Vissza a tartalomjegyzékhez!

Experiment topics:

- Voltage transformation
- Transformer under load
- Current transformation
- Autotransformer
- Leakage field experiments
- Induction oven
- Point welding
- Fusing experiments
- High voltage experiments



U8497180, U8497420, U8497410

U8497180

Transformer Core D

U shaped core made of high grade laminated transformer plates, with removable yoke. Provided with two clips for securing the yoke or attaching special pole shoes with drilled holes (U8497200).

Cross-section of core:	40x40 mm²
U-core:	approx. 150x130 mm²
Length of yoke:	approx. 150 mm
Weight:	approx. 6 kg

U8497460

High Voltage Coil Including 2 Horn Shaped Electrodes

Secondary coil for transformer core D (U8497180), generating high voltages which can cause spark discharges between two shielded horn electrodes. Covered with impact resistant plastic, safe to touch.

Number of turns:	24000
Open-circuit voltage:	approx. 9200 V
Resistance:	10 kΩ
Max. current:	0.02 A
Inductance:	28 H



U8497460



U8497450



U8497440



U8497430

Additionally required:

U8497180 Transformer Core D
U8497420-230 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
U8497420-115 Mains Coil with Connecting Lead (115 V, 50/60 Hz)

Primary or Secondary Coils for Transformer Core D

Coils, covered with impact resistant plastic so that they are safe to touch, for use as primary or secondary coils in combination with transformer core D (U8497180). With safety connection sockets. As secondary coils these can output either low or high voltage, depending on the primary voltage, and therefore they cannot be used in student experiments.

	U8497430	U8497440	U8497450
Number of turns	600	1200	6000
Taps	200/600	400/1200	2000/6000
Resistance	3 Ω	12 Ω	300 Ω
Max. current	2.2 A	1.2 A	0.2 A
Inductance	15 mH	60 mH	1,5 H

U8497410

Low Voltage Coil D

Secondary coil for use with a transformer core D (U8497180) to generate low voltages up to 28 V. With five tapping points. Covered by impact resistant plastic, safe to touch.

Terminals:	Safety sockets
Number of turns:	72
Taps:	6/ 30/ 54/ 66/ 72
Resistance:	0.1 Ω
Max. current:	12 A
Inductance:	0.23 mH

U8497406

High Current Coil for Nail Fusing Experiment

Secondary coil for use with the transformer core D (U8497180) to generate a large current sufficient to melt nails. Covered by impact resistant plastic.

Number of turns:	6
Resistance:	3 mΩ
Max. current:	60 A
Inductance:	0.25 mH

Additionally required:

U8497180 Transformer Core D
U8497420-230 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
U8497420-115 Mains Coil with Connecting Lead (115 V, 50/60 Hz)



U8497420-230

U8497420-115



U8497410



U8497406

	U8497420-230	U8497420-115
Description	Mains Coil with Connecting Lead (230 V, 50/60 Hz)	Mains Coil with Connecting Lead (115 V, 50/60 Hz)
Number of turns	600	300
Resistance	3 Ω	0.75 Ω
Max. current	2,2 A	4,4 A
Inductance	15 mH	7.5 mH

Mains Coil with Connecting Lead

Coil that is safe to touch with mains connecting lead for use as primary coil in combination with the transformer core D (U8497180). Covered by impact resistant plastic, safe to touch.

U8497200

Pair of Pole Shoes

Pair of pole shoes with conical ends for generating a highly non uniform magnetic field when fitted onto the U shaped core of the transformer core D (U8497180). Provided with holes for optical experiments in a magnetic field.

Pole shoe: approx. 40x40 mm²
Weight: approx. 1.7 kg

U8497210

U Core

U shaped transformer core D (U8497180).

U8497181

Pair of Clamps

Pair of clamps from the transformer core D (U8497180).

U8497331

Set of 20 Nails for Nail Fusing Experiment

20 nails for experiments involving fusing using high current coil (U8497406).

U8497320

High Current Coil with Five Turns

Secondary coil for transformer core D (U8497180), generating high voltages which can be used for spot-welding of metal sheets up to 2 mm thick.

Number of turns: 5
Short-circuit current: approx. 260 A
Coil diameter: 57 mm
Weight: approx. 650 g

Additionally required:
U8497330 Set of Metal Strips
U8497180 Transformer Core D
U8497420-230 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
U8497420-115 Mains Coil with Connecting Lead (115 V, 50/60 Hz)

U8497330

Set of Metal Strips

Five metal strips used to demonstrate spot welding techniques in conjunction with a coil with 5 turns (U8497320).

Dimensions: 120x10 mm²





U8497470

Metal Ring

Metal ring for performing Thomson's ring experiment in conjunction with the mains coil (U84974020-230 or U84974020-115) and the transformer core D (U8497180).
First the metal ring is fitted around one stem of a U core and allowed to rest on the mains coil. The stem of the U core is extended by the yoke positioned vertically on top of it. When the mains coil is switched on the ring jumps into the air.

Diameter: 55 mm

Additionally required:
U8497180 Transformer Core D
U8497420-230 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
U8497420-115 Mains Coil with Connecting Lead (115 V, 50/60 Hz)

U8497310

Fusion Ring

Circular aluminium channel with insulated handle for demonstrating the principle of induction melting, when used as a secondary coil with the transformer core D (U8497180).

Max. current: approx 1300 A
Internal diameter: approx. 57 mm
Weight: approx. 80 g

Suitable melting materials:
Wood's Alloy, Tin

Additionally required:
U8497180 Transformer Core D
U8497420-230 Mains Coil with Connecting Lead (230 V, 50/60 Hz)
or
U8497420-115 Mains Coil with Connecting Lead (115 V, 50/60 Hz)



U8498112

U8498112

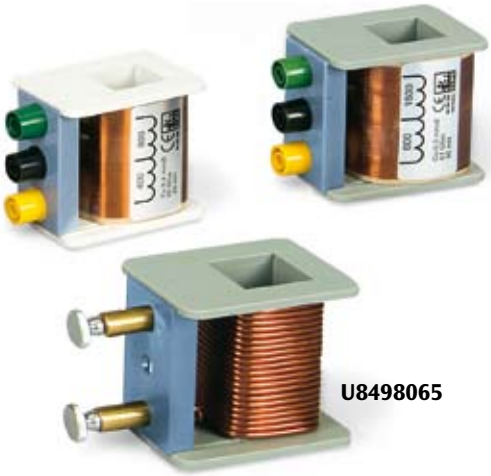
Transformer Core S

U-core with removable yoke made of high quality transformer laminate.

Core cross section:	20x20 mm approx.
U-core:	70x70 mm approx.
Length of yoke:	70 mm approx.



U8498070 - U8498090



U8498065

U8498065

High Current Coil S

Secondary coil for transformer core S (U498112) for generating high current output.

No. of windings: 22

Transformer Coils S

Impact resistant plastic covered coils, safe to touch, for assembling a transformer in conjunction with the transformer core S (U8498112).

Maximum voltage:	50 V (safety extra-low voltage)
Terminals:	4 mm safety sockets
Opening for iron cores:	approx. 20x20 mm²

Art. Nr.	Number of turns	Taps	Inductance
U8498070	600	200/400/600	approx. 6 mH
U8498080	800	400/800	approx. 10 mH
U8498085	1200	400/800/1200	approx. 25 mH
U8498090	2400	800/1600/2400	approx. 100 mH

U8496250

Tesla Transformer

Classic Tesla transformer for the generation of a safe high frequency high voltage starting from approx. 100 kV. The well-conceived, open configuration of all components facilitating demonstration of both design and function. The apparatus is rendered shock proof on account of its extra low voltage operation.

No. of turns in the primary coil:	2 – 10
No. of turns in the secondary coils:	1150
Primary voltage:	20 V AC
Secondary voltage:	>100 kV
Transformer:	approx. 330x200x120 mm³
Secondary coils:	approx. 240 mm x75 mm dia.
Weight:	approx. 3 kg

Contents:

1 Tesla transformer, basic apparatus
1 Hand coil
1 Secondary coil
1 Spherical electrode, short
1 Spherical electrode, long
1 Needle electrode with spray wheel
1 Flourescent tube
1 Reflector

Additionally recommended:
U8496255 Additional Coil for Tesla Transformer



U8496250

U8496255

Additional Coil for Tesla Transformer

Additional secondary coil for Tesla transformer (U8496250).

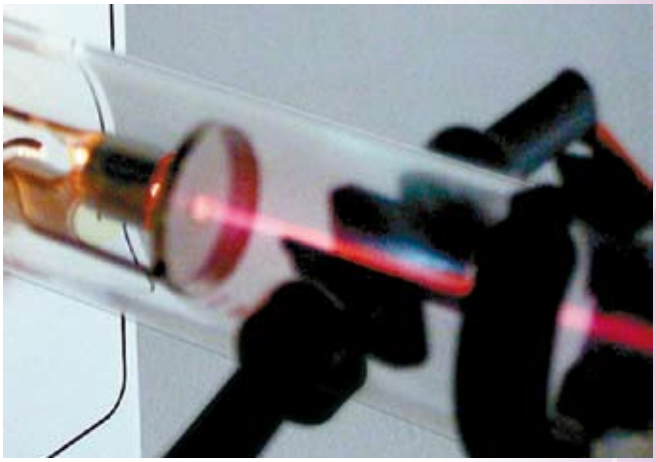
Dimensions: approx. 240 mm x 75 mm dia.



U8496255

Experiment topics:

- **Linear propagation of electrons in a zero-field space**
- **Deflection of electron beams in an electrical field**
- **Deflection of electron beams in a magnetic field**
- **Magnetic lens**
- **Phase displacement, superimposition of magnetic fields, Lissajous figures**
- **Determination of an electron's specific charge**
- **Determination of an electron's speed**



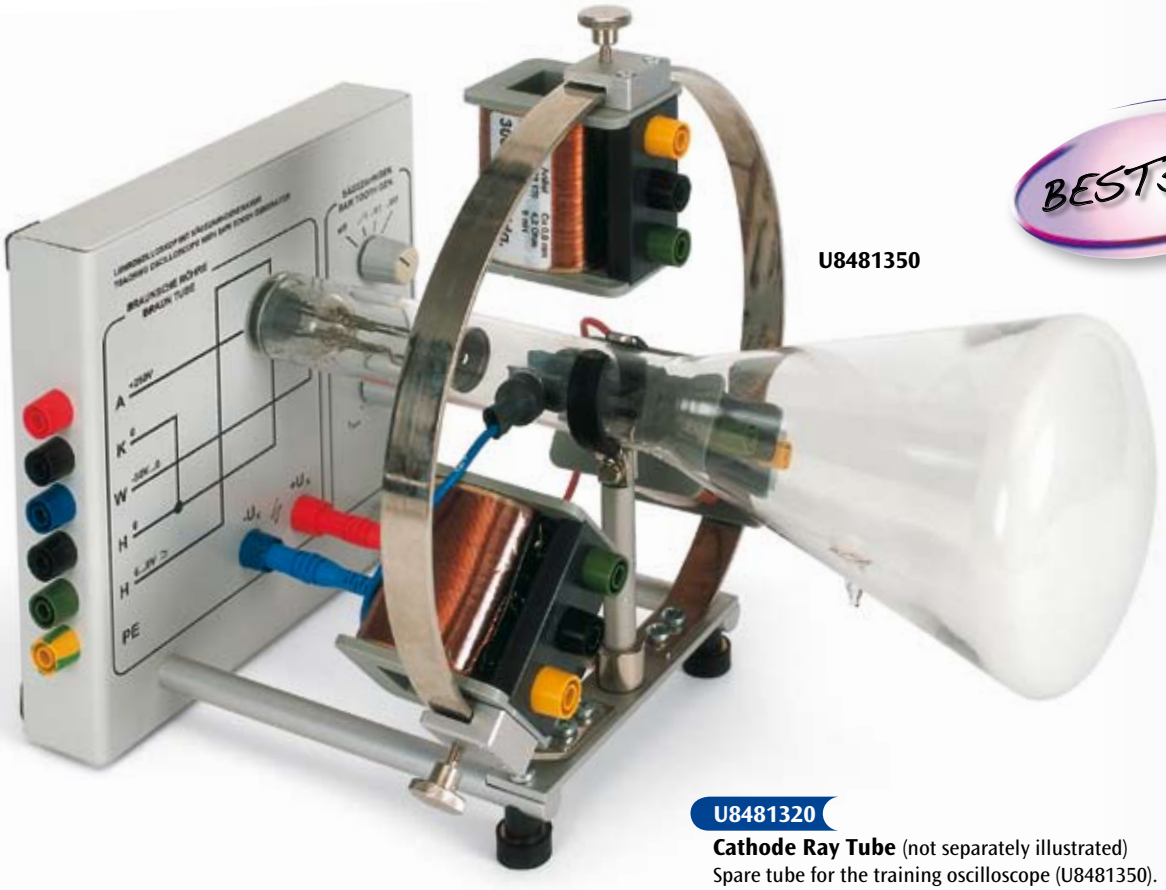
U8481350

Training Oscilloscope

Electron tube mounted on a terminal base for investigating the design and operation of a cathode ray tube. The electron beam can be deflected by an electric field produced by the deflection plates integrated into the tube, and by a magnetic field from three external coils mounted on a ring.
A Wehnelt cylinder is used to focus the beam. The gas filling and the fluorescent screen make it possible to observe the beam in the tube.
A continuously adjustable saw-tooth generator can be used to analyse and visualize time dependent processes. The device comes with a socket and printed wiring diagram.

Anode voltage:	250 – 400 V DC
Anode current:	1 mA
Filament voltage:	6 – 8 V AC/DC
Filament current:	0.3 A
Wehnelt voltage:	0 – 50 V DC
Deflection plate dimensions:	approx. 12x20 mm²
Plate spacing:	approx. 12 mm
Electric deflection sensitivity:	0,2 mm/V
Screen diameter:	approx. 100 mm
Tube length:	approx. 260 mm
Residual gas:	Neon
Gas pressure:	10^{-4} hPa
Sweep frequency:	10 – 200 Hz, continuously adjustable
3 deflection coils:	600 turns each, with a center pickup
Weight:	approx.1.6 kg

Additionally recommended:
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
U21010-230 Function Generator with Interface (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)
U21010-115 Function Generator with Interface (115 V, 50/60 Hz)



U8481350

U8481320

Cathode Ray Tube (not separately illustrated)
Spare tube for the training oscilloscope (U8481350).

Experiment topics:

- Thermionic emission of electrons
- Linear propagation of electrons in field free spaces
- Deflection in magnetic and electric fields
- Determination of the polarity of electron charges
- Determination of specific charge e/m
- Inelastic electron collisions
- Luminescence
- Wave and particle nature of electrons



U191501

U19151

TELTRON® Electron Tubes D

Electron tubes with thermionic cathodes for experimental investigations of the properties of electrons and various topics in atomic physics as well as for applications in standard cathode ray tube technology.
Some electron tubes are operated at voltages up to 500 V, others at high voltages.
During operation at high voltages of up to 5 kV, no ionizing radiation occurs outside the tubes, thus eliminating the need for radiation protection measures.
All the tubes of the D series can be used in the tube holder D (U19100).



U19100

U19100

Tube Holder D

Tube holder made of powder-coated cast aluminium for holding electron tubes of the D series and the optical equivalent (U19172).
With 360o rotating clamp made of heat-resistant plastic and two holes for fixing the Helmholtz coil pair D (U191051). On rubber feet to prevent slipping.

Dimensions:	approx. 340x180x350 mm^3
Weight:	approx. 2 kg

U19151

Triode D

Highly evacuated electron tube with thermionic cathode, control grid and anode for quantitative investigation of controllable high vacuum tubes, plotting the characteristics of a triode, demonstrating the negative polarity of the electron charge, studying the practical applications of a triode as an amplifier and generating undamped oscillations in LC circuits

Max. heater voltage:	7.5 V AC/DC
Max. anode voltage:	500 V
Anode current:	approx. 2 mA at 200 V anode voltage
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 260 mm

Additionally required:
U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

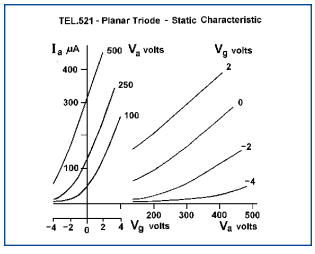
U191501

Diode D

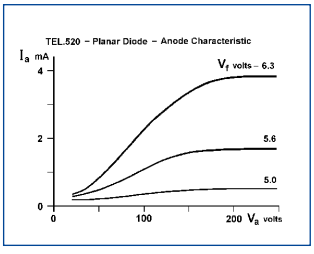
Highly evacuated electron tube with thermionic cathode and anode for investigating the thermoelectric effect (Edison effect) and measuring the emission current as a function of the heating power applied to the cathode. Also for plotting diode characteristics and for demonstrating the rectifying effect of a diode.

Max. heater voltage:	7.5 V AC/DC
Max. Anode voltage:	500 V
Anode current:	approx. 2 mA at 200 V Anode voltage
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 260 mm

Additionally required:
U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)



U19151:
Anode current I_A as a function of the grid voltage U_G and as a function of the anode voltage U_A at different grid voltage U_G



U191501:
Anode current I_A as a function of the anode voltage U_A



U191051



U19157

U191051

Helmholtz Pair of Coils D

Pair of coils for generating a uniform magnetic field perpendicular to the axis of a tube when using the tube holder D (U19100). In plastic sleeve on an insulated stand rod.

Coil diameter:	136 mm
Number of turns:	320 each
Effective resistance:	approx. 6.5 Ω each
Load rating:	1.5 A each
Terminals:	4 mm sockets
Rod:	approx. 145 mm x 8 mm dia.

U19154

Perrin Tube D

Highly evacuated electron tube with focusing electron gun, fluorescent screen, and Faraday cage positioned on one side. For demonstrating the negative polarity of electrons and estimating the specific electron charge (charge-to-mass ratio) e/m by magnetic deflection into the Faraday cage, which is connected to an electroscope (U17250). It is also possible to investigate the deflection of electrons by two magnetic fields at right-angles to each other and to demonstrate the effects, for example by generating Lissajou figures.

Filament voltage:	6.3 V AC
Max. Anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Beam current:	4 µA at 4000V
Glass bulb:	approx. 130 mm dia.
Luminescent screen:	85 mm dia.
Total length:	approx. 250 mm

Additionally required:

U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)

U191051 Helmholtz Pair of Coils D
U33020-230 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Additionally recommended:

U17250 Electroscope
U19106 Auxiliary Coil

U19106

Auxiliary Coil

Extra coil for generating an additional magnetic field in a Perrin tube, for example, to demonstrate the principle of an oscilloscope and for generating Lissajou's figures.

Number of turns:	1000
DC resistance:	approx. 7 Ω
Load rating:	max. 2 A
Connections:	4 mm jacks
Dimensions:	approx. 33 mm x 80 mm dia.

U19157

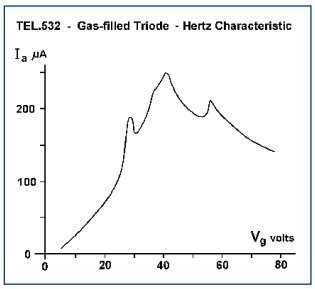
Gas Triode D

Electron tube filled with low pressure helium gas, with thermionic cathode, control grid, and anode for quantitative investigations of the typical properties of a gas-filled triode, recording the I_A - U_A characteristics of a thyratron, observing independent and dependent discharges as well as discontinuous energy release of He atoms during inelastic collisions with free electrons.

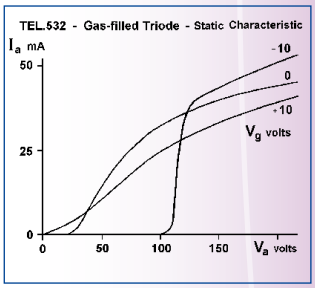
Max. heater voltage:	7.5 V AC/DC
Max. anode voltage:	500 V
Anode current:	approx. 10 mA at 200 V anode voltage
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 260 mm

Additionally required:

U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)



U19157:
Anode current I_A as a function of the anode voltage U_A at different grid voltages U_G



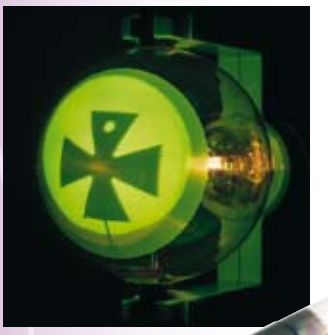
U19157:
Electron collision excitation in Helium as a function of the acceleration voltage U_G

U19106



U19154







U19153



U19155

U19153

Maltese-Cross Tube D

Highly evacuated electron tube with divergent electron gun, fluorescent screen and Maltese cross. For demonstrating the straight line propagation of electrons in the absence of any electric or magnetic field by projecting the shadow of a Maltese cross onto the fluorescent screen and for introducing students to electron optics.

Filament voltage:	6.3 V AC
Max. Anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Glass bulb:	approx. 130 mm dia.
Luminescent screen:	85 mm dia.
Total length:	approx. 260 mm

Additionally required:

U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)

Additionally recommended:

U191051 Helmholtz Pair of Coils D
U33020-230 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

U19155

Electron Deflection Tube D

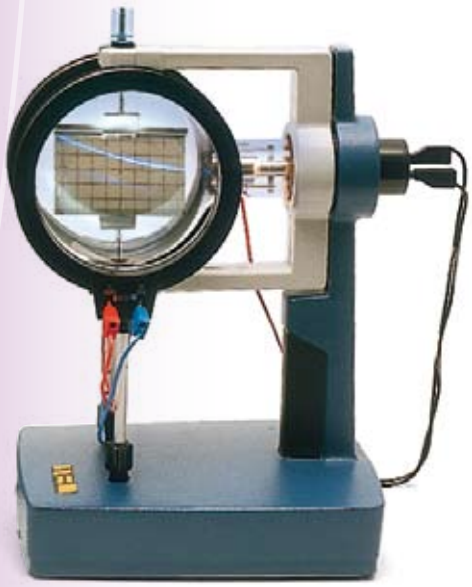
Highly evacuated electron tube with focusing electron gun and fluorescent screen inclined relative to the beam axis, so that the path of the beam can be seen and the effects of electric and magnetic fields can be studied. The electron beam can be deflected electrically in the electric field of the built-in plate capacitor, and magnetically by using the Helmholtz pair of coils D (U191051). By adjusting the electric field so that it cancels the magnetic deflection, it is possible to determine the specific charge e/m and the velocity of the electrons.

Filament voltage:	6.3 V AC
Max. Anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Max. capacitor voltage:	5000 V
Fluorescent screen:	approx. 90x60 mm^2
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 260 mm

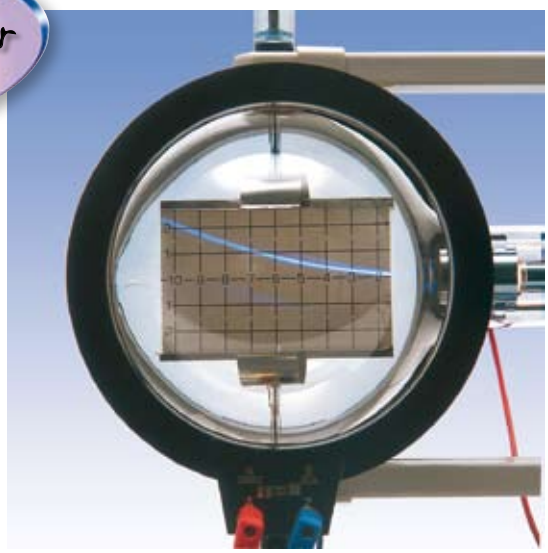
Additionally required:

U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)
U191051 Helmholtz Pair of Coils D

U33020-230 DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)



BESTseller

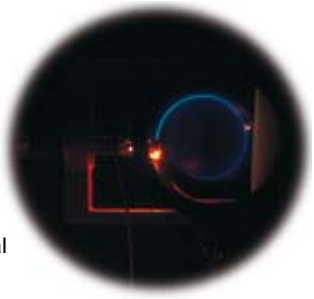


U19155

Deflection of electrons by a magnetic field

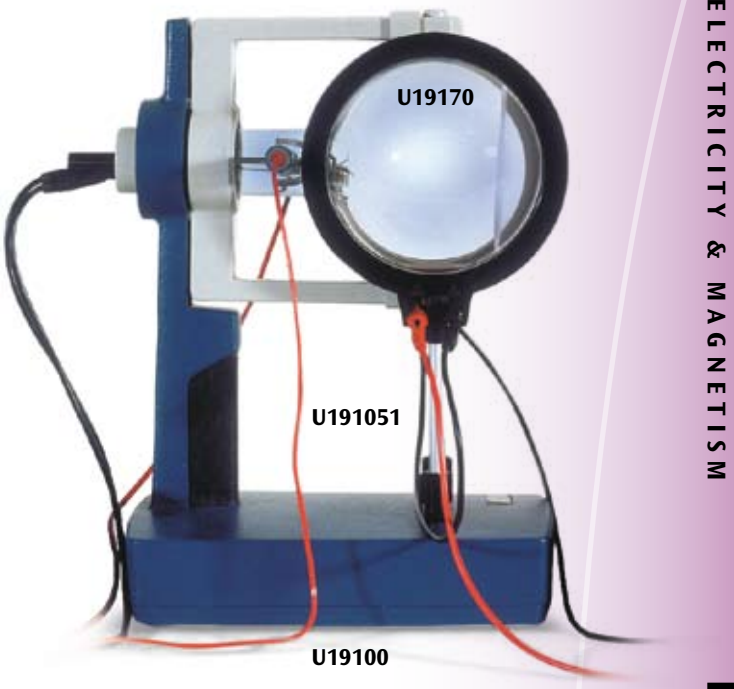
U19170

Dual Beam Tube D



Part evacuated electron tube, filled with helium at low pressure, with tangential and axial electron gun. For determining specific charge e/m from the diameter of the filament beam in the case of tangential bombardment and a perpendicularly aligned mag-netic field, and observing spiral paths of electrons in the case of axial bom-bardment and a co-axial magnetic field.
The electron paths are rendered visible in the form of fine luminescent beams through impact excitation of the helium atoms.

Max. filament voltage:	7,5 V
Max. anode voltage:	300 V DC
Anode current:	approx. 30 mA
Max. deflection voltage:	50 V DC
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 260 mm



Additionally required:
U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U191051 Helmholtz Pair of Coils D
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

U19171

Electron Diffraction Tube D



Highly evacuated electron tube for determining the wavelength of electrons as a function of the anode voltage from the radii of the diffraction rings and the distance between the lattice planes of graphite (Debye-Scherrer-diffraction) and rendered visible on a fluorescent screen. Also intended for determining the wavelengths of monochromatic radiation at different anode voltages from the radii of the diffraction rings and the lattice plane spacing of graphite, as well as confirming de Broglie's hypothesis.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Focussing voltage:	0 – 50 V
Lattice constant of graphite:	d_{10} = 0.213 nm, d_{11} = 0.123 nm

U19171



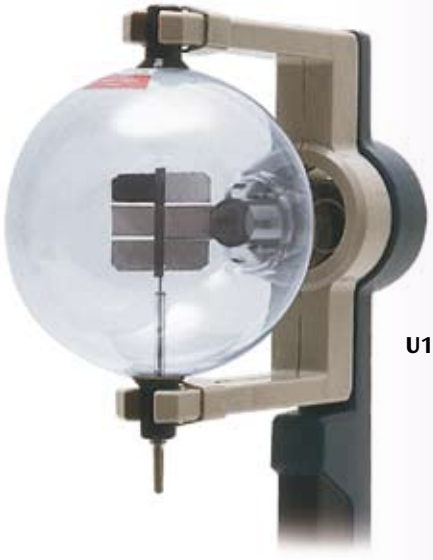
Additionally required:
U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)

U19152

Luminescence Tube D

Highly evacuated electron tube with divergent electron gun and three fluorescent strips in red, green and blue. For demonstrating stimulated light emission during and after electron bombardment.

Filament voltage:	6.3 V AC
Max. Anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 260 mm



U19152

Additionally required:
U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)

Electron Tubes S

Electron tubes with thermionic cathodes for experimental investigations of the properties of electrons and various topics in atomic physics as well as for applications in standard cathode ray tube technology.
Some electron tubes are operated at voltages up to 500 V, others at high voltages.
During operation at high voltages of up to 5 kV, no ionizing radiation occurs outside the tubes, thus eliminating the need for radiation protection measures.
All the tubes of the S series can be used in the tube holder S (U185001).

Experiment topics:

- **Thermionic emission of electrons**
- **Linear propagation of electrons in field free spaces**
- **Deflection in magnetic and electric fields**
- **Determination of the polarity of electron charges**
- **Determination of specific charge e/m**
- **Luminescence**
- **Excitation spectra of noble gases**
- **Inelastic electron collisions**
- **Resolution of primary and secondary quantum numbers of atomic excitation levels**
- **Wave and particle nature of electrons**

U185001

Tube Holder S

Tube holder to support all S series electron tubes for easy and safe operation.
The five pin sockets for the tube are concealed inside the tube holder.
A cathode protection switch is integrated into the tube holder, to protect the heated cathode from excessive voltage. The base plate has a slot for attaching the Helmholtz pair of coils S (U185051).

Terminals :	4 mm safety sockets
Dimensions:	approx. 130x190x250 mm³
Weight:	approx. 570 g



U18551

Triode S

Highly evacuated electron tube with thermionic cathode, control grid and anode for quantitative investigation of controllable high vacuum tubes, plotting the characteristics of a triode, demonstrating the negative polarity of the electron charge, studying the practical applications of a triode as an amplifier and generating undamped oscillations in LC circuits

Max. heater voltage:	7.5 V AC/DC
Max. anode voltage:	500 V
Anode current:	approx. 2 mA at 200 V anode voltage
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 250 mm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

U185051

Helmholtz Pair of Coils S

Pair of coils for generating a uniform magnetic field perpendicular to the axis of a tube when using the demonstration tube holder S (U185001).

Number of turns:	320 each
Coil diameter:	138 mm each
Load rating:	1.0 A (Continuous operation) each
	1.5 A (Short-term operation)
Effective Resistance:	approx. 6,5 Ω each
Terminals:	4 mm safety sockets

U185501

Diode S

Highly evacuated electron tube with thermionic cathode and anode for investigating the thermoelectric effect (Edison effect) and measuring the emission current as a function of the heating power applied to the cathode. Also for plotting diode characteristics and for demonstrating the rectifying effect of a diode.

Max. heater voltage:	7.5 V AC/DC
Max. Anode voltage:	500 V
Anode current:	approx. 2 mA at 200 V Anode voltage
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 250 mm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)





U18557

Gas Triode S

Electron tube filled with low pressure helium gas, with thermionic cathode, control grid, and anode for quantitative investigations of the typical properties of a gas-filled triode, recording the I_A - U_A characteristics of a thyratron, observing independent and dependent discharges as well as discontinuous energy release of He atoms during inelastic collisions with free electrons

Max. heater voltage:	7.5 V AC/DC
Max. anode voltage:	500 V
Anode current:	approx. 10 mA at 200 V anode voltage
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 250 mm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

U18553

Maltese Cross Tube S

Highly evacuated electron tube with divergent electron gun, fluorescent screen and Maltese cross. For demonstrating the straight line propagation of electrons in the absence of any electric or magnetic field by projecting the shadow of a Maltese cross onto the fluorescent screen and for introducing students to electron optics.

Filament voltage:	6.3 V AC
Max. Anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Glass bulb:	approx. 130 mm dia.
Luminescent screen:	approx. 85 mm dia.
Total length:	approx. 250 mm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)

Additionally recommended:
U185051 Helmholtz Pair of Coils S
U33020-230 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

U18552

Luminescence Tube S

Highly evacuated electron tube with divergent electron gun and three fluorescent strips in red, green and blue. For demonstrating stimulated light emission during and after electron bombardment.

Filament voltage:	6.3 V AC
Max. Anode voltage:	5000 V
Anode current:	approx. 0,1 mA at 4000 V
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 250 mm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)

U18554

Perrin Tube S

Highly evacuated electron tube with focusing electron gun, fluorescent screen, and Faraday cage positioned on one side. For demonstrating the negative polarity of electrons and estimating the specific electron charge (charge to mass ratio) e/m by magnetic deflection into the Faraday cage, which is connected to an electroscope (U17250). It is also possible to investigate the deflection of electrons by two magnetic fields at right-angles to each other and to demonstrate the effects, for example by generating Lissajou figures.

Filament voltage:	6.3 V AC
Max. Anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Beam current:	4 µA at 4000V
Glass bulb:	approx. 130 mm dia.
Luminescent screen:	approx. 85 mm dia.
Total length:	approx. 250 mm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)

U185051 Helmholtz Pair of Coils S
U33020-230 DC-Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)
or
U33020-115 DC-Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)

Additionally recommended:
U17250 Electroscope, U19106 Auxiliary Coil

Vissza a tartalomjegyzékhez!

BESTseller



U18555



U18571

U18555

Thomson Tube S

Highly evacuated electron tube with focusing electron gun and fluorescent screen inclined relative to the beam axis, so that the path of the beam can be seen and the effects of electric and magnetic fields can be studied. The electron beam can be deflected electrically in the electric field of the built-in plate capacitor, and magnetically by using the Helmholtz coil pair S (U185051). By adjusting the electric field so that it cancels the magnetic deflection, it is possible to determine the specific charge e/m and the velocity of the electrons.

Filament voltage:	6.3 V AC
Max. Anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Max. Capacitor voltage:	500 V
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 250 mm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)

U185051 Helmholtz Pair of Coils S
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

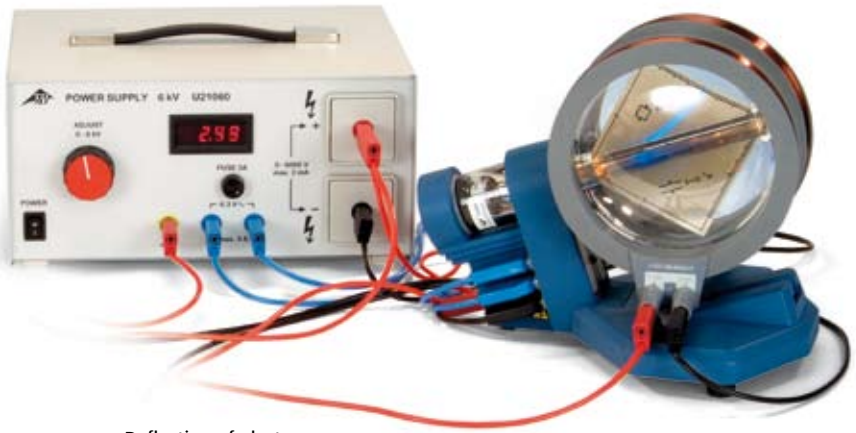
U18571

Electron Diffraction Tube S

Highly evacuated tube for determining the wavelength of electrons as a function of the anode voltage from the radii of the diffraction rings and the distance between the lattice planes of graphite (Debye-Scherrer-diffraction) and rendered visible on a fluorescent screen. Also intended for determining the wavelengths of monochromatic radiation at different anode voltages from the radii of the diffraction rings and the lattice plane spacing of graphite, as well as confirming de Broglie's hypothesis.

Filament voltage:	6.3 V AC
Max. anode voltage:	5000 V
Anode current:	approx. 0.1 mA at 4000 V
Lattice constant of graphite:	d_{10} = 0.213 nm, d_{11} = 0.123 nm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)



Deflection of electrons
by electric and magnetic fields

U18570

Dual Beam Tube S

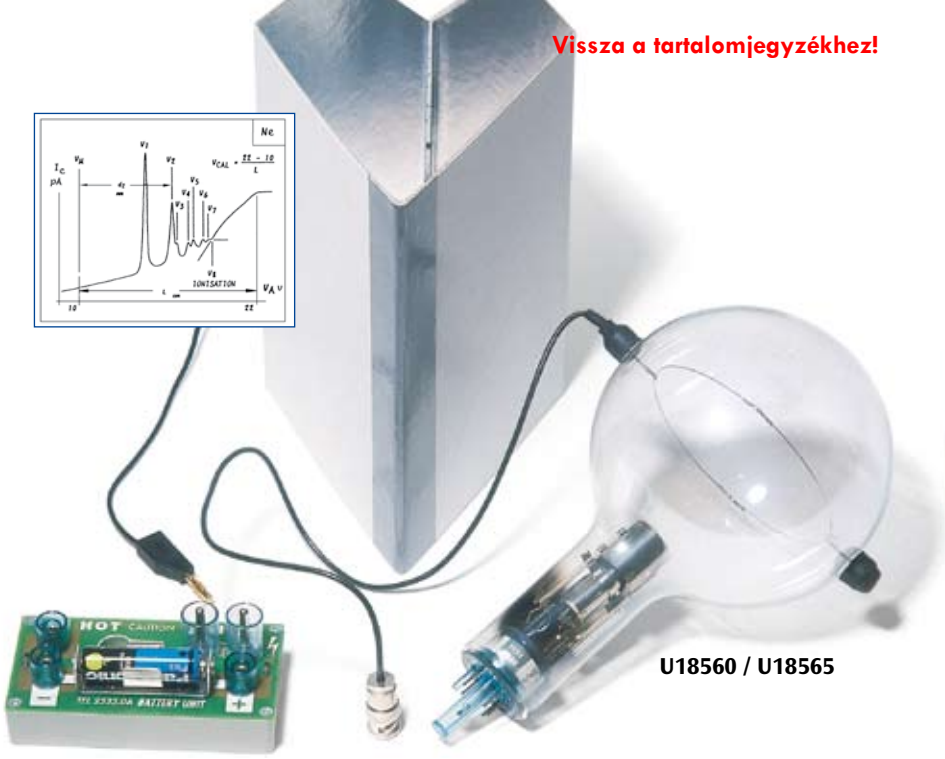
Partly evacuated electron tube, filled with helium at low pressure, with tangential and axial electron gun. For determining specific charge e/m from the diameter of the filament beam in the case of tangential bombardment and a perpendicularly aligned magnetic field, and observing spiral paths of electrons in the case of axial bombardment and a co-axial magnetic field.
The electron paths are rendered visible in the form of fine luminescent beams through impact excitation of the helium atoms.

Max. filament voltage:	7,5 V
Max. anode voltage:	300 V DC
Anode current:	approx. 30 mA
Max. deflection voltage:	50 V DC
Glass bulb:	approx. 130 mm dia.
Total length:	approx. 250 mm

Additionally required:
U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U185051 Helmholtz Pair of Coils S
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)

U18570





U18560 / U18565



U18620

U18650

Critical Potential Tube S

Hertz electron tube for quantitative investigations of inelastic collisions of electrons with inert gas atoms, determination of ionization energy and excitation energies of helium resp. neon, resolution of the energy states of various primary and orbital angular momentum quantum numbers, as well as demonstrating meta-stable states. Includes shielding as well as a discharge tube and battery unit (battery included) for the collector voltage.

Cathode filament voltage:	U_F Ø3 V, I_F Ø1,3 A
Anode voltage:	U_A Ø60 V
Anode current:	I_A Ø10 mA
Collector voltage:	U_c = 1.5 V
Collector current:	I_c Ø200 pA

U18560

Critical Potential Tube S with He Filling

U18565

Critical Potential Tube S with Ne Filling

Additionally required:
U185001 Tube Holder S
U18650 Control Unit for Critical Potential Tubes

U18620

Digital Display with Adjustable Threshold

Digital display device for direct use with the control unit for the critical potential tubes (U18650). A selection of four input channels is available; adjustable lower and upper limiting values can be indicated acoustically. The digital display is supplied with its operating voltage by the host instrument.

Display:	3½ digit, 12.5 mm high
Dimensions:	approx. 105x76 mm²



U18700

U18650

Control Unit for Critical Potential Tubes

Control unit for operating the critical potential tubes. Equipped with an output for sawtooth acceleration voltages; adjustable upper and lower limits of the acceleration voltage. Integrated pico-ammeter amplifier for anode current measurement. Allows recording of the acceleration voltage as a function of the anode current. A slow sawtooth voltage (approx. 6 seconds per cycle) is available with an interface or XY-recorder; a sawtooth voltage with a repetition rate of 20 Hz is available for oscilloscopic observations.
The anode current, acceleration voltage as well as their upper and lower limits can be represented directly in conjunction with the digital display with an adjustable threshold (U18620).

Input:	Anode current measurement via a BNC jack
Outputs:	
Tube	Sawtooth acceleration voltage of 0 to 60 V, 20 Hz
Fast	Voltage signal of 0 to 1 V, proportional to the acceleration voltage, for oscilloscopic observations
Slow	Voltage signal of 0 to 1 V proportional to the acceleration voltage, for recording data with an XY-recorder or interface
Anode current	Voltage signal of 0 to 1 V proportional to the anode current (1 V/nA)
Supply voltage:	12 V DC
Dimensions:	approx. 170x105x45 mm³

Additionally required:
U18700-230 Plug in Power Supply TEL (230 V, 50/60 Hz)
or
U18700-115 Plug in Power Supply TEL (115 V, 50/60 Hz)

Additionally recommended:
U18620 Digital Display with Adjustable Threshold

Plug in Power Supply TEL

Plug in Power supply with an electronically regulated output voltage. Connecting lead with a 6-pole, self locking special plug.

Lead length:	approx. 1 m
Output:	12 VDC, 400 mA

U18700-230

Plug in Power Supply TEL (230 V, 50/60 Hz)

U18700-115

Plug in Power Supply TEL (115 V, 50/60 Hz)



U18580

U18580

Discharge Tube S

Evacuable glass tube with fluorescent screens at both ends for observation of electrical discharges in gases under reduced pressure as well as for investigation of cathode beams and canal rays, which appear at low pressure outside the discharge path.
Demountable design, installation in tube holder (U185001).
Includes a needle ventilation valve and vacuum hoses.

Length:	approx. 280 mm
Polarization voltage:	3 kV
Discharge current:	approx. 1.2 mA
Connections:	4 mm contact pins

Additionally required:
U185001 Tube Holder S
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
U17400-230 Rotary Vane Pump, two stage (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)
U17400-115 Rotary Vane Pump, two stage (115 V, 50/60 Hz)

U14380

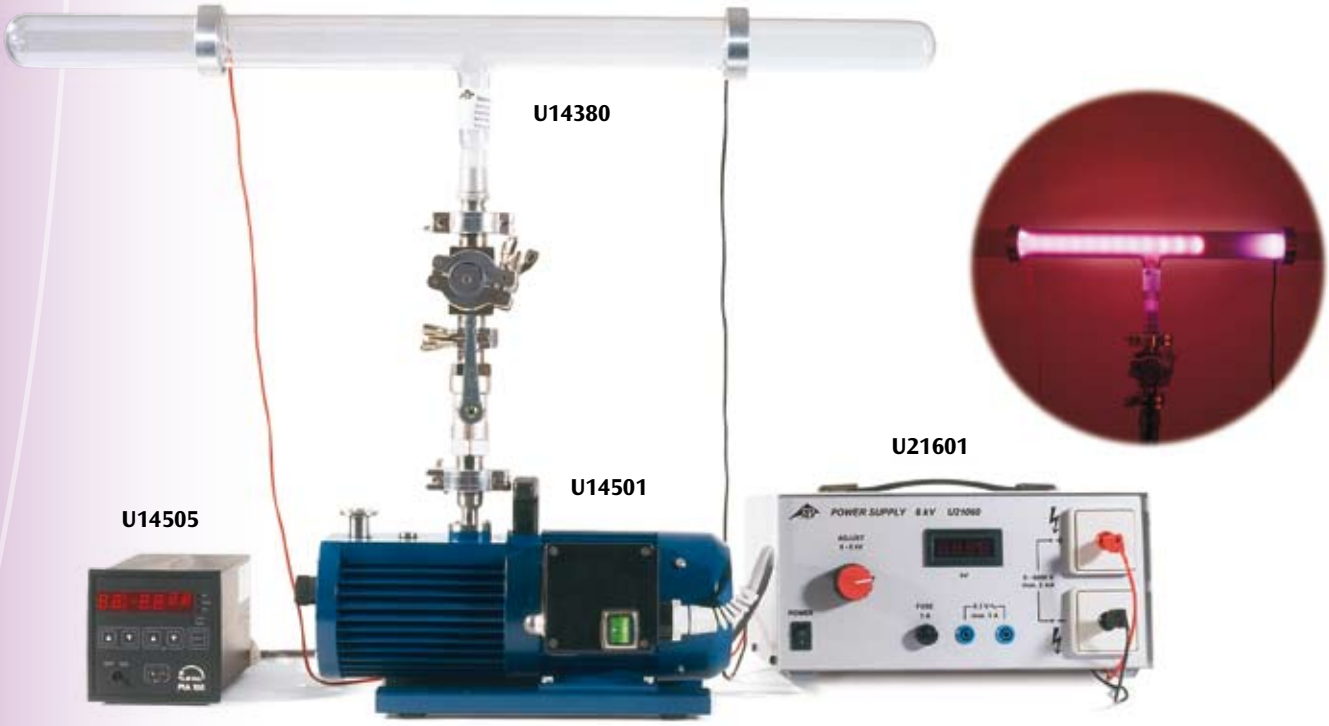
Gas Discharge Tube

Evacuable glass tube for observation of luminous effects of electrical discharges in gases under reduced pressure. Glass tube with graded seal, disc shaped, perforated electrodes and 4 mm jacks for connecting the voltage supply.

Material:	glass
Dimensions:	approx. 700 mm x 40 mm dia.
Vacuum connection:	graded seal NS 19/26

Additionally recommended:
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
U14501-230 Rotary Vane Pump PK 4D (230 V, 50/60 Hz)
U14505-230 Pirani Vacuum Gauge (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)
U14501-115 Rotary Vane Pump PK 4D (115 V, 50/60 Hz
U14505-115 Pirani Vacuum Gauge (115 V, 50/60 Hz)

U14510 2-Way Ball Valve DN 16 KF
U14511 Crosspiece DN 16 KF
U14516 Adapter Flange DN 16 – Core NS 19/26



U14380

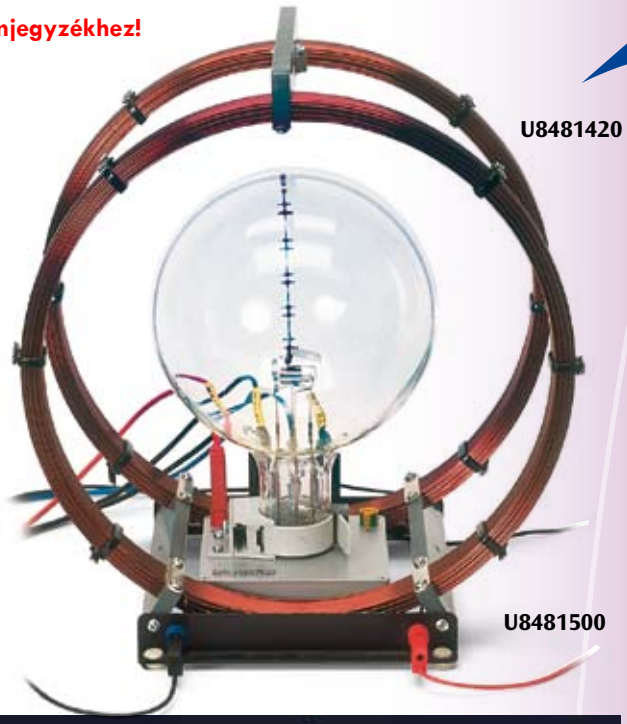
U21601

U14501

U14505

Experiment topics:

- **Deflection of electrons in a closed circular path inside a magnetic field**
- **Determination of specific charge of an electron e/m**





U8481420

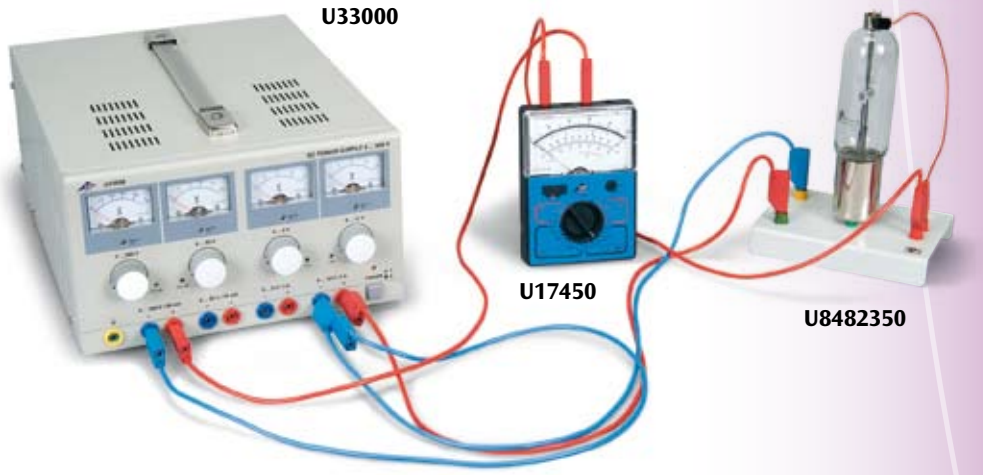
Fine Beam Tube

For examining the deflection of electron beams in a uniform magnetic field using a pair of Helmholtz coils (U8481500) and for the quantitative determination of the specific charge of the electron e/m.
Glass vessel with integrated electron beam system, consisting of an indirectly heated oxide cathode, a Wehnelt cylinder and a perforated anode, in neon residual gas atmosphere with precisely set gas pressure and with integrated measurement marks for parallax-free determination of the diameter of the fine beam.
Gas atoms are ionized along the electron path and produce a sharply defined, visible fluorescent beam. Tube mounted on base with color coded connectors.

Gas filling:	Neon
Gas pressure:	1,3x10-5 hPa
Filament voltage:	4 – 10 V AC/DC
Filament current:	300 – 450 mA
Wehnelt voltage:	0 – -50 V
Anode voltage:	200 – 300 V
Anode current:	<0,3 mA
Circular path diameter:	20 – 120 mm
Division spacing:	approx. 20 mm
Tube diameter:	approx. 160 mm
Dimensions:	approx. 260x115x35 mm³
Weight:	approx. 820 g

Additionally required:
U8481500 Helmholtz Coils

Additionally recommended:
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)



U8482350

Dual Pole Tube

Evacuated electron tube with hot thermionic cathode made of tungsten wire and a cylindrical anode for verification of the Edison effect, demonstration of Richardson's equation and recording the current-voltage characteristic of a vacuum diode. Mounted on connector base with safety sockets.

Cathode surface:	32 mm²
Max. anode voltage:	400 V
Heating voltage:	1.5 – 5.9 V
Heating current:	2 – 5 A
Dimensions of the tube:	approx. 120x45 mm²
Dimensions:	approx. 155x100x160 mm³
Weight:	approx. 440 g

Additionally required:
U33000-230 DC Power Supply, 0 – 500 V (230 V, 50/60 Hz)
or
U33000-115 DC Power Supply, 0 – 500 V (115 V, 50/60 Hz)



U19700

Periodic Table of the Elements, with Electron Configurations

Chart of the periodic table of the elements showing the configurations of electron shells. On canvas screen with two rollers and hanging cord. Bilingual.

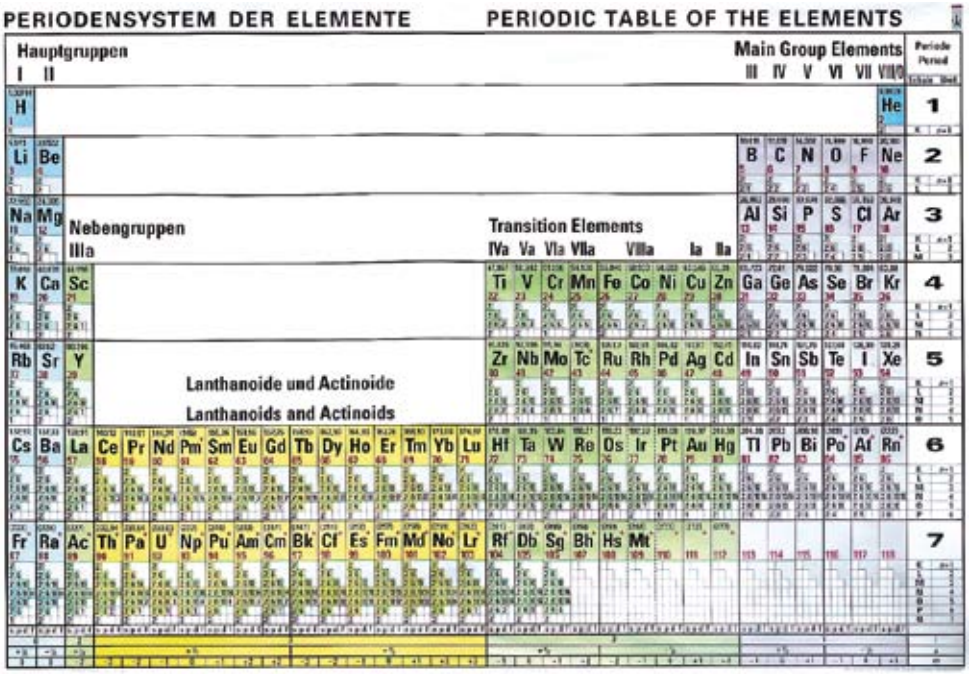
Dimensions:	1950x1390 mm² approx.
Languages:	English and German

U19705

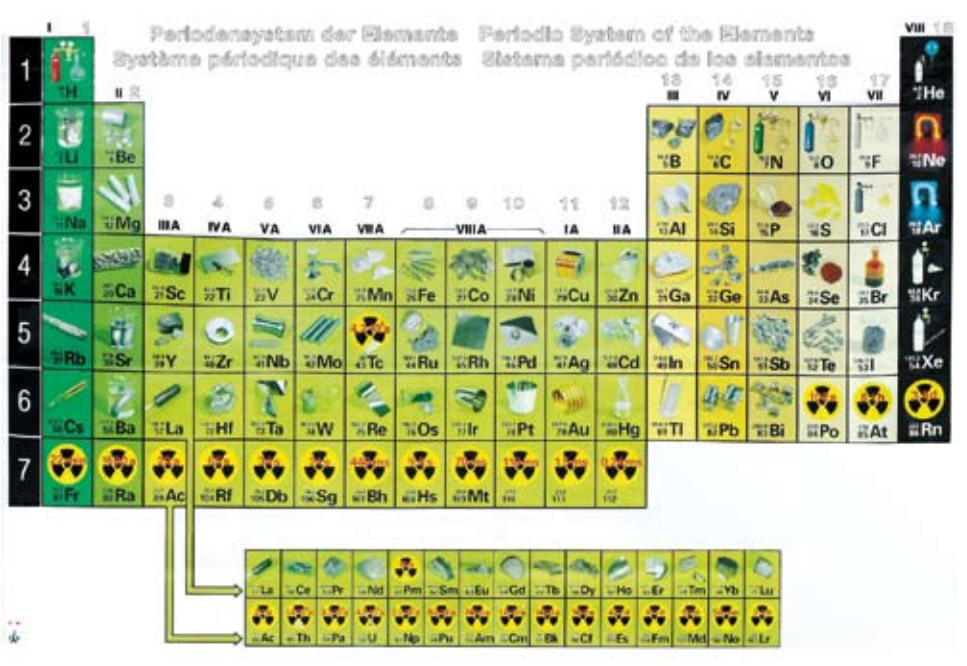
Periodic Table of the Elements, with Pictures

Chart of the periodic table of the elements with pictures of the elements. On canvas screen with rollers and hanging cord. In four languages.

Dimensions:	2290x1530 mm² approx.
Languages:	English, German, French, Spanish



U19700



U19705

Experiment topics:

- **Millikan's experiment**
- **Elementary electric charge**
- **Charged oil droplets in an electric field**
- **Stokes viscous drag, weight, buoyancy**
- **Measurements of the equilibrium voltage and the velocity of fall**
- **Measurements of the velocity of fall, the velocity of rise, and the associated plate voltages**



U13100

U13100

Millikan's Apparatus

Compact apparatus for demonstrating the discrete nature (quantisation) of electric charge and for determining the elementary charge of an electron. The experiment is set up on a height-adjustable tripod and consists of a plate capacitor under a plastic cover, measuring microscope, lighting apparatus and an oil atomiser. Includes a plastic bottle containing oil.

Distance between plates:	6 mm
Plate diameter:	80 mm
Halogen lamp:	12 V / 10 W
Objective magnification:	2x
Eyepiece magnification:	10x
Micrometer range:	10 mm
Scale divisions:	0.1 mm
Connections:	4 mm sockets
Dimensions:	250x300x450 mm³ approx.
Weight:	4.0 kg approx.

Additionally required:

U13105-230 Power Supply for Millikan's Apparatus (230 V, 50/60 Hz)

or

U13105-115 Power Supply for Millikan's Apparatus (115 V, 50/60 Hz)



U13105

Power Supply for Millikan's Apparatus

Operating equipment supplying voltages for the plate capacitor and the halogen lamp used in Millikan's apparatus (U13100). With digital voltage read-out, rotary potentiometer for adjusting voltage, a switch for enabling the two stopwatch outputs for measurements with one stopwatch (falling from equilibrium method) or with two stopwatches (rising and falling method) and a switch for turning the capacitor voltage on and off with simultaneous switching between the two stopwatch outputs. Includes mains-powered supply unit.

Output connections:	4 mm safety sockets
Plate capacitor:	0 – 600 V
Halogen lamp:	12 V / 10 W
Voltage readout:	3-digit, height of numerals: 14 mm
Operating voltage:	12 V, 20 W, from the mains-powered unit that is provided
Dimensions:	190x150x110 mm³ approx.
Weight:	1 kg approx.

U13105-230

Power Supply for Millikan's Apparatus (230 V, 50/60 Hz)

U13105-115

Power Supply for Millikan's Apparatus (115 V, 50/60 Hz)

Additionally recommended:

U21001 Student Timer

U8482410

Vacuum Photocell

Evacuated photocell for demonstrating the photoelectric effect and showing that the emission of electrons increases with increasing light intensity. Mounted ready for use on a base plate with electrical wiring and clamping bar.

Cathode:	Caesium on oxidized silver
Cathode area:	2.4 cm²
Wavelength for maximum sensitivity:	850 nm
Operating voltage:	50 V, max. 250 V
Working resistance:	1 MΩ
Dark current:	<0.05 µA
Sensitivity:	20 µA/lumen
Photoelectric current density:	max. 3.0 µA/cm²

U8482440

Gas Filled Photocell

Gas-filled photocell for demonstrating the photoelectric effect with simple measuring instruments for use by students that also shows how the emission of electrons increases with increasing light intensity. Mounted ready for use on a base plate with electrical wiring and clamping bar.

Cathode:	Caesium on oxidized silver
Cathode area:	2.4 cm²
Wavelength for maximum sensitivity:	850 nm
Operating voltage:	50 V, max. 90 V
Working resistance:	1 MΩ
Dark current:	<0,1 µA
Sensitivity:	125 µA/Lumen
Photoelectric current density:	max. 0,7 µA/cm²

U8482410, U8482440



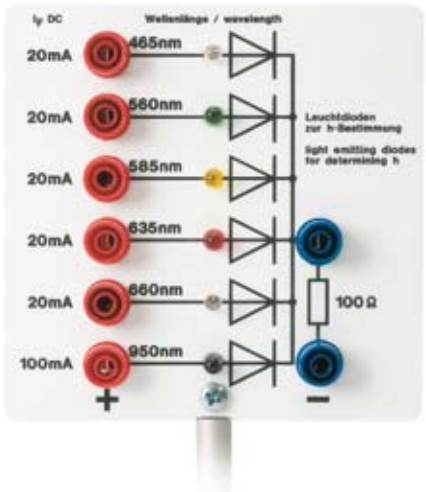
U8482460

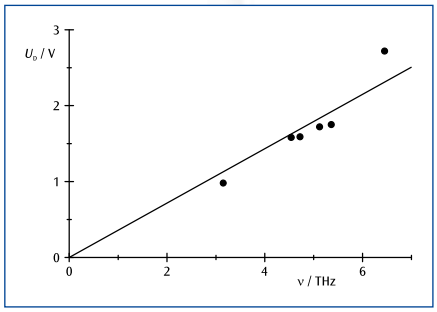
Light Emitting Diodes for Determination of *h*

Mounting plate with six coloured light-emitting diodes with different emission wavelengths for quickly determining Planck's constant *h* by measuring the cut-off voltage as a function of the frequency of the emitted light. Light-emitting diodes with series resistors mounted on a base plate with a stem.

Wavelengths:	480 nm, 560 nm, 590 nm, 635 nm, 655 nm, 950 nm
Series resistor:	100 Ω
Max. voltage:	6 V
Dimensions:	115x115 mm² approx.
Weight:	120 g approx.

U8482460





U8482260

Sodium Fluorescence Tube on Furnace Wall

Highly evacuated glass tube containing several times distilled sodium for demonstrating the resonance fluorescence of sodium vapour. Filled with argon. The entire tube emits yellow light at the wavelength of the sodium D line when it is brought to the heated state and illuminated with sodium spectral light. If it is instead illuminated with white incandescent filament light, the transmitted light exhibits a dark absorption line at the position of the sodium D line.

Dimensions of tube:	170 mm x 42 mm dia.
Dimensions of hotplate:	230x160 mm2 approx.
Weight:	550 g approx.

Additionally required:

U8482190-230 Heating Chamber (230 V, 50/60 Hz)
or
U8482190-115 Heating Chamber (115 V, 50/60 Hz)

Additionally recommended:

U11817 Digital Thermometer, Single Channel
U11854 Immersible Temperature Sensor, NiCr-Ni, Type K, -65°C to 550°C
U8472660 Hand Held Spectroscope with Amici Prism
U8476840 Sodium Vapour Spectrum Lamp
U21905-230 Choke for Spectrum Lamps (230 V, 50/60 Hz)
or
U21905-115 Choke for Spectrum Lamps (115 V, 50/60 Hz)

Heating Chamber

Electric heating chamber with thermostat. In lacquered metal housing with two viewing windows, opening with spring-clip for thermometer and thermally insulated carrying handle.

Dimensions of front opening:	230x160 mm² approx.
Heating power:	400 W
Temperature range:	160 – 240°C
Temperature constancy:	±5°C
Dimensions:	160x150x240 mm³ approx.
Weight:	3.5 kg approx.

U8482190-230

Heating chamber (230 V, 50/60 Hz)

U8482190-115

Heating chamber (115 V, 50/60 Hz)

U8482260



U8482190

U18571

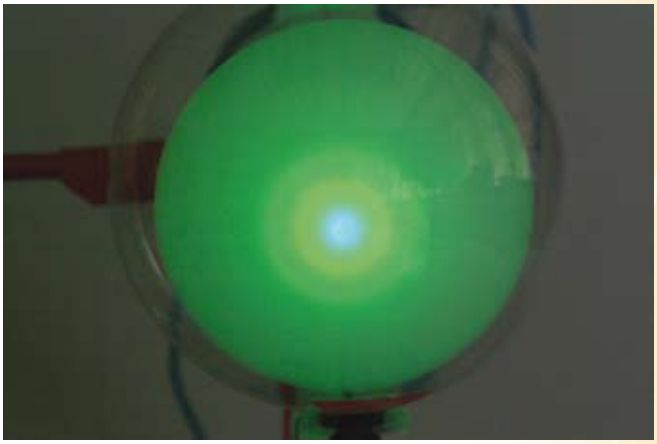
Electron Diffraction Tube S

Highly evacuated electron tube for determining the wavelength of electrons as a function of the anode voltage from the radii of the diffraction rings and the distance between the lattice planes of graphite (Debye-Scherrer-diffraction) and rendered visible on a fluorescent screen. Also intended for determining the wavelengths of monochromatic radiation at different anode voltages from the radii of the diffraction rings and the lattice plane spacing of graphite, as well as confirming de Broglie's hypothesis.

Filament voltage:	$U_F \leq 7$ V, $I_F \leq 0.4$ A
Anode voltage:	$U_A \leq 5$ kV
Anodenstrom:	approx. $I_A = 0{,}1$ mA at $U_A = 4{,}0$ kV
Lattice constant of graphite:	$d_{10} = 0{,}213$ nm, $d_{11} = 0{,}123$ nm

Additionally required:

U185001 Tube Holder S
U138021 Set of 15 Safety Experiment Leads, 75 cm
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)





U18571

U19171

Electron Diffraction Tube D

Highly evacuated electron tube for determining the wavelength of electrons as a function of the anode voltage from the radii of the diffraction rings and the distance between the lattice planes of graphite (Debye-Scherrer-diffraction) and rendered visible on a fluorescent screen. Also intended for determining the wavelengths of monochromatic radiation at different anode voltages from the radii of the diffraction rings and the lattice plane spacing of graphite, as well as confirming de Broglie's hypothesis.

Filament voltage:	$U_F \leq 7$ V, $I_F \leq 0.4$ A
Anode voltage:	$U_A \leq 5$ kV
Anode current:	approx. $I_A = 0{,}1$ mA at $U_A = 4{,}0$ kV
Focussing voltage:	$U \leq 50$ V
Lattice constant of graphite:	$d_{10} = 0{,}213$ nm, $d_{11} = 0{,}123$ nm

Additionally required:

U19100 Tube Holder D
U138101 Set of Leads for Electron Tube Experiments
U210601-230 High Voltage Power Supply, 6 kV (230 V, 50/60 Hz)
or
U210601-115 High Voltage Power Supply, 6 kV (115 V, 50/60 Hz)



U19171

U19172

Optical Equivalent to Debye-Scherrer Interference

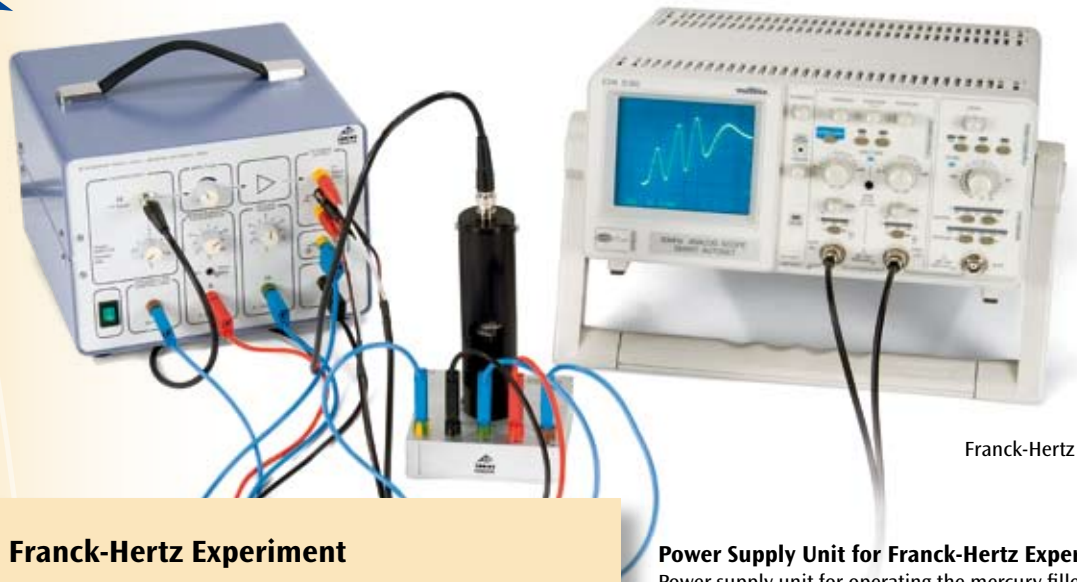
Aluminium disc with ball bearing mounted optical lattice grating for illustrating the principle of Debye-Scherrer interference using visible light. The rotating lattice grating serves as a model for the polycrystalline graphite lattice in the electron diffraction tube. Includes an aperture and red and green colour filters.

Cross lattice:	20 grid points/mm, 3 mm dia.
Flywheel:	100 mm dia.
Pinhole aperture:	1 mm dia.
Aperture frame:	approx. 50x50 mm²
Filter:	approx. 80x100 mm²



U19172

Vissza a tartalomjegyzékhez!



Franck-Hertz experiment with neon

Franck-Hertz Experiment

The quantization of energy and the generation, recording and evaluation of spectra, along with the experimental verification thereof, is included in most of the curricula used around the world. The well known experiment first performed by Franck and Hertz in 1913 is critically important in terms of demonstrating discrete energy states in atoms.

Power Supply Unit for Franck-Hertz Experiment

Power supply unit for operating the mercury filled Franck-Hertz tube (U8482150-230 or U8482150-115) and the neon filled Franck-Hertz tube (U8482220). The equipment provides all the voltages needed to power the tubes and includes a sensitive built-in DC amplifier for measuring collector current.
The accelerating voltage can be either adjusted manually or derived from the supply unit as a continuously varying voltage. Additional measuring inputs are also available for the anode current and accelerating voltage.

Filament voltage:	4 – 12 V, continuously adjustable
Control voltage:	9 V / 10 mA
Accelerating voltage:	0 – 80 V
Modes of operation:	manually adjusted, continuously varied
Countervoltage:	1.2 – 10 V, continuously adjustable
Output A for collector current *I*:	$I = U_A * 7$ nA/V (0 – 12 V)
Output B for accelerating voltage *U*:	$U = U_B * 10$
Outputs:	4 mm safety sockets
Input:	BNC socket
Dimensions:	160x132x210 mm³ approx.
Weight:	2.4 kg approx.



U8482130

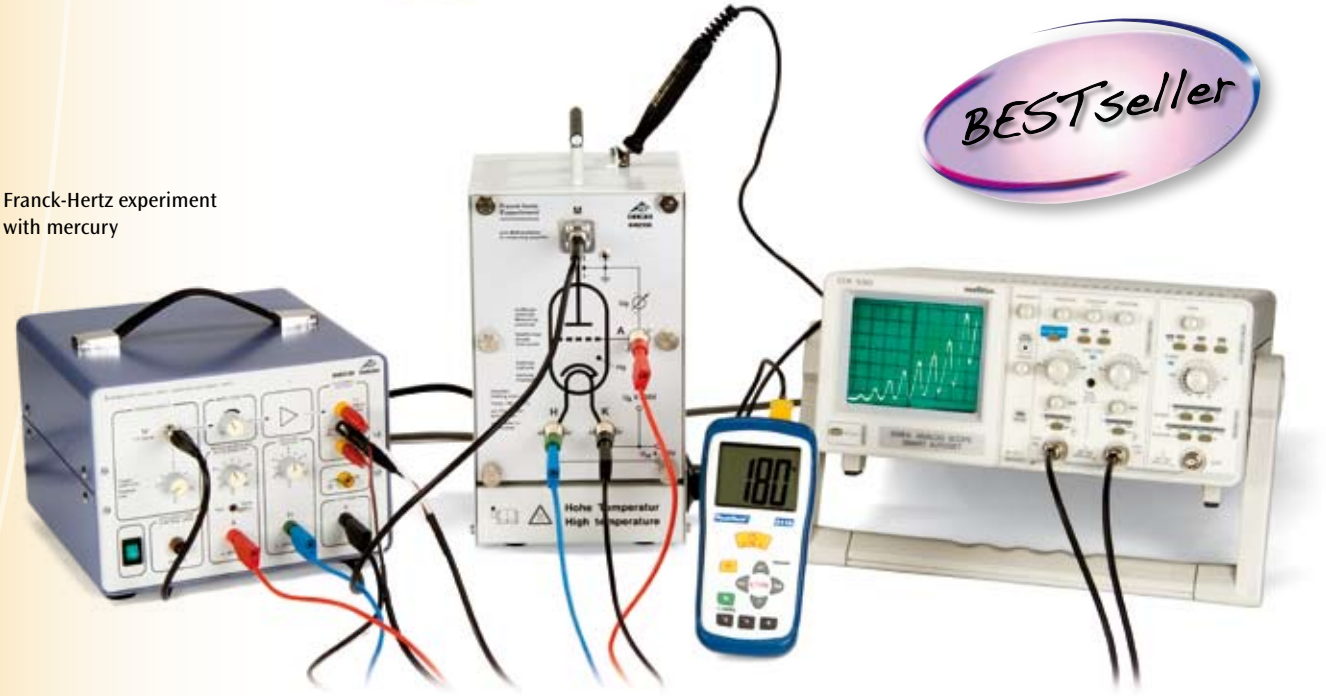
U8482130-230

Power Supply Unit for Franck-Hertz Experiment (230 V, 50/60 Hz)

U8482130-115

Power Supply Unit for Franck-Hertz Experiment (115 V, 50/60 Hz)

BESTseller



Franck-Hertz experiment with mercury

Franck-Hertz Tube with Mercury Filling and Heating Chamber

Highly evacuated electron tube containing mercury in a heating chamber for demonstrating the discrete nature (quantisation) of the energy released by free electrons in collisions with mercury atoms, and for determining the excitation energy of the mercury resonance line ($6^1S_0 - 6^3P_1$), which is 4.9 eV. The electron tube must be heated in the chamber to generate the necessary mercury vapour pressure to achieve a sufficiently high probability of collisions between electrons and mercury atoms.
Electron tube with a plane parallel electrode system consisting of an indirectly heated oxide cathode with aperture, a grid and a collecting electrode. Front plate with printed tube symbol visible from a distance.
Electric heating chamber with thermostat. In lacquered metal housing with two observation windows, opening with spring clip for thermometer, and thermally insulated carrying handle.

Heater voltage:	4 – 12 V
Grid voltage:	0 – 70 V
Suppressor voltage:	1.5 V approx.
Tube dimensions:	130 mm x 26 mm dia. approx.
Heater output:	400 W
Temperature range:	160° – 240° C
Temperature constancy:	±5° C approx.
Overall dimensions:	240x160x150 mm³ approx.
Weight:	4 kg approx.

U8482150-230

Franck-Hertz Tube with Mercury Filling and Heating Chamber (230 V, 50/60 Hz)

U8482150-115

Franck-Hertz Tube with Mercury Filling and Heating Chamber (115 V, 50/60 Hz)

Additionally recommended:

U8482130-230 Power Supply Unit for Franck-Hertz Experiment (230 V, 50/60 Hz)

or

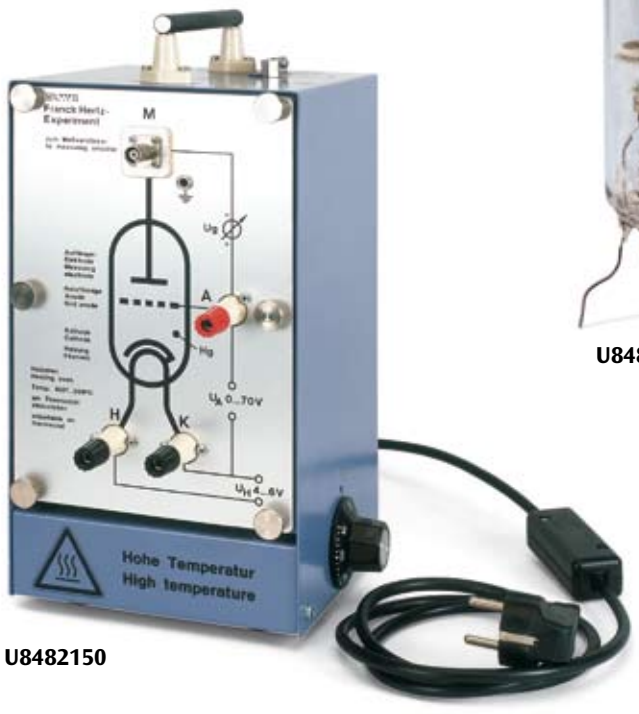
U8482130-115 Power Supply Unit for Franck-Hertz Experiment (115 V, 50/60 Hz)

U11175 Analogue Oscilloscope 2x30 MHz

U8451204 Thermometer -10°C – 200°C

or

U11817 Digital Thermometer, Single Channel
U11854 Immersible Temperature Sensor, NiCr-Ni, Type K, -65°C – 550°C



U8482150

U8482220

Franck-Hertz Tube with Neon Filling

Highly evacuated electron tube containing neon, mounted on a base with socket connection for demonstrating that free electrons colliding with neon atoms emit energy in quantized packets and for determining the excitation energy of the $^3P_0$ or $^3S_1$ states at about 19 eV. When excited, these states emit visible light due to the energy drop from intermediate levels to a ground state at an excitation energy of about 16.7 eV. The light so emitted is in the red-yellow region of the spectrum. Parallel bands of light are formed between the control grid and the accelerator grid and can be observed through a window. The Franck-Hertz neon tube can be operated at room temperature.
Tetrode with indirectly heated cathode, mesh control grid, mesh accelerating grid and collector (counter) electrode. Mounted on a base with color coded connection sockets.

Filament voltage:	4 – 8 V
Control voltage:	9 V
Accelerating voltage:	max. 80 V
Countervoltage:	1.2 – 10 V
Tube:	130 mm x 26 mm dia. approx
Base with connector sockets:	190x115x115 mm³ approx.
Weight:	450 g approx.

Additionally recommended:

U8482130-230 Power Supply Unit for Franck-Hertz Experiment (230 V, 50/60 Hz)

or

U8482130-115 Power Supply Unit for Franck-Hertz Experiment (115 V, 50/60 Hz)

U11175 Analogue Oscilloscope 2x30 MHz





U8482220



U8482170



U8482240

Replacement Tubes for Frank-Hertz Experiment

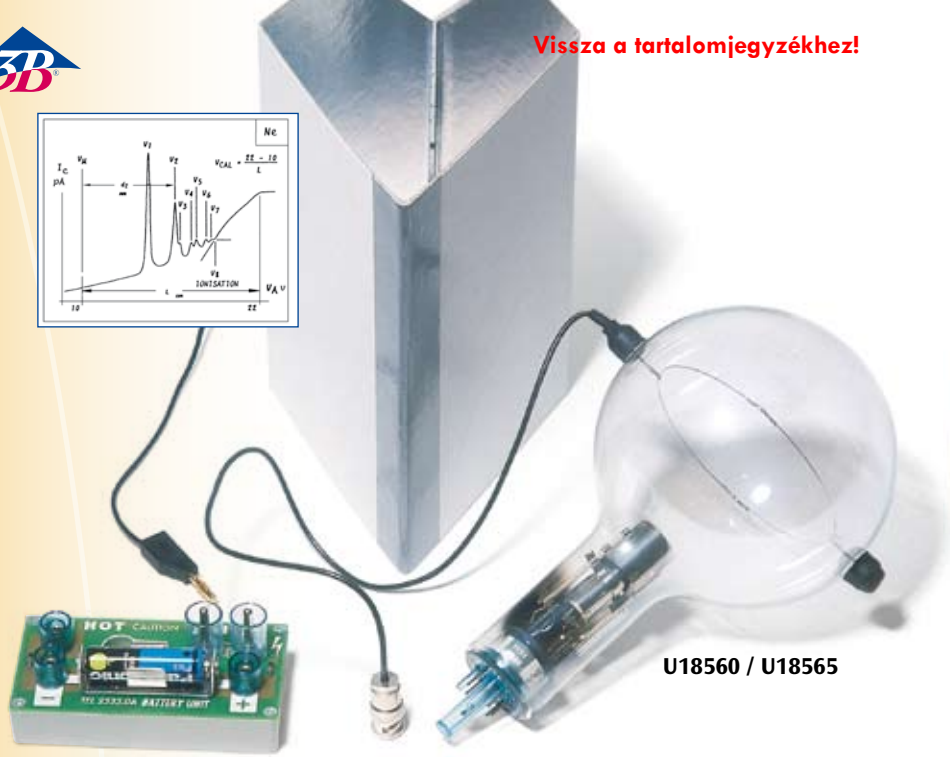
U8482170

Franck-Hertz Tube with Hg

U8482240

Franck-Hertz Tube with Ne

Vissza a tartalomjegyzékhez!



U18620



U18650

U18560 / U18565

Critical Potential Tube S
Hertz electron tube for quantitative investigations of inelastic collisions of electrons with inert gas atoms, determination of ionization energy and excitation energies of helium resp. neon, resolution of the energy states of various primary and orbital angular-momentum quantum numbers, as well as demonstrating meta stable states. Includes shielding as well as a discharge tube and battery unit (battery included) for the collector voltage.

Cathode filament voltage:	$U_F \leq 3$ V, $I_F \leq 1{,}3$ A
Anode voltage:	$U_A \leq 60$ V
Anode current:	$I_A \leq 10$ mA
Collector voltage:	$U_C = 1{,}5$ V
Collector current:	$I_c \leq 200$ pA

U18560

Critical Potential Tube S with He Filling

U18565

Critical Potential Tube S with Ne Filling

Additionally required:
U185001 Tube Holder S
U18650 Control Unit for Critical Potential Tubes

U18620

Digital Display with Adjustable Threshold
Digital display device for direct use with the control unit for the critical potential tubes (U18650). A selection of four input channels is available; adjustable lower and upper limiting values can be indicated acoustically. The digital display is supplied with its operating voltage by the host instrument.

Display:	3½ digit, 12.5 mm high
Dimensions:	approx. 105x76 mm²



U18700

U18650

Control Unit for Critical Potential Tubes
Control unit for operating the critical potential tubes. Equipped with an output for sawtooth acceleration voltages; adjustable upper and lower limits of the acceleration voltage. Integrated pico-ammeter amplifier for anode current measurement. Allows recording of the acceleration voltage as a function of the anode current. A slow sawtooth voltage (approx. 6 seconds per cycle) is available with an interface or XY-recorder; a sawtooth voltage with a repetition rate of 20 Hz is available for oscilloscopic observations.
The anode current, acceleration voltage as well as their upper and lower limits can be represented directly in conjunction with the digital display with an adjustable threshold (U18620).

Input:	Anode current measurement via a BNC jack
Outputs:	
Tube	Sawtooth acceleration voltage of 0 – 60 V, 20 Hz
Fast	Voltage signal of 0 – 1 V, proportional to the acceleration voltage, for oscilloscopic observations
Slow	Voltage signal of 0 – 1 V, proportional to the acceleration Voltage, for recording data with an XY-recorder or interface
Anode current	Voltage signal of 0 – 1 V, proportional to the anode current (1 V/nA)
Supply voltage:	12 V DC
Dimensions:	approx. 170x105x45 mm³

Additionally required:
U18700-230 Plug in Power Supply TEL (230 V, 50/60 Hz)
or
U18700-115 Plug in Power Supply TEL (115 V, 50/60 Hz)

Additionally recommended:
U18620 Digital Display with Adjustable Threshold

Plug in Power Supply TEL
Plug in Power supply with an electronically regulated output voltage. Connecting lead with a 6-pole, self locking special plug.

Lead length:	approx. 1 m
Output:	12 VDC, 400 mA

U18700-230

U18700-230 Plug in Power Supply TEL (230 V, 50/60 Hz)

U18700-115

U18700-115 Plug in Power Supply TEL (115 V, 50/60 Hz)

U13111

Undoped Germanium on Printed Circuit Board

Interchangeable board with an undoped germanium crystal for investigating the conductivity of undoped germanium as a function of temperature. With contacts for transverse current, integrated resistive heating element with temperature sensor directly under the crystal, and multi pin plug for connecting the circuit board to the basic Hall effect apparatus (U13114).

Crystal dimensions: 20x10x1 mm³ approx.
Overall dimensions: 100x100x10 mm³ approx.
Weight: 200 g approx.

Additionally required:
U13114 Hall Effect Basic Apparatus

Experiment topics:

- **Extrinsic conductivity**
- **Intrinsic conductivity**
- **Mobility of electrons and holes**
- **Drift velocity of charge carriers**
- **Carrier concentration**
- **Band separation**



U13114

U13112

P-Doped Germanium on Printed Circuit Board

Interchangeable board with an p-doped germanium crystal for investigating the conductivity and Hall potential for p-doped germanium as a function of temperature. With contacts for transverse current and Hall potential, integrated resistive heating element with temperature sensor directly under the crystal and multi pin plug for connecting the circuit board to the basic Hall effect apparatus (U13114).

Crystal dimensions: 20x10x1 mm³ approx.
Overall dimensions: 100x100x10 mm³ approx.
Weight: 200 g approx.

Additionally required:
U13114 Hall Effect Basic Apparatus

U13113

N-Doped Germanium on Printed Circuit Board

Interchangeable board with an n-doped germanium crystal for investigating the conductivity and Hall potential for n-doped germanium as a function of temperature. With contacts for transverse current and Hall potential, integrated resistive heating element with temperature sensor directly under the crystal, and multi pin plug for connecting the circuit board to the basic Hall effect apparatus (U13114).

Crystal dimensions: 20x10x1 mm³ approx.
Overall dimensions: 100x100x10 mm³ approx.
Weight: 200 g approx.

Additionally required:
U13114 Hall Effect Basic Apparatus

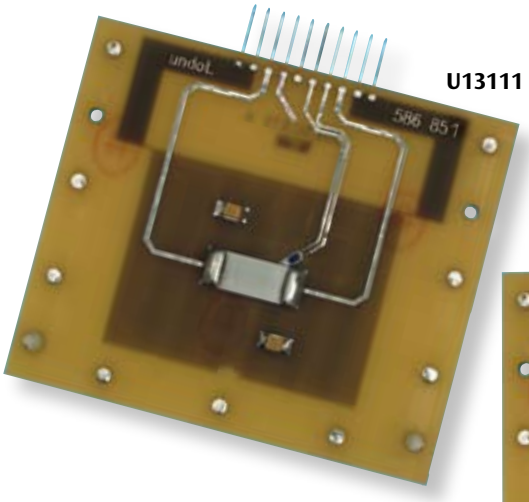
U13114

Hall Effect Basic Apparatus

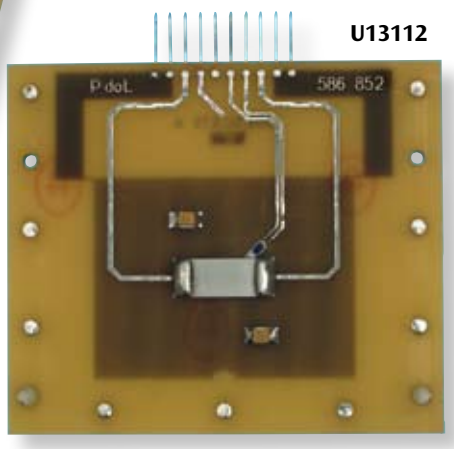
Basic apparatus for attaching contacts and supplying voltages to germanium crystals on printed circuit boards (U13111 - U13113) for experiments on the measurement of Hall potentials and conductivities at different temperatures. With stem for setting up the apparatus between the pole-shoes of the transformer assembly kit. With integrated adjustable constant-current source, amplifier for temperature measurement, automatic heater cut out to protect the crystal, and compensation circuit with matching and cut out functions for offset voltages.

Heater voltage: 15 V DC, 2 – 4 A
Constant-current source: 12 V DC, 40 mA
Output signals: Hall potential, temperature, voltage drop across crystal
Connections: 4 mm safety sockets
Dimensions: 150x250x50 mm³ approx.
Weight: 0.5 kg approx.

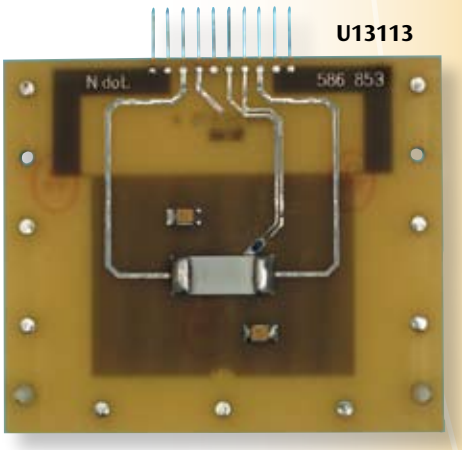
Additionally required:
U8497210 U-Shaped Core
U8497200 Pair of Pole-Shoes
U8497181 Pair of Clamps
U8497430 Coil with 600 Turns (2x)
U33020-230 DC Power Supply 0–20 V, 0–5 A (230 V, 50/60 Hz) (2x)
U8521121-230 DC Power Supply 1.5 – 15 V, 1.5 A (230 V, 50/60 Hz)
or
U33020-115 DC Power Supply 0–20 V, 0–5 A (115 V, 50/60 Hz) (2x)
U8521121-115 DC Power Supply 1.5 – 15 V, 1.5 A (115 V, 50/60 Hz)



U13111



U13112

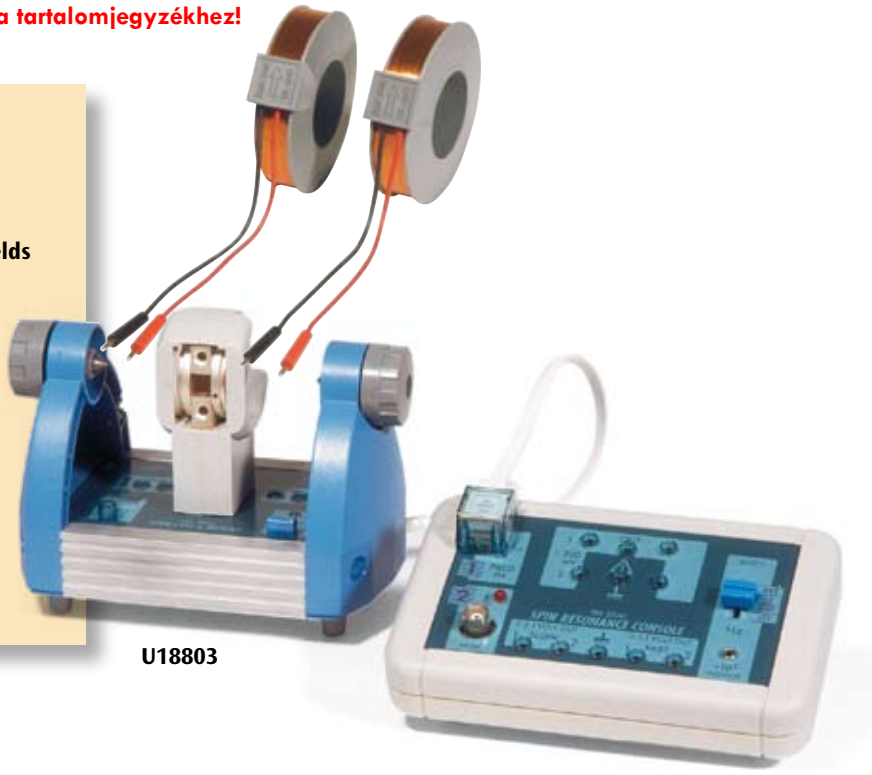


U13113

Vissza a tartalomjegyzékhez!

Experimental topics:

- **Resonance absorption of a high-frequency oscillating circuit**
- **Dependence of resonance frequency on magnetic fields**
- **Line width**
- **Electron spin**
- **Magnetic moment of an electron**
- **Determination of the electron g factor**
- **Proton spin**
- **Magnetic moment of a proton and nucleus**
- **Determination of the nucleus g factor**
- **Nuclear-spin tomography**



U18803

U18803

Basic Equipment Set for ESR/NMR

This basic equipment set is intended for investigating the electron spin resonance (ESR) of an unpaired electron of a DPPH sample as well as the nuclear magnetic resonance (NMR) of glycerin, teflon and polystyrene. Resonances are observed via transitions induced through high frequencies resulting from changes in the external magnetic field. Resonance absorption curves can be represented with an oscilloscope, XY recorder or interface.

The control panel for ESR/NMR provides all the required supply voltages and high frequencies, and amplifies and processes the signals needed for observation of the results.

Analogue input:	BNC jack for connecting the ESR/NMR sample heads
Output “Fast”:	voltage signals of 0 – 1 V proportional to the coil current and resonance signal for oscilloscopic observations via 4 mm jacks
Output “Slow”:	voltage signals of 0 – 1 V proportional to the coil current and resonance signal for recording data with an XY recorder or interface via 4 mm jacks
Frequencies:	45 MHz, 60 MHz, 75 MHz approx. (ESR) 13 MHz approx. (NMR)
Digital output:	BNC jack for frequency measurement, 1:1000 scaling
Connection for basic unit:	Multi pin socket
Dimensions:	170x105x45 mm^3 approx.
Weight:	0.4 kg approx.

The **basic ESR/NMR Unit** can accommodate measuring probes (from U18850 or U18902) together with coils and a permanent magnet (from U18902). Includes an integrated saw-tooth current source for driving the coil pair and an acoustic signal generator for producing a sound volume proportional to the intensity of the resonance signal. The base unit is controlled by the ESR/NMR control console.

Saw-tooth current generator:	0 – 250 mA, fast mode: 50 ms, slow mode: 25 s
Connections for coil pair:	2 mm sockets
Connections for control unit:	Multi pin plug
Dimensions:	165x105x135 mm^3 approx.
Weight:	1.25 kg approx.

The coil pair is used to generate the variable magnetic field for electron spin resonance and – in conjunction with the permanent magnet (from U18902) – nuclear spin resonance.

Magnetic flux density:	0 – 3,7 mT
Connection:	2 mm plugs
Dimensions:	20 mm x 74 mm dia. approx. each
Weight:	0.2 kg approx. each

Contents:

1 Control panel for ESR/NMR
1 Basic unit for ESR/NMR
1 Pair of coils
1 HF cable with jack plug/BNC plug

Additionally required:

U18700-230 Plug in Power Supply TEL (230 V, 50/60 Hz) (2x)
or
U18700-115 Plug in Power Supply TEL (115 V, 50/60 Hz) (2x)

Additionally recommended:

U11175 Analogue Oscilloscope, 2x30 MHz
U21005-230 Digital Counter (230 V, 50/60 Hz)
or
U21005-115 Digital Counter (115 V, 50/60 Hz)



U18700

Plug in Power Supply TEL

Plug-in power supply with an electronically regulated output voltage. Connecting lead with a 6 pole, self locking special plug.
Lead length: 100 cm
Output: 12 V DC, 400 mA

U18700-230

Plug in Power Supply TEL (230 V, 50/60 Hz)

U18700-115

Plug in Power Supply TEL (115 V, 50/60 Hz)

U18902

Equipment Set for NMR

Apparatus for experiments on nuclear magnetic resonance using three different samples. Consists of an NMR probe-head with radio frequency coil, a permanent magnet giving a highly uniform field, a sample of glycerine, a sample of polystyrene, a sample of Teflon, an empty sample tube for comparison and two mounting discs.

Frequencies:	13 MHz approx., adjusted via ESR/NMR control console (from U18803)
Sensitivity adjustment:	Via helical potentiometer
Frequency adjustment:	Via helical potentiometer
Connection to the probe-head:	Coaxial cable with BNC plug
Magnetic flux density:	300 mT approx.



U18902



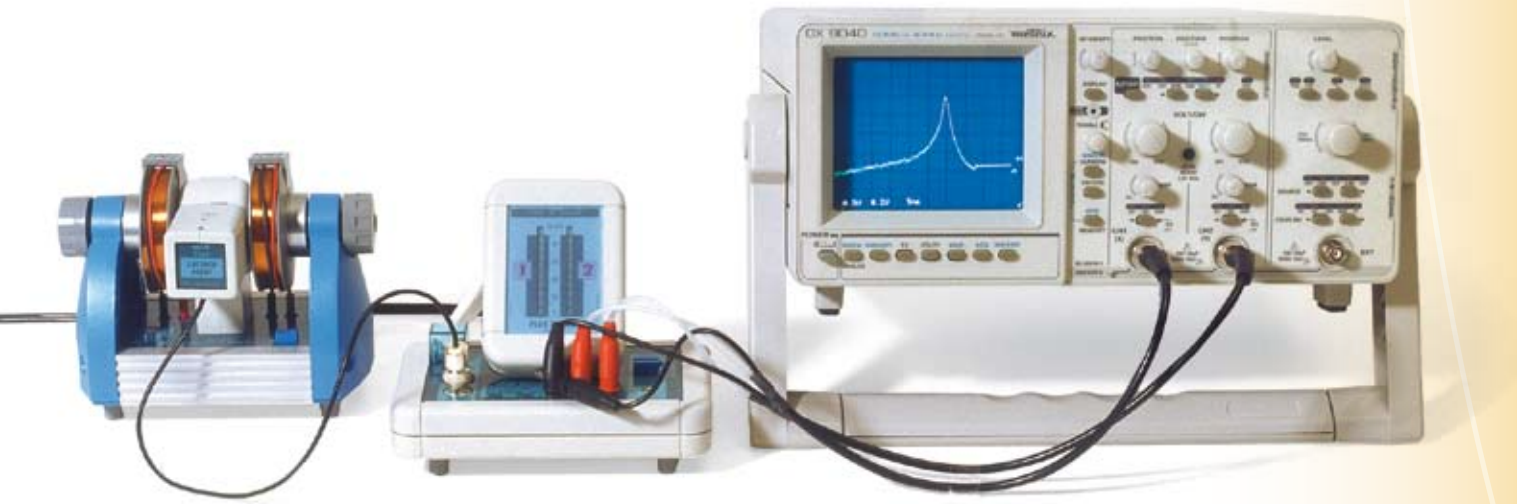
U18850

U18850

Equipment Set for ESR

Apparatus for experiments on electron spin resonance using DPPH. Consists of an ESR probe-head with radio frequency coil, a sample of DPPH (diphenyl picryl hydrazyl), an empty sample tube for comparison, two mounting rings, and two mounting cylinders.

Frequencies:	45 MHz, 60 MHz, 75 MHz approx., adjusted via ESR/NMR control console (from U18803)
Sensitivity adjustment:	Via helical potentiometer
Frequency adjustment:	Via helical potentiometer
Connection to the probe-head:	Coaxial cable with BNC plug



U111511

Geiger Counter

Versatile, easy to use and compact precision instrument for measuring α-, β- and γ-radiation. With filter selection switch at the front of the Geiger-Müller counter tube for filtering out types of radiation (γ/β, γ/α/β or γ only), large display and integrated USB interface. Including USB cable, Windows software, and operating instructions.

The following functions and operating modes are available for measurement:

- Standard mode for displaying the current radiation level. Display of the equivalent dose as a numerical value and as bar chart and display of the time until a selected cumulative dose limit is reached (default 5 µSv/h). Also equipped with variable acoustic and optical warning threshold signal and display of average radiation from previous day.
- Pulse counting either permanent or with variable gate time. Gate time adjustable in seconds, minute or hours. Additional optional acoustic count indication.
- Count rate measurement. The pulses registered are measured successively and converted into a count rate (number of pulses per second).
- Integrated display of date and time for correct recording of measured radiation.
- The number of pulses registered is stored in the internal memory. This facilitates recording e.g. of weekly values for up to 10 years.
- Computer docking station. The software enables the measured data to be evaluated and processed on an MS-Windows PC.

Radiation types:	α from 4 MeV, β from 0.2 MeV, γ from 0.02 MeV
Measured variables:	equivalent dose in Sv/h, mSv/h, µSv/h pulses/s, pulses/variable time interval
Display:	LCD, 4 digit, numerical with display of measured variable, quasi analogue bar chart, operating mode indicators
Radiation detector:	End window Geiger-Müller counter tube, stainless steel housing with neon-halogen filling
Measuring length:	38.1 mm
Measuring diameter:	9.1 mm
Mica window:	1.5 – 2 mg/cm²
Gamma sensitivity:	114 pulses/min for ^{60}Co radiation = 1 µSv/h in background radiation energy band
Background rate:	10 pulses per minute approx.
Internal memory:	2 kilobytes
Battery life:	10 years approx.
Dimensions:	163x72x30 mm³ approx.
Weight:	155 g approx.

U8533430

Geiger-Müller Counter Tube

Self-quenching halogen pulse ionisation chamber for detecting alpha, beta, gamma and x-ray radiation. In metal housing with mica window, removable mounting clamp with shaft. Long plateau length.

Filling:	Neon/argon mixture, halogen as quenching agent
Cathode dimensions:	approx. 39x14 mm²
Window:	mica, 9 mm dia.
Mass per unit area:	1.5 – 2.0 mg/cm²
Plateau length:	400 V – 600 V
Operating voltage:	400 – 600 V (recommended: 500 V)
Relative plateau slope:	0.04 %/V
Dead time:	90 µs
Limiting resistor:	10 MΩ, integrated in holder
Shaft:	approx. 100 mm x 10 mm dia.
Dimensions counter tube:	approx. 85 mm x 25 mm dia.
Weight:	approx. 160 g

Additionally required:

U11255 HF Patch Cord, 1 m

U8533341-230 Digital Counter (230 V, 50/60 Hz)

or

U8533341-115 Digital Counter (115 V, 50/60 Hz)

Digital Counter

Digital counter/timer for measuring duration of motion, transition times, periods, pendulum periods and frequencies, as well as for counting events or Geiger tube pulses. Includes a speaker that can be turned on and off, power supplies for direct connection to light barriers (U11365) or for powering a Geiger-Müller counter (U8533430). For event counting, a fixed counting period can be programmed in a range from 1 s to 99999 s. Counter events (start, stop) can either be triggered by a signal to the input sockets or manually via switches. Includes plug-in power supply.

Time measurement:	0.1 ms – 99999 s
Resolution:	0.1 ms / 1 ms / 0.1 s
Frequency measurement:	1 – 100 kHz, where voltage > 1.5 V_{pp}
Resolution:	1 mHz (1 – 100 Hz), 1 Hz (1 – 100 kHz)
Counting periods:	1/10/60/100 s or manually triggered
Input A:	miniDIN 8 socket, 4-mm safety sockets
Input B:	miniDIN 8 socket, 4-mm safety sockets
Input voltage A:	0.5 V – 15 V AC
Input voltage B:	1 V – 15 V AC
Active edge	Rising/falling
Counter tube input:	BNC socket
Power supply:	550 V / 1 MΩ
Display:	5-digit LED display
Operating voltage:	9 – 12 V DC via plug-in power supply
Dimensions:	250x100x160 mm³ approx.
Weight:	0.8 kg approx.

U8533341-230

Digital Counter (230 V, 50/60 MHz)

U8533341-115

Digital Counter (115 V, 50/60 MHz)





U8483212

Isotope Generator, ^{137}Cs/^{137}Ba-m

^{137}Cs preparation for demonstrating the law of radioactive decay by generating small quantities of a solution with short lived radioactivity. Includes 250 ml of elution solution.
The isotope generator contains about 370 kBq of ^{137}Cs as a long lived radioactive mother isotope. This decays with the emission of β-radiation to form the metastable state ^{137}Ba-m, which decays with a half-life of about 2.5 min to the ground state of the isotope ^{137}Ba. By elution of the daughter substance ^{137}Ba-m from the isotope generator it is possible to obtain a solution with this short lived radioactivity, the activity of which demonstrates the law of radioactive decay.

Number of possible elution cycles:	>1000
Elution time:	30 s approx.
Design license:	Nds. 151/90, valid until 20.11.2010

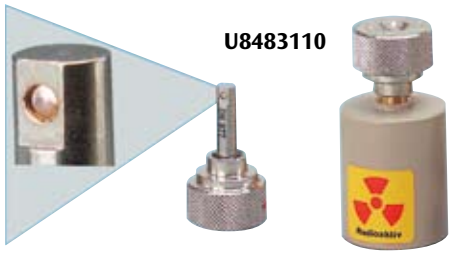
Additionally required:
U8483213 Elution Solution, 250 ml

Important Note:
In accordance with radiation protection regulations, anyone who works with radioactive materials or ionising radiation or plans to do so has the following obligations:

- Avoid unnecessary exposure to radiation or contamination of persons or of the environment.
- Ensure that any unavoidable exposure to radiation or contamination of persons or of the environment is below the limits specified by the regulations and is reduced to the minimum that is possible with present science and technology, taking into account all the circumstances of the case.



U8483212



U8483110





U8483219 U8483218

U8483213

Elution Solution, 250 ml
(not illustrated)
250 ml of elution solution for the ^{137}Cs/ ^{137}Ba-m isotope generator (U8483212).

U8483218

Warning Notice: „Radioactive“
Warning notice on white plastic. On stem.
Dimensions: 210x300 mm² approx.
Weight: 80 g approx.

U8483110

Radiation Cartridge, ^{226}Ra, 3.7 kBq
Regulation-exempt radiation source with lead container for shielding. Radium sulphate rolled in gold foil and sealed at one end of a stainless steel cartridge.
Activity: 3.7 kBq
Weight: 400 g approx.

U8483219

Steel Safe for Radioactive Materials
Steel safe for theft proof storage of radioactive materials in accordance with radiation protection requirements.
Dimensions: 140x300x350 mm³ approx.
Weight: 3 kg approx.

U8483220

Cloud Chamber
Expansion cloud chamber for observing the paths of α-rays.
Cover and sidewall are of plexiglas. With threaded hole for inserting the ^{226}Ra, 3.7 kBq radiation cartridge (U8483110), hinged absorption foil for opening and closing the beam outlet and carrying handle at the side.
By compressing the attached rubber ball and then allowing it to expand, a supersaturated methanol-water mixture is produced in the cloud chamber. Following that, the paths of the α-rays revealed by droplet formation are visible for 1 – 2 seconds in the light of an optical lamp.

Additionally required:
U8483110 Radiation Cartridge, ^{226}Ra, 3,7 kBq



U8483220



U8482490

U8482490

Spinthariscope
Expansion cloud chamber for observing the paths of α-rays.
Cover and sidewall are of plexiglas. With threaded hole for inserting the ^{226}Ra, 3.7 kBq radiation cartridge (U8483110), hinged absorption foil for opening and closing the beam outlet and carrying handle at the side.
By compressing the attached rubber ball and then allowing it to expand, a supersaturated methanol-water mixture is produced in the cloud chamber. Following that, the paths of the α-rays revealed by droplet formation are visible for 1 – 2 seconds in the light of an optical lamp.

Additionally required:
U8483110 Radiation Cartridge, ^{226}Ra, 3,7 kBq



U18620



U19203

U19203

Ratemeter

Intended for counting pulses with the Geiger-Müller tube (U19201). With an adjustable Geiger-Müller-tube voltage, adjustable measuring ranges and gate times as well as a connectable, acoustic signal generator. An additional current input allows, for example, measurement of the emission current of the tube of the X-ray apparatus (U19200). In conjunction with the digital display with an adjustable threshold (U18620), it is possible to directly display the output signals, counter-tube voltage, count rates and current.

G-M tube connection:	via a BNC jack
Voltage supply for the G-M tube:	250 V to 500 V, adjustable
Current measurement input:	via a 0 – 200 µA jack, for example, for measuring emission currents from the tube of the X-ray apparatus (U19200)
Ratemeter measurement ranges:	0 to 2000 pulses/s 0 to 20,000 pulses/s
Gate times:	3 s, 15 s, 30 s, 60 s

Additionally required:
U18700-230 Plug-in Power Supply TEL (230 V, 50/60 Hz)
or
U18700-115 Plug-in Power Supply TEL (115 V, 50/60 Hz)

Additionally recommended:
U18620 Digital Display with Adjustable Threshold

U18620

Digital Display with Adjustable Threshold

Digital display device for direct use with the control unit for the critical potential tubes (U18650), pico-ammeter amplifier (U18630), ammeter (U18635) and ratemeter (U19203). A selection of four input channels is available; adjustable lower and upper limiting values can be indicated acoustically. The digital display is supplied with its operating voltage by the host instrument.

Display:	3½-digit, 12.5 mm high
Dimensions:	105x76 mm

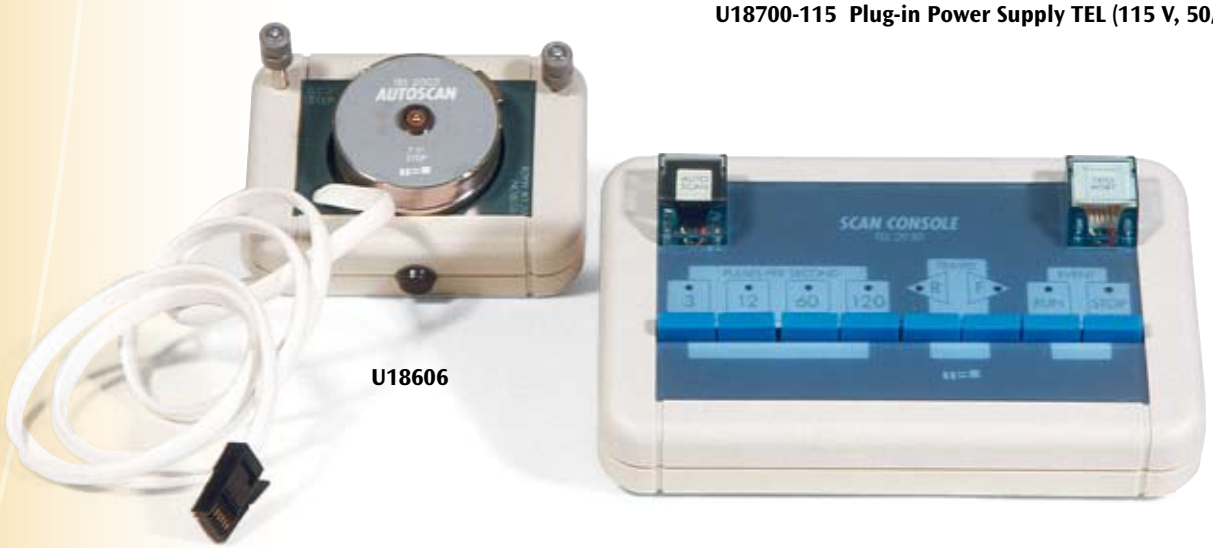
U18606

Stepper Motor with Control Unit

Stepper motor with a gearbox and two drive axles with different reduction ratios; power transmission via a friction drive; control via a scan console. Four adjustable speeds for clockwise and anti-clockwise operation; the speed can be increased to 220 steps/second via an external control. Start and stop keys.
The 6-pole TRIGPORT jack allows all functions to be controlled jointly or individually via external devices; alternatively, this jack can be used as a pulse-output channel for registration. The stepper motor is connected to the control unit via a 6-pole, self-locking plug.

Gearbox reduction:	7.5° or 0.03° in accordance with the gearbox axle
Step rate:	3, 12, 60, 120 steps/second or 220 steps/second via an external trigger
TRIGPORT jack:	for external control / pulse-output channel
Dimensions (stepper motor):	105x76x36 mm
Dimensions (control unit):	170 x105x70 mm

Additionally required:
U18700-230 Plug-in Power Supply TEL (230 V, 50/60 Hz)
or
U18700-115 Plug-in Power Supply TEL (115 V, 50/60 Hz)



U18606

X-Ray Apparatus

The experiment chamber is contained in a closed, radiation-proof housing with a transparent synthetic-glass shield. If the synthetic-glass shield is opened, the high-voltage source for the X-ray tube is deactivated automatically.

The high-vacuum X-ray tube with a directly heated tungsten cathode and copper anode is positioned in a borosilicate glass chamber with a thin-walled, concave ray emission window. A lead-glass hood with a collimator causes X-rays to emerge in parallel with the experiment plane and provides a shield against scattered radiation.

The horizontal counter-tube goniometer consists of a central sample holder and a swiveling arm. In the form of a slide tray, this arm serves as a mount for the Geiger-Müller tube (U19201), ionization chamber (U19208) as well as experimental devices in slide format or on a 5 cm x 5 cm base plate (for example, from U19205, U19206, U19207).

The swiveling arm can be rotated manually independently of the sample holder, or at a fixed mutual angle with a ratio of 2:1, for instance, for experiments involving Bragg's reflection.

The device is equipped with angle and millimeter scales, position markings for experimental devices, as well as radiation-proof bushings for cables and hoses.

Anode voltage:	20/30 kV, switchable and electronically stabilized
Emission current:	0 to 80 µA, continuously adjustable and electronically stabilized
Cathode heating:	4 V, 1 A
Focal spot:	5x1 mm^2
Anode material:	Cu
Lead-glass collimator:	radiation emission aperture with 5-mm dia.
Ray divergence:	better than 10°
Characteristic radiation wavelength:	Cu-K_Θ: 154 pm Cu-K_P: 138 pm

Experiment topics:

- **Properties of X-rays:**
  Transmission
  Linear propagation
  Ionization
  X-ray photography
- **Fluorescent radiation**
- **Shielding of X-rays**
- **Absorption experiments**
- **Distance law**
- **Dosimetry and radiation protection**
- **Diffraction of X-rays:**
  Laue's recordings
  Debye-Scherrer's recordings
  Bragg's reflection
  Duane-Hunt's displacement law (h-determination)
- **Moseley's law**



U19200

Counter-tube goniometer:

Swiveling ranges:	0°, +10° to +130° and -10° to +130° relative to the ray axis
Angular coupling:	independent of the sample holder or with a ratio of 2:1
Measurement accuracy of Bragg's angle:	5 arc minutes
Timer:	0 to 55 minutes, continuously adjustable
Power consumption:	100 VA

Dimensions:

X-Ray apparatus:	approx. 250 mm x 370 mm dia.
X-Ray tube:	approx. 100 mm x 32 mm dia.
Weight:	approx. 9 kg

U192001

X-Ray Apparatus (230 V, 50/60 Hz)

U192001-US

X-Ray Apparatus (115 V, 50/60 Hz)

U19205

Basic Equipment Set for the X-Ray Apparatus

Equipment set for qualitative and quantitative experiments involving, for instance, linear propagation, ionization, penetration capacity of X-radiation and X-ray photography; also for demonstrating the wave nature of X-radiation, investigating fluorescent X-radiation and determining mass-absorption coefficients. In a specially molded storage box.



U19205

Contents:

1 fluorescent screen
1 Debye-Scherrer camera
2 film cassettes
1 lead mask
2 plate electrodes on a 4 mm contact pin
1 slit diaphragm collimator, 1 mm
1 pin diaphragm collimator, 1 mm dia.
1 ancillary magazine with a circular aperture
2 slit diaphragms, 1 mm/3 mm
1 pin diaphragm, 9.5 mm dia.
2 single crystals, LiF, NaCl
2 mini crystals, LiF
1 powder sample, LiF
10 copper wires
4 absorption foils, Ni, Cu, Co, Zn
1 scattering-foil revolver, coated with V, Cr, Mn, Fe, Co, Ni, Cu, Zn
1 set of assembly aids (acetate adhesive, clips)
1 storage box, specially molded

U19207

Radiography Accessories

These accessories for the basic equipment set (U19205) are intended for investigating the following topics: scattering, absorption; dependence on acceleration voltage, emission current and penetration power, resolving power; shielding, half-width; exposure time, non-destructive materials testing.

Contents:

1 Maltese cross
1 phantom
1 pin diaphragm
1 aluminum layer, stepped
5 aluminum absorbers, 0.1/0.25/0.5/1.0/2.0 mm
1 lead absorber, 0.5 mm
1 plastic absorber
2 magnets
4 materials testing models (porosity, fissures, welding seam, painting)

U19207



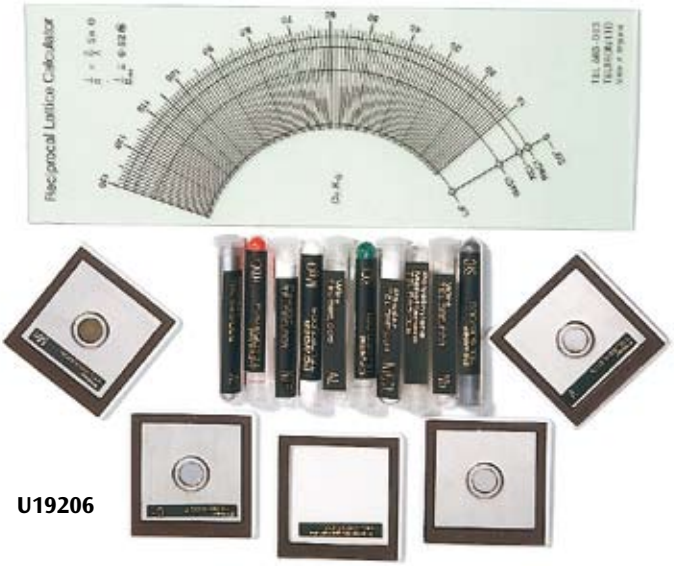
U19206

Crystallography Accessories

These accessories for the basic equipment set (U19205) are intended for additional crystallographic experiments as well as treatments of Moseley's law, the Debye-Scherrer method, Bragg's reflection and material tests.

Contents:

4 foils, Fe, V, Mn, Cr
2 single crystals, KCl, RbCl
5 powder samples, NaF, SiC, NH_4Cl, MgO, Al
2 wire samples, Al, Nb (3x each) for Debye-Scherrer experiments
10 polyethylene threads
1 disc for calculating Bragg's angle



U19206



U19201



U19202

U19201

Geiger-Müller Tube

Self-extinguishing halogen-trigger counter tube for registering Θ-, P-, 6- and X-radiation. Enclosed in a plastic housing with a holder for mounting on the swiveling arm of the X-ray apparatus (U19201); equipped with a firmly installed BNC patch cord.
Includes a retention clip for other types of mounting.

Dose-rate range:	10^{-3} to 10^{2} mGy/h
Mass of the active surface:	mica: 2.0 to 3.0 mg/cm
Operating voltage:	500 V
Dimensions:	50x50x22 mm Ø
Cable length:	1 m

Motor Drive

For structural investigations using the rotating-crystal method, suitable for the Debye-Scherrer camera (contained in U19205). Power transmission via bevel gears.
Power consumption: 3 VA

U19202-230

Motor Drive (230 V, 50/60 Hz)

U19202-115

Motor Drive (115 V, 50/60 Hz)



U19209



U19208

U19209

Filmpack 2

Highly sensitive film (38x35 mm) for Θ-, P- and X-radiation.
Single packaging in opaque plastic cases allows development and fixing in daylight (duration: approx. 6 minutes).

Contents:

20 film sheets (38 mm x 35 mm) in light-tight plastic cases
1 bottle of X-ray developer
1 bottle of X-ray fixer
1 syringe with a cannula for introducing chemicals into the film cases
1 metal clip

U19208

Ionization Chamber

Intended for investigating the ionization of air and other gases brought about by X-radiation at different pressures (saturation characteristics, model of a Geiger-Müller tube, dosimetry). Possesses a cylinder-shaped cathode, rod-anode and hose shaft for evacuating and introducing gases.

Operating voltage:	max. 2 kV
Ionization current:	10^{-11} to 10^{-10} A
Rod-electrode:	75 mm long
Chamber:	85 mm x 25 mm Ø
Hose shaft:	5mm Ø

U19210

Filmpack 4

Like U19209, but consisting of 12 film sheets, 150x12 mm, in light-tight plastic cases for a Debye-Scherrer camera.

Vissza a tartalomjegyzékhez!



U8475430



U13900



U33200

Transformer 12 V, 25 VA
Simple transformer for student exercises. Cast in an impact resistant plastic block, short circuit proof, with two safety plugs.
Output: 12 V AC, max. 2 A
Dimensions: approx. 70x58x60 mm³
Weight: approx. 0.9 kg

U8475430-230
Transformer 12 V, 25 VA (230 V, 50/60 Hz)

U8475430-115
Transformer 12 V, 25 VA (115 V, 50/60 Hz)

Transformer 12 V, 60 VA
Powerful electronic power supply, e.g. for the operation of lamps as used in optics. Short circuit proof, with 2 m lead and two stackable 4 mm safety plugs.
Output: 12 V AC, max. 5 A

U13900-230
Transformer 12 V, 60 VA (230 V, 50/60 Hz)
Dimensions: approx. 100x45x70 mm³

U13900-115
Transformer 12 V, 60 VA (115 V, 50/60 Hz)
Dimensions: approx. 75x45x45 mm³

Plug In Power Supply 24 V, 700 mA
Plug in 24 V power supply for the operation of a Pohl torsion pendulum (U15040). With 2 m lead and two stackable 4 mm safety plugs.
Output: 24 V AC, max. 700 mA

U33200-230
Plug In Power Supply 24 V, 700 mA (230 V, 50/60 Hz)

U33200-115
Plug In Power Supply 24 V, 700 mA (115 V, 50/60 Hz)

U117401-230
Voltage Regulating Transformer (230 V, 50/60 Hz)
High performance voltage regulating transformer with high load capacity and continuously adjustable AC output voltage. Two digital rms displays for current strength and output voltage. Thermally protected against overload with an overcurrent circuit breaker. Output electrically isolated from mains input.
Output: 0 – 260 V AC, max. 3 A
Overload protection: Thermal
Display: 3 digit LCD
Connection: earthed socket outlet
Power: 780 VA
Voltage supply: 230 V ± 10% 50/60 Hz
Dimensions: approx. 250x235x178 mm³
Weight: approx. 20 kg

W10851
Voltage Transformer, 120 V
This device is used to transform a 120 V input signal into a 230 V output signal.
Input: 120 V AC, 50/60 Hz
Output: 230 V AC, 100 W

W10852
Voltage Transformer, 230 V
This device is used to transform a 230 V input signal into a 110 V output signal.
Input: 230 V AC, 50 Hz
Output: 110 V AC, 100 W



U117401



W10851



W10852



U33300

Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A
Extra low voltage power supply with overload protection contained in plastic housing. Output voltage switchable in four stages.

AC output:	3/ 6/ 9/ 12 V, max. 3 A
DC output:	3/ 6/ 9/ 12 V, max. 3 A
Terminals:	4 mm safety sockets
Dimensions:	approx. 210x170x90 mm³
Weight:	approx. 2.6 kg

U33300-230
Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (230 V, 50/60 Hz)

U33300-115
Transformer with Rectifier 3/ 6/ 9/ 12 V, 3 A (115 V, 50/60 Hz)

U11825
Universal Plug In Power Supply
Almost universally deployable plug in power supply unit with 4 pluggable adapters covering the most conventional electric socket systems (Europe, USA, UK etc.) and a 6 part output connector set. Short circuit proof, with an automatic thermal release and overload protection.

Input voltage:	100 – 240 V AC, 50/60 Hz, 20 W
Output voltage:	3.0/ 4.5/ 6.0/ 7.5/ 9.0/ 12.0 V DC, stabilised
Max. output current:	1200 mA DC
Dimensions:	approx. 105x80x60 mm³
Weight:	approx. 75 g

DC Power Supply 1.5 – 15 V, 1.5 A
Handy DC power supply contained in a sturdy metal housing. The output voltage is continuously adjustable and is displayed via an analog measuring instrument. The output is short circuit proof and floating.

Output voltage:	1.5 – 15 V, max. 1.5 A
Output Ripple U:	10 mV
Terminals:	4 mm safety sockets
Dimensions:	approx. 100x80x150 mm³
Weight:	approx. 2 kg

U8521121-230
DC Power Supply 1.5 – 15 V, 1.5 A (230 V, 50/60 Hz)

U8521121-115
DC Power Supply 1.5 – 15 V, 1.5 A (115 V, 50/60 Hz)



U8521121



U11825



U8521112

Transformer with Rectifier 2/ 4/ 6/ 8/ 10/ 12/ 14 V, 5 A
Safety isolating transformer with safety cut out contained in metal housing. Output voltage switchable in 7 steps

AC output:	2/ 4/ 6/ 8/ 10/ 12/ 14 V, max. 5 A
DC output:	2/ 4/ 6/ 8/ 10/ 12/ 14 V, max. 5 A
Terminals:	4 mm safety sockets
Dimensions:	approx. 260x140x130 mm3
Weight:	approx. 3.1 kg

U8521112-230
Transformer with Rectifier 2/ 4/ 6/ 8/ 10/ 12/ 14 V, 5 A (230 V, 50/60 Hz)

U8521112-115
Transformer with Rectifier 2/ 4/ 6/ 8/ 10/ 12/ 14 V, 5 A (115 V, 50/60 Hz)

DC Power Supply 0 – 20 V, 0 – 5 A
Universal power supply with digital current and voltage display. Output voltage and output current are continuously adjustable. The device can be used as a constant voltage source with current limiting or as a constant current source with voltage limiting.

DC output:	0 – 20 V, 0 – 5 A
Output power:	100 W
Stability under full load	≤0,01% + 5 mV, ≤0,2% + 5 mA
Residual ripple	≤1 mV, 3 mA
Display:	2 x 3 digit LED
Terminals:	4 mm safety sockets
Dimensions:	approx. 130x150x300 mm³
Weight:	approx. 4.7 kg

U33020-230
DC Power Supply 0 – 20 V, 0 – 5 A (230 V, 50/60 Hz)

U33020-115
DC Power Supply 0 – 20 V, 0 – 5 A (115 V, 50/60 Hz)



U33020



U11705

DC Power Supply

Universal power supply with a digital display for voltage and current. The output voltage and current are continuously adjustable. The device can be used as a constant voltage supply with current limiting or a constant current supply with voltage limiting. Two or more devices can be operated in parallel or series.

Display:	2 x 3 digit LED
Accuracy:	1% + 2 digits for *U*, 1% + 4 digit for *I*
Terminals:	4 mm safety sockets
Dimensions:	approx. 210x132x255 mm³

	U11705	U11710
Output voltage	0 – 16 V	0 – 32 V
Output current	0 – 10 A	0 –2,5 A
Output power	160 W	80 W
Stability under full load	≤ 10 mV	≤ 10 mV
Residual ripple	≤ 4 mV	≤ 4 mV
Weight	approx. 5.9 kg	approx. 5.3 kg

U11705-230 DC Power Supply 0 – 16 V, 0 – 10 A (230 V, 50/60 Hz)
U11705-115 DC Power Supply 0 – 16 V, 0 – 10 A (115 V, 50/60 Hz)
U11710-230 DC Power Supply 0 – 32 V, 0 – 2.5 A (230 V, 50/60 Hz)
U11710-115 DC Power Supply 0 – 32 V, 0 – 2.5 A (115 V, 50/60 Hz)



U117361

U117361

DC Power Supply 0 – 16 V, 0 – 16 A

DC high current power supply with digital display of voltage and current. The voltage and current are continuously adjustable by means of coarse and fine controllers. The device can be used as a constant voltage source with current limiting, or a constant current source with voltage limiting. The selected operating mode is indicated by an LED on the front panel. High reliability even under extremely adverse conditions is ensured by automatic transformer switchover, MOSFET power amplifiers and temperature controlled fan speed with monitoring function. This equipment is also provided with a preset function for protecting against excess current and voltage.
The design of the device omits any air vents at the top or bottom and does not require an external heat sink. The output is protected against sustained short circuits.
Two or more such units can be operated in series or in parallel.

DC output:	0 – 16 V, 0 – 20 A
Fine adjustment range *U*:	800 mV
Stability at 0 – 100% load:	<12 mV
Residual ripple:	<1 mV
Fine-adjustment range *I*:	2 A
Connections:	4 mm jacks
Mains connection:	115 V/230 V, 50/60 Hz
Dimensions:	approx. 240x120x300 mm³
Weight:	approx. 10 kg

AC/DC Power Supply 0 – 12 V, 3 A

Extra low voltage power supply for training and demonstration experiments with continuously adjustable, stabilised and regulated DC output voltage and illuminated, analog display panel. DC voltage output is short circuit proof and noise voltage proof. Four AC outputs galvanically isolated from the DC voltage outputs are overload protected via semiconductor fuses (multifuses).

DC output:	0 – 12 V, max. 3 A
Stability under full load:	≤20 mV
Residual ripple under full load:	≤2 mV
Analog display:	class 2.5
AC outputs:	3, 6, 9, 12 V, max. 3 A
Terminals:	4 mm safety sockets
Dimensions:	approx. 230x115x190 mm³
Masse:	approx. 3.5 kg

U117601-230

AC/DC Power Supply 0 – 12 V, 3 A (230 V, 50/60 Hz)

U117601-115

AC/DC Power Supply 0 – 12 V, 3 A (115 V, 50/60 Hz)



U117601

AC/DC Power Supply 0 – 12 V, 4 A

Extra low voltage power supply for student exercises with continuously adjustable, stabilised DC voltage or stabilised AC voltage. Selection between DC and AC output voltage is performed using a toggle switch.

DC output:	0 – 12 V, max. 4 A, stabilised
AC output:	0 – 12 V, max. 4 A, stabilised
Dimensions:	approx. 260x206x69 mm³
Weight:	approx. 3.5 kg

U8521105-230

AC/DC Power Supply 0 – 12 V, 4 A (230 V, 50/60 Hz)

U8521105-115

AC/DC Power Supply 0 – 12 V, 4 A (115 V, 50/60 Hz)



U8521105



U117301



U8521131

U117301-230

AC/DC Power Supply 0 – 30 V, 5 A (230 V, 50/60 Hz)

Equipped with digital displays for voltage and current readings, these continuously adjustable AC / DC power supply units are particularly suitable for experiments for students and trainees. The outputs are galvanically isolated. A pushbutton can be used to turn the capacitor filtration of the output direct voltage on and off (smoothing). In the event of an overload, the device is turned off by a thermal overload protection switch.

DC output:	0 – 30 V, max. 5 A
AC output:	0 – 30 V, max. 5 A
Max. output power:	150 VA
Display:	2 x 3 digit LED
Connections:	4 mm jacks
Dimensions:	approx. 280x205x140 mm³
Weight:	approx. 8.3 kg

AC/DC Power Supply 0 – 20 V, 0 – 5 A

Power supply with adjustable and stabilised DC voltage and analog voltage and current display for DC voltage. The DC voltage component features an automatically alternating voltage and current control and is protected against continuous short circuits. The AC voltage can be selected in eight steps, the output is protected by an overcurrent circuit breaker.
The AC and DC voltage outputs are DC isolated. A temperature regulated fan protects the unit from overheating.

DC output:	0 – 20 V, 0 – 5 A
AC output:	2, 4, 6, 8, 10, 12, 15, 20 V, max. 5 A
Ripple U:	<10 mV rms
Dimensions:	approx. 235x175x245 mm³
Weight:	approx. 8 kg

U8521131-230

AC/DC Power Supply 0 – 20 V, 5 A (230 V, 50/60 Hz)

U8521131-115

AC/DC Power Supply 0 – 20 V, 5 A (115 V, 50/60 Hz)

DC Power Supply for Torsion Pendulum

Power supply for supplying the electric motor and eddy current brake of the torsion pendulum in accordance with Prof. Pohl (U15040) with the required direct voltage.

Output voltages:	24 V DC, 1 A (fixed)
	0 – 24 V DC, 2 A (continuously adjustable)
Stability under full load:	≤30 mV
Residual ripple:	≤2 mVeff
Connections:	4 mm safety jacks
Dimensions:	approx. 200x210x230 mm³
Weight:	approx. 3.7 kg

U11755-230

DC Power Supply for Torsion Pendulum (230 V, 50/60 Hz)

U11755-115

DC Power Supply for Torsion Pendulum (115 V, 50/60 Hz)

U15040



U11755

Vissza a tartalomjegyzékhez!



U33000



U33010



U8521371

DC Power Supply 0 – 500 V

Low voltage power supply with four outputs primarily intended to supply power for electron tubes, including for Helmholtz coils, with four independently adjustable DC voltages and analog dials for each of them. The DC voltages are stabilised and regulated, floating and galvanically isolated from one another, short circuit proof and secure from external voltages.

500 V output:	Voltage:	0 – 500 V DC, max. 50 mA
	Stability at full load:	≤ 0,01 % ± 100 mV
	Residual ripple:	≤ 20 mV
50 V output:	Voltage:	0 – 50 V DC, max. 50 mA
	Stability at full load:	≤ 0,1 % ± 30 mV
	Residual ripple:	≤ 5 mV
8 V output:	Voltage:	0 – 8 V DC, max. 3 A
	Residual ripple:	≤ 0,1 % ± 30 mV
	Overload protection:	Thermal cut-out
12 V output:	Voltage:	0 – 12 V DC, max. 4 A
	Residual ripple:	≤ 0,1 % ± 30 mV
	Overload protection:	Thermal cut-out
Displays:	Analog, class 2	
Connections:	4 mm safety sockets	
Power consumption:	50 VA	
Dimensions:	85x325x190 mm³ approx.	
Weight:	4 kg approx.	

U33000-230

DC Power Supply 0 – 500 V (230 V, 50/60 Hz)

U33000-115

DC Power Supply 0 – 500 V (115 V, 50/60 Hz)

High Voltage Power Supply 5 kV

Universally applicable, floating, high-voltage source for operation of electron tubes. With built in, high voltage resistant transformer to supply the heater voltage for electron tubes. Continuously adjustable high voltage, safe to touch, with passive current limitation and digital voltage display.

High voltage output:	0 – -5000 V DC, max. 2 mA
Heater voltage output:	6.3 V AC, max. 3 A, high voltage resistant up to 6 kV
Connections:	4 mm safety sockets
High-voltage display:	3 digit LED

U33010-230

High Voltage Power Supply 5 kV (230 V, 50/60 Hz)

U33010-115

High Voltage Power Supply 5 kV (115 V, 50/60 Hz)

DC Power Supply 0 – 300 V

Low voltage power supply to supply voltages for operating narrow electron beam tubes (U8481420) or training oscilloscope (U8481350). The DC voltages 0 – -50 V and 0 – +300 V have a common zero volt ground so that DC voltages of up to 350 V can be supplied. In addition, a ramp generator is available for generating an adjustable, temporally linear rising or falling voltage. For this reason, experiments on the law of induction and the charging and discharging of capacitors can also be carried out.

Outputs:	0 – 300 V DC, max. 200 mA/ 0 – -50 V DC, max. 10 mA/ 4 – 12 V DC, max. 400 mA
Ramp generator:	2.5 – 50 V/s, linear rising or falling
Operating voltage:	230/115 V AC, 50 (60) Hz
Connections:	4 mm safety sockets
Dimensions:	240x230x170 mm approx.
Weight:	3.7 kg approx.

U8521371-230

DC Power Supply 0 – 300 V (230 V, 50/60 Hz)

U8521371-115

DC Power Supply 0 – 300 V (115 V, 50/60 Hz)

High Voltage Power Supply 6 kV

Universally applicable, floating, high voltage source for electrostatic experiments or operation of spectrum tubes, gas discharge tubes and electron tubes. With built in, high voltage resistant transformer to supply the heater voltage for electron tubes.
Continuously adjustable high voltage, safe to touch, with passive current limitation and digital voltage display.

High voltage output:	0 – 6000 V DC, max. 2 mA
Heater voltage output:	6.3 V AC, max. 3 A, high-voltage resistant up to 6 kV
Overload protection:	Miniature fuse 3 A, slow-blow
Connections:	4 mm safety sockets
Power consumption:	50 VA
High-voltage display:	3 digit LED
Dimensions:	140x285x220 mm approx.
Weight:	6 kg approx.

U210601-230

High Voltage Power Supply 6 kV (230 V, 50/60 Hz)

U210601-115

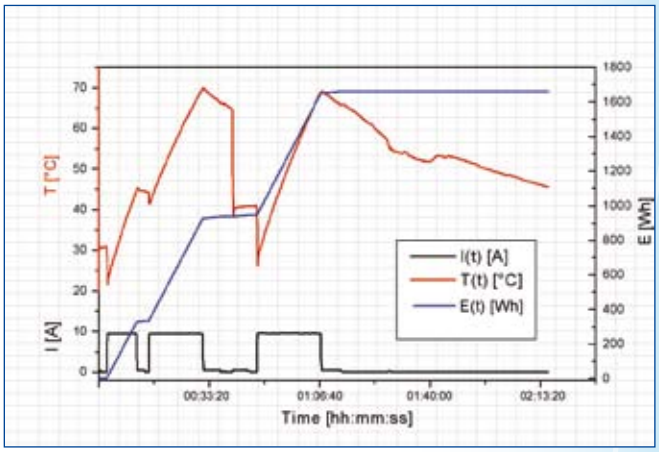
High Voltage Power Supply 6 kV (115 V, 50/60 Hz)



U210601



U21020



Temperature, energy consumption and current consumption for a washing machine during rinse cycle.

Power and Energy Meter with Interface

Power and Energy Meter for measuring electrical active, apparent and reactive power as well as electrical work in the case of voltages and currents with any continuous curve shape. The voltage, current, frequency, phase angle, power factor and time are measured simultaneously and can be displayed digitally via a pushbutton. It is also possible to simultaneously measure and display two temperatures as well as the difference between them. This device is particularly suitable for experiments involving heat pumps and Stirling engines.

The power and energy meter can be used alone or together with a PC. It has an internal data logger with a real-time clock. All 13 parameters and the time – a total of 3100 measured values - can be stored. The storage of measured values can be commenced manually, or at a specified point in time, or if a power or temperature limit is exceeded or fallen short of. The stored data can be transferred subsequently to a PC via a RS232 interface. Includes Windows Software and interface cable. The software permits programming of the data logger, graphic displays of measured values and export of all measured data to a spreadsheet program.

Voltage (front panel):	
Measuring ranges:	0 – 30 V RMS, 0 – 42 V DC
Resolution:	0.01 / 0.1 V RMS, 0.01 / 0.1 V DC
Accuracy:	±1% of measured value / ± 1 digit
Input impedance:	75 kΩ
Frequency range:	0 – 1000 Hz
Current (front panel):	
Measuring range:	0 – 10 A
Resolution:	0.01 A
Accuracy:	±1% of measured value / ± 1 digit
Frequency range:	0 – 1000 Hz
Input impedance:	50 mΩ
Frequency range:	0 – 1000 Hz
Voltage (rear panel):	
Measuring range:	10 – 240 V RMS
Resolution:	0.01 / 0.1 V RMS
Accuracy:	±1% of measured value / ± 1 digit
Input impedance:	950 kΩ
Current (rear panel):	
Measuring range:	0 – 10 A RMS
Resolution:	0.01 A RMS
Accuracy:	±1% of measured value / ± 1 digit
Frequency range:	45 Hz – 65 Hz
Input impedance:	50 mΩ
Power:	
Active power:	0 – 2400 W
Reactive power:	0 – 2400 VAr (only sinusoidal)
Apparent power:	0 – 2400 VA (only sinusoidal)
Resolution:	0.01 / 0.1 / 1 W
Accuracy:	±2% of measured value / ± 1 digit
Frequency:	
Measuring range:	DC/ 16 – 999 Hz
Resolution:	0.1 Hz
Accuracy:	±1% of measured value / ± 1 digit
Phase angle:	
φ:	0° – ±90°
Resolution:	0.1°
cos φ:	0,999 – 0,000
Resolution:	0,001
Accuracy:	±1% of measured value / ± 1 digit
Power factor (ratio of active power to apparent power):	
cosphi:	0.999 – 0.000
Resolution:	0.001
Accuracy:	±1% of measured value / ± 1 digit
Work:	
Measuring ranges:	0.0 – 9999 x 1000 Ws / 0.0 – 9999 Wh
Resolution:	0.1 Ws / 0.0001 Wh
Accuracy:	±2% of measured value / ± 1 digit
Time:	
Measuring range:	0 – 9999 x 1000 s
Resolution:	1 s
Accuracy:	±0.1%
Temperature 1 and 2	
Measuring range:	-100°C – 450°C
Resolution:	0.1° C
Accuracy:	±1% of measured value / ± 1 digit
Connections:	Thermocouple jack Type K
Display:	4 digit LED, 7 segments
Digit height:	20 mm
Computer connection:	Serial interface (RS232) for PC (DB9)
Power consumption:	50 VA
Dimensions:	approx. 215x310x210 mm³
Weight:	approx. 5.7 kg

U21020-230

Power and Energy Meter with Interface (230 V, 50/60 Hz)

U21020-115

Power and Energy Meter with Interface (115 V, 50/60 Hz)



U21015

BESTseller

Function Generator F12

Sine and square wave generator with power amplifier especially well suited for student experiments. With illuminated, digital display for frequency and signal shape. The output is short circuit proof and protected against induction voltages and spark discharges; e.g. in the case of connected coils and accidental disconnection of the experiment cables when operated under load. Including plug in power supply.

Signal wave:	Sine, square, positive square-wave
Frequency range:	0.05 Hz – 50 kHz
Resolution:	0.05 Hz (0,05 Hz – 3 kHz), 1 Hz (1 Hz – 50 kHz)
Non-linear distortion factor (sine):	<1% (10 kHz)
Sinusoidal curve resolution:	16 bit
Rise time (square wave):	0.2 µs/V
Output voltage:	0 – ±12 V continuously adjustable, short-circuit proof
Max. output current:	1 A
Connection:	4 mm safety sockets
Display:	16 digit LCD, 2 rows, illuminated
Voltage supply:	12 V AC, 15 VA from plug in power supply
Power consumption:	max. 15 VA
Dimensions:	approx. 45x195x115 mm³
Weight:	approx. 1.2 kg

U21015-230

Function Generator F12 (230 V, 50/60 Hz)

U21015-115

Function Generator F12 (115 V, 50/60 Hz)

Power Function Generator

Function generator with external sweep capability including power amplifier designed to conduct experiments on simple harmonic oscillation, alternating current and induction. Can be used as a function generator, a stabilised current source or a power amplifier. Equipped with a digital frequency display showing value and unit and an electronic circuit to protect against capacitive and inductive overload.

Frequency display:	3½ digit LED display with 13 mm digit height
Unit display:	mHz, Hz, kHz
Function generator:	
Waveform:	Sinusoidal, triangular, square-wave
Frequency range:	10 mHz – 100 kHz, 7 decades
Output voltage:	0 – 20 V, 10 mA, short-circuit proof
DC Offset:	0 – ±10 V
Internal resistance:	10 mΩ
Modulation:	FM and AM via external generator
Sweep range:	sweep through 7 decades
Power unit:	
Frequency range:	0 – 50 kHz
Input impedance:	1 MΩ | | 60 pF
AF-gain:	10
Max. output power:	30 W
Dimensions:	approx. 125x170x225 mm³
Weight:	approx. 6.5 kg

U8533510-230

Power Function Generator (230 V, 50/60 Hz)

U8533510-115

Power Function Generator (115 V, 50/60 Hz)



U8533550

U8533550

Sine Wave Generator

Sine wave generator with power output up to 16 W in a frequency range from 1 Hz to 100 kHz.
The apparatus contains a preamplifier, which can be used in isolation (e.g. as a microphone amplifier) or with a power output stage connected downstream as a broadband amplifier (0 up to 100 kHz).

Sine wave generator with power output:	
Frequency range:	1 Hz – 100 kHz, in 5 decadic stages, scale with linear division
Frequency deviation:	<5 %
Output voltage:	0 – 6 V, adjustable
Max. output current:	10 A, short circuit proof
Max. output power:	16 W constant, 30 W temporary
Input impedance:	100 kΩ
Preamplifier:	
Gain factor:	1 – 300, continuously adjustable
Input:	AC coupled, with switchable microphone voltage
Max. output voltage:	10 Vpp
Max. output current:	15 mA, short circuit proof
Output impedance:	1 kΩ
Power amplifier:	
Voltage gain:	8.5
Operating voltage:	12 V AC
Dimensions:	approx. 160x160x50 mm³
Weight:	approx. 1.1 kg

Additionally required:
U8475430-230 Transformer 12 V, 25 VA (230 V, 50/60 Hz)
or
U8475430-115 Transformer 12 V, 25 VA (115 V, 50/60 Hz)



U8533510





U11230

Function Generator 0.02 Hz – 2 MHz

Multifunctional function generator with four different functions in a single device: function generator, sweep generator, pulse generator and 50 MHz frequency meter.

Frequency range:	0.02 Hz – 2 MHz in 7 ranges
Accuracy:	± 5%
Waveform:	Sine, square, triangle, pulse, saw-tooth, ramp
Signal outputs:	
Output voltage:	0 – ±5 VSS
Output impedance:	50 Ω ± 5%
Attenuator:	0 – 20 dB continuously adjustable and 20 dB fixed
Sinusoidal:	Ripple factor <1% (0.2 Hz – 100 kHz)
Square-wave:	Rise time <120 ns
Triangular:	Linearity error <1% (0.2 Hz – 100 kHz)
Rise time TTL:	<25 ns
Rise time CMOS:	<140 ns (max.)
Pulse duty factor:	1:1 – 10:1
Sweep generator:	
Sweep generator:	internal or external, linear
Sweep frequencies:	0.02 Hz – 2 MHz (7 ranges)
Sweep time:	20 ms – 2 s
Frequency meter:	
Frequency range:	200 mHz – 50 MHz
Accuracy:	5% of reading ± 1 Digit
Max. input voltage:	250 Vpp
Input impedance:	890 Ω
Display:	6-digit LED
Dimensions:	approx. 280x240x90 mm³
Weight:	approx. 2 kg

U11230-230

Function Generator 0.02 Hz – 2 MHz (230 V, 50/60 Hz)

U11230-115

Function Generator 0.02 Hz – 2 MHz (115 V, 50/60 Hz)



U21010

Function Generator with Interface

Sine, square, triangular waveform generator with built-in sweep generator and power amplifier. Menu driven operation to set operating mode as well as built in, illuminated, digital display for the visualisation of all set parameters. The outputs are protected and short circuit proof against both induction voltages and spark discharges, for example, when coils are connected and the experiment cable is accidentally pulled out under load. With built in serial interface RS232 for the PC. Including Windows program and interface cable. Among other things the software enables the user to carry out all function generator settings via computer. The amplitudes measured via the microphone input and the corresponding sweep range frequencies (resonance experiments) can be measured, graphically displayed and exported into a spread sheet software program.

Frequency range 1:	
Frequency range:	0.10 Hz – 20.00 Hz
Resolution:	0.01 Hz
Waveform:	Sine, triangular
Frequency range 2:	
Frequency range:	1 Hz – 130 kHz
Resolution:	1 Hz (1 – 65.535 Hz), 2 Hz (65.536 – 130.000 Hz)
Waveform:	Sine, square, positive square
Signal outputs:	
Output amplitude:	0 – 10.20 VPP, adjustable, resolution 0.05 V
Output impedance:	50 Ω / 600 Ω adjustable
Display:	VRMS, VP, VPP, adjustable
Synchronous signal output:	TTL-compatible
Sine:	Distortion factor <1% (100 kHz)
Square wave:	Duty cycle 1:1, rise time < 0,2 µs/V
Internal sweep generator:	
Function:	linear 1 Hz – 130 kHz
Frequency steps:	1 Hz – 10,000 Hz adjustable, resolution 1 Hz
Time steps:	0.05 s – 5.00 s adjustable, resolution 0.05 s
Microphone input:	
Microphone input:	for measuring voltage amplitudes
Input impedance:	100 kΩ
Frequency range:	10 – 50,000 Hz
Power amplifier:	
Frequency range:	DC to 20 kHz
Signal waveform:	any given curve shape
Input impedance:	22 kΩ
Output amplitude:	0 – 24 VPP, continuously adjustable
Output power:	30 W at 4 Ω
Display:	16-digit LCD, 2-rows, illuminated
Computer connection:	Serial interface (RS 232) for PC (DB9 plug)
Power consumption:	approx. 80 VA
Dimensions:	approx. 98x290x210 mm³
Weight:	approx. 3.7 kg

U21010-230

Function Generator with Interface (230 V, 50/60 Hz)

U21010-115

Function Generator with Interface (115 V, 50/60 Hz)



U11234-230

U11234-230

Analogue Oscilloscope, 1x10 MHz (230 V, 50/60 Hz)

Analogue single channel oscilloscope with all the functions and possible display modes of conventional dual beam analogue oscilloscopes. With a bandwidth of 10 MHz, this is a high performance device which is easy to operate, even for inexperienced users.

Additionally recommended:
U11800 Oscilloscope Probe 100 MHz



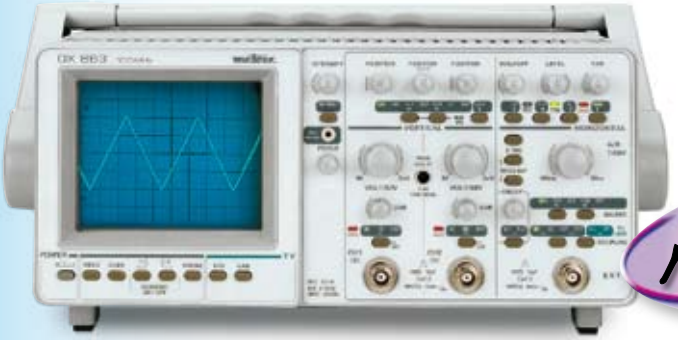
U11175

U11175

Analogue Oscilloscope, 2x30 MHz

Microprocessor controlled analogue oscilloscope for the display of rapid periodic signals. With SMART AUTOSET for both channels, which reproduces the last configuration used when the device is switched back on.

Additionally recommended:
U11800 Oscilloscope Probe 100 MHz



U11177

U11177

Analogue Oscilloscope 2x150 MHz

Analogue dual channel oscilloscope with high bandwidth for accurate tracing of very fast periodic events. Including two scope probes.

NEW



U11176

U11176

Analogue/Digital Storage Oscilloscope 2x40 MHz

Analogue/digital storage oscilloscope for the display and storage of rapid periodic and aperiodic signals. With moveable cursors and 17 measurement functions. Fully equipped for direct PC and printer connection (RS232 interface).

Cursor measurements:	ΔV, Δt, 1/Δt, phase
Memory:	2048 x 8 Bit pro channel
Scan rate:	Single Shot: 50 MS/s
Glitch capture:	20 ns
Operating mode:	Roll Refresh, Single, XY-mode, Envelope, Average, Dot Join

Additionally recommended:
U11800 Oscilloscope Probe 100 MHz



U11800

U11800

Oscilloscope Probe, 100 MHz

Probe to extend the voltage measurement range of any standard commercial oscilloscope. A changeover switch allows selection of bandwidth. The device includes a channel identification terminal, spring-loaded terminal connection, ground lead, insulating cover tip, measuring tip, special tip for IC measurements, trimmer key and BNC adapter.

Bandwidth:	DC to 100 MHz (1:10), DC to 6 MHz (1:1)
Input resistance:	10 MΩ (1:10), 1MΩ (1:1)
Input capacitance:	16 pF (1:10), 90 pF (1:1)
Max. measuring voltage:	600 VDC, 600 VAC
Connection:	BNC plug
Cable length:	approx. 1.20 m

	U11234-230	U11175	U11177	U11176
Vertical deflection				
Operation modes	CH1, XY	CH1, CH2, -CH2, ALT, CHOP, ADD, XY	CH1, CH2, -CH2, ALT, CHOP, ADD, XY	CH1, CH2, -CH2, ALT, CHOP, ADD, XY
Bandwidth	10 MHz	30 MHz	150 MHz	40 MHz
Rise time	≤ 35 ns	< 11.7 ns	≤ 2.3 ns	≤ 8.75 ns
Deflection coefficient	5 mV/div. – 5 V/div., 10 steps	5 mV/div. – 20 V/div., 12 steps	2 mV/div. – 5 V/div., 11 steps	5 mV/div. – 20 V/div., 12 steps
Accuracy	± 3%	± 3%	± 3%	± 3%
Input impedance	1 MΩ ± 3% // 25 pF ± 5 pF	1 MΩ // 25 pF	1 MΩ ± 1% // 15 pF	1 MΩ // 25 pF
Horizontal deflection				
Time coefficient	100 ns/div. – 100 ms/div., 19 steps	50 ns/div. – 200 ms/div., 21 steps	50 ns/div. – 100 ms/div., 20 steps	10 ns/div. – 200 s/div. (digital), 50 ns/div. – 200 ms/div. (analogue)
Accuracy	± 3%	± 3%	± 3%	±2% (digital), ±3% (analogue)
Enhancement	---	Up to 10 ns/div	Up to 5 ns/div.	Up to 5 ns/div. (analogue)
Accuracy	---	± 5%	± 5%	± 5%
Triggering				
Operation mode	Auto, Normal, TV	Auto, Normal, TV	Auto, Normal, TV	Flanke +/-, TV
Trigger source	Y INPUT, LINE, EXT	CH1, CH2, ALT, LINE, EXT	CH1, CH2, ALT, LINE, EXT	CH1, CH2, ALT, LINE, EXT
Trigger coupling	DC	DC, AC, LFR, HFR, TVV, TVH	DC, AC, LFR, HFR, TV ALL, TV CPT	DC, AC, LFR, HFR, TV
Data				
Screen size	approx. 48x60 mm²	approx. 80x100 mm²	approx. 80x100 mm²	approx. 80x100 mm²
Supply voltage	230 V, 50/60 Hz	94 – 264 V, 48 – 440 Hz	94 – 264 V, 48 – 440 Hz	94 – 264 V, 48 – 440 Hz
Dimensions:	approx. 278x215x85 mm³	approx. 435x330x163 mm³	approx. 435x330x163 mm³	approx. 435x330x163 mm³
Weight	approx. 3 kg	approx. 5.5 kg	approx. 5.5 kg	approx. 5.5 kg

U11170

Zero Point Galvanometer CA 403

Reasonably priced, sturdy and easy to use analog measuring instrument with moving coil instrument and rectifier, particularly well suited for student and practical experiments, may be used as a DC microammeter and DC millivoltmeter. This device has only one control knob, includes safety sockets and quick break fuses, is electrically protected and double insulated.

Meas. ranges:	100 mV DC, 30 µA DC, 3 mA DC
Int. resistance:	3333 Ω, 460 Ω, 500 Ω
Accuracy:	±1.5%
Zero point:	center
Mirrored scale:	yes
Connection:	4 mm security sockets
Fuse:	0.315 A HBC 380 V 50 kA
Dimensions:	approx. 165x105x50 mm³
Weight:	approx. 450 g



U11170

U11171

Wattmeter CA 404

Analog wattmeter with mirror scale to eliminate parallax effects when reading, plus dynamic, oil damped, moving iron galvanometer. Low priced and robust meter for student experiments and practicals. Simple to use, since all ranges can be selected simply by turning a single rotary selector switch. Electronically protected and double insulated with colour coded safety sockets and fold out prop for standing the device on a table.

Model:	Single-phase
Voltage:	60/ 120/ 240/ 480 V (4 ranges)
Current:	0.5/ 1 A (2 ranges)
Accuracy:	±1% at AC, ±2,5% at DC
Frequency range:	0 – 500 Hz
Overload capacity:	25%, continuous
Fuses:	1.25 A HBC 100 kA 380 V AC
Dimensions:	approx. 165x105x50 mm³
Weight:	approx. 500 g



U11171

Measuring Instruments for Student Use

Sturdy pointer instruments for measuring current or voltage. In shock proof desktop housings built. Especially for student and practical lab experiments. With moving coil instruments, mirror scale and 4 mm safety sockets.

Accuracy: class 2.0

Dimensions: approx. 90x106x103 mm³



U11810 U11812 U11814



U11811 U11813

	Designation	Measuring ranges	Scale division	Internal resistance
U11810	Ammeter, DC	50 mA, 500 mA, 5.0 A	1 mA, 10 mA, 0.1 A	10 Ω
U11811	Voltmeter, DC	3,0 V, 15 V, 300 V	0,1 V, 1 V, 10 V	50 Ω
U11812	Ammeter, AC	1,00 A, 5,0 A	0,02 A, 0,1 A	Rectifier
U11813	Voltmeter, AC	15,0 V, 150 V	0,5 V, 5 V	Rectifier
U11814	Galvanometer, DC	± 35 µA	1 µA	1000 Ω

U17450

Analogue Multimeter AM50

Hand held multimeter for measuring voltage and current for a wide range of applications in student and practical experiments. A heavy duty device with excellent overload protection, zero point of scale center or left and automatic battery cut off after approx. 45 minutes.

Measuring ranges:

- Direct voltage: 100 mV – 300 V, 8 levels
- Alternating voltage: 3 V – 300 V, 5 levels
- Direct current: 0.1 mA – 3 A, 6 levels
- Alternating current: 0.1 mA – 3 A, 6 levels

Internal resistance: 10 MΩ

Scale zero-point: Centre/left

Accuracy: class 2 (DC) / class 3 (AC)

Supply voltage: 1 x 9 V battery

Dimensions: approx. 98x138x35 mm³

Weight: approx. 0.3 kg



U17450

U17451

Analogue Multimeter AM51

Low price hand held multimeter for measuring current, voltage and resistance. For universal use in student experiments and practicals.

Measuring ranges:

- Direct voltage: 100 mV – 600 V, 7 steps
- Alternating voltage: 10 V – 600 V, 5 steps
- Direct current: 50 µA – 1 A, 5 steps
- Alternating current: 3 mA – 3 A, 4 steps
- Resistance: Ω x 1/ 10/ 100

Internal resistance: 20 kΩ/V (DC) / 6.67 kΩ/V (AC)

Scale zero-point: left

Accuracy: class 2.5

Supply voltage: 1 x 1.5 V battery

Dimensions: approx. 98x138x35 mm³

Weight: approx. 0.253 kg



U17451

BESTseller



U8531150



U8531170



U8531160

Multimeter ESCOLA

Moving coil multimeter contained in shockproof plastic housing for any requirements in student experiments. Two easy-to-read, linear mirror scales and clearly identifiable measurement ranges guarantee error-free readings of the measurement values.

Electronic overload protection is achieved without equipment safety fuses, thus eliminating the tedious task of changing of fuses and ordering replacement parts. The protective circuitry operates without auxiliary power and is also guaranteed to function with a flat or missing battery.

Alternating quantities are linearised by the use of a measurement amplifier with a cut-off frequency of 20 kHz. The amplifier operates with a single, low cost 1.5 V battery cell (R6; Mignon cell). Nevertheless, under normal use the measuring instrument should remain operational for years between battery replacements since the maximum discharge current during operation is 2 mA and the battery cell is not discharged when the measurement leads are disconnected.

Scale length:	80 mm
Supply voltage:	1 x 1.5 V Mignon cell/IEC R6
Dimensions:	approx. 100x147x49 mm^3
Weight:	approx. 300 g

U8531150

Multimeter ESCOLA1

Student measuring instrument for the measurement of voltages and currents. Equipped with electronic protection against overloading.

Measuring ranges:

Direct and alternating voltage:	0.3 – 30 V, 5 ranges each
Direct and alternating current:	1 – 3000 mA, 5 ranges each
Accuracy:	class 2 (DC), class 3 (AC)
Scale zero point:	left

U8531170

Multimeter ESCOLA2

Student measuring instrument for the measurement of voltages and currents. Equipped with electronic protection against overloading and electronic zero calibration for all DC current and voltage ranges.

Measurement ranges:

Direct and alternating voltage:	0.3 – 30 V, 5 ranges each
Direct and alternating current:	1 – 3000 mA, 5 ranges each
Accuracy:	Class 2 (DC), class 3 (AC)
Scale length:	80 mm
Scale zero point:	Centre/left

U8531160

Multimeter ESCOLA10

Student measuring instrument for the measurement of voltage, current, resistance, impedance, conductance and admittance. Equipped with electronic protection against overload and a potentiometer to electronically calibrate the zero point as well as the end value setting for measuring resistance and conductance. Includes battery test function.

The separate terminal sockets for current and voltage permit connection of the instrument that allows for current as well as voltage to be measured without having to reconnect the measuring leads. Thus the resistance and conductance, capacitance and admittance can also be measured.

Measurement ranges:

Direct and alternating voltage:	0 1 – 600 V, 9 ranges each
Direct and alternating current:	0 1 mA – 10 A, 11 ranges each
Resistance and impedance:	0 1 – 6 MΩ, 77 ranges each
Conductance und admittance:	150 nS – 10 S, 77 ranges each
Frequency range:	20 Hz – 20 kHz
Internal resistance:	1 MΩ
Accuracy:	class 2 (DC), class 3 (AC)
Scale zero point:	Centre/left
Supply voltage:	1 x 1 5 V Mignon cell/IEC R6
Long term maximum voltage:	600 V
Long term maximum current:	15 A

U11807

Digital Mini Multimeter

Very reasonably priced mini multimeter in pocket format for measuring voltage, DC current, resistance and temperature, and also including diode and hFE testing.
Overload protection for mA ranges via fuse. 10 amp range is unprotected.
Includes measuring leads, type K thermocouple and battery.

DC voltage:	200 mV – 600 V, 5 ranges, ±0.5% ± 2 digits
AC voltage:	200/ 600 V, 2 ranges, ±1.2% ± 3 digits
DC current:	2000 µA – 10 A, 4 ranges, ±1% ± 2 digits
Resistance:	200 Ω– 2000 kΩ5 ranges, ±0.8% ± 2 digits
Temperature:	0 – 1000°C, ±2% ± 2 digits
Display:	3½ digit LCD, 13 mm, max: 1999
Operating voltage:	9 V battery
Safety classification:	CAT II 600 V (IEC-1010-1)
Dimensions:	approx. 70x130x28 mm³
Weight:	approx. 140 g

U11806

Digital Multimeter P1035

Compact 3½ digit multimeter for measuring voltage, current, resistance and temperature and also including diode and continuity tests.
Complete with pouch, leads and battery.

DC voltage:	200 mV – 600 V, 5 ranges, ±0.5% ± 2 digits
AC voltage:	200/ 600 V, 2 ranges, ±1.2% ± 10 digits
DC current:	2000 µA – 10 A, 4 ranges, ±1% ± 2 digits
Resistance:	200 Ω– 2000 kΩ5 ranges, ±0.8% ± 2 digits
Temperature:	0 – 1000°C, ±2% ± 2 digits
Display:	3½ digit LCD, 27 mm, max: 1999
Operating voltage:	9 V battery
Safety classification:	CAT III 600 V (IEC-1010-1)
Dimensions:	approx. 70x150x48 mm³
Weight:	approx. 260 g



U11807



U11806



U118091



U118081

U118091

Digital Multimeter P3340

Digital multimeter for universal use in measuring voltage, current, resistance, frequency, capacitance and temperature. Includes a measurement value hold function, analogue bar graphs, automatic polarity reversing, overload and overvoltage protection as well as an acoustic overload indicator, automatic switch off as well as mechanical socket guards. Device comes in a shock-proof holster with fold-out stand.
Including testing leads, type K temperature sensor and batteries.

DC voltage:	400 mV – 1000 V, 5 ranges, ±0.5% ± 2 digits
AC voltage:	4 – 700 V, 4 ranges, ±1.2% ± 3 digits
DC current:	400 µA – 10 A, 6 ranges, ±1% ± 3 digits
AC current:	400 µA – 10 A, 6 ranges, ±1.5% ± 5 digits
Resistance:	400 Ω– 40 MΩ6 ranges, ±1% ± 2 digits
Capacity:	40 nF – 100 µF, 5 ranges, ±3% ± 5 digits
Temperature:	-20 – 760°C, ±3% ± 3 digits
Display:	3¾ digit LCD, 39 mm, max: 3999
Operating voltage:	9 V battery
Safety classification:	CAT II 1000 V (IEC-1010-1)
Dimensions:	approx. 92x195x38 mm³
Weight:	approx. 200 g

U118081

Digital Multimeter P3345

Digital multimeter for universal use in measuring voltage, current, resistance, frequency, capacitance and temperature. With real time rms measurement feature and backlighting. 3¾ digit LCD display with function symbols and analogue bar graphics. Automatic and manual range selection. Frequency measurement up to 100 MHz. Includes measuring leads, type K thermocouple, shock resistant pouch and battery.

DC voltage:	400 mV – 600 V, 5 ranges, ±0,5% ± 2 digits
AC voltage:	400 mV – 600 V, 5 ranges, ±1,5% ± 3 digits
DC current:	400 µA – 10 A, 6 ranges, ±1% ± 3 digits
AC current:	400 µA – 10 A, 6 ranges, ±1.5% ± 5 digits
Resistance:	400 Ω– 40 MΩ6 ranges, ±1% ± 2 digits
Capacitiy:	4 nF – 40 mF, 7 ranges, ±3% ± 5 digits
Frequency:	4 kHz – 100 MHz, 6 ranges, ±1,2% ± 5 digits
Temperature:	-20 – 760°C, ±3% ± 3 digits
Display:	3¾ digit LCD, 19 mm, max: 3999
Operating voltage:	9 V battery
Safety classification:	CAT II 1000 V (IEC-1010-1)
Dimensions:	approx. 66x146x42 mm³
Weight:	approx. 380 g

U11155

Digital Multimeter MX22

Robust multimeter for universal use in measuring voltage, current, resistance and frequency, and also including diode and continuity tests. With measurement hold function and memory for minimum and maximum values. With electronic protection and double insulation. Includes two measuring leads with probes, two spare fuses and battery.

DC voltage:	40 mV – 600 V, 6 ranges, ±0.8% ± 4 digits
AC voltage:	40 mV – 600 V, 6 ranges, ±2% ± 6 digits
DC current:	400 µA – 10 A, 6 ranges, ±1% ± 3 digits
AC current:	400 µA – 10 A, 6 ranges, ±1.2% ± 5 digits
Resistance ranges:	400 Ω– 40 MΩ6 ranges
Frequency:	4 kHz – 40 MHz, 5 ranges
Display:	3½ digit LCD, 12 mm
Safety classification:	9-V- battery, 6LR61
Safety classification:	CAT III 600 V (IEC-1010-1)
Dimensions:	approx. 170x80x35 mm³
Weight:	approx. 285 g



U11155

U11822

Type K/IR Thermometer

Digital two channel thermometer with two K- type inputs and additional external infrared sensor. Can also be used for measurements at low temperatures. With automatic shut off, maximum value storage and data hold function. Includes case, 2 K-type thermocouple sensors, infrared temperature sensor, 9 V battery and instruction manual.

Measurement inputs:	2x K-type, external IR input
Measuring functions:	T1, T2, T3, T1-T2, T1-T3, T2-T3
Measuring range:	-200 – 1372°C (type K), -30 – 550°C (IR)
Measurement error:	±0.5% + 2°C (type K), ±2.5% + 2°C (IR)
Resolution:	0.1°C
Unit of measurement:	°C or K
Emission factor:	0.95 fixed
Digital display:	3¾ digit LCD
Background lighting:	blue
Operating voltage:	9 V battery
Dimensions:	75x200x50 mm³ approx.
Mass:	280 g approx.



U11822

U11803

Digital Luxmeter

Extremely reasonably priced, easy to use pocket luxmeter for testing and measurement of light conditions. C.I.E. standard spectrum. Including light sensor, pouch and battery

Measuring ranges:	200 – 50000 lux, 4 ranges, ±5%
Operating voltage:	Battery
Dimensions:	approx. 65x115x25 mm³
Weight:	approx. 160 g



U11803

Demo Multimeter with Interface

- Large, 4 digit LED display, 57 mm high
- Indication of measuring unit
- 5 measuring functions: V, A, Ω°C / K and pH
- 4 easy to operate keys
- Rear panel inspection display for the teacher
- Large display for balances, for example
- Galvanically isolated RS232 interface

Universal, microprocessor controlled demonstration multimeter for measuring voltage, current, resistance, temperature and pH. Can also be used as an outsized display for the digital counter/timer with interface (U21005), function generator with interface (U21010), power and energy meter with interface (U21020), pH and temperature meter with interface (U21035) or for electronic scales, e.g. Mettler-Toledo PB3001-s, Sartorius LC4201, Kern 572, Ohaus Explorer and Scout Pro. Includes adapter and Interface cable, cable adapter for connecting scales on request.
Includes Windows software for setting all parameters on the multimeter, graphic display or representation of the measured data in tabular form, as well as export of this data to a spreadsheet program.



U21100

Voltage:

Measurement ranges:	400 mV – 4 kV DC in 5 ranges, 4 V – 4 kV AC in 4 ranges
Accuracy:	±1% ± 1 digit
Internal resistance:	10 MΩ
Input:	4 mm safety sockets

Current:

Measurement ranges:	4 mA – 20 A AC/DC (max. 2 min: 40 A) in 5 ranges
Accuracy:	±1% ± 2 digit
Internal resistance:	100 Ω in smallest range
Input:	4-mm safety sockets
esistance:	
Measurement ranges:	400 Ω – 4 MΩ in 5 ranges
Accuracy:	±1% ± 1 digit
Input:	4 mm safety sockets

Temperature:

Measurement unit:	Celcius, Fahrenheit or Kelvin
Measurement ranges:	-40° C – +1200° C
Resolution:	0.1° C (T < 1000°C), 1°C (T > 1000° C)
Accuracy:	±1% ± 1 digit
Input:	Type K socket for standard NiCr-Ni thermocouple

pH Meter:

Measurement range:	0 – 14 pH with temperature compensation
Resolution:	0.01 pH
Accuracy:	± 1% ± 1 digit
Input:	BNC plug
Computer connection:	Serial interface (RS232) for PC (DB9), galvanically isolated from the measurement inputs.

Displays:

Front panel:	4 digit LED and sign, 7 segments
Digit height:	57 mm
Measuring unit:	2 digit LED, 5x8 dot matrix display
Rear panel:	4 digit LED and sign, 7 segments
Digit height:	21 mm
Power consumption:	45 VA
Dimensions:	approx. 215x310x210 mm³
Weight:	approx. 5.7 kg

U21100-230
Demo Multimeter with Interface (230 V, 50/60 Hz)

U21100-115
Demo Multimeter with Interface (115 V, 50/60 Hz)

Microvoltmeter

Measuring instrument and amplifier for measuring very small DC and AC voltages, e.g. thermo-voltages, inductive voltages and photo-electric voltages. With LED display.
The measuring input includes a filter that can be switched in for smoothing the signal or for setting an upper frequency limit. The signal is input via a BNC socket or 4 mm safety sockets. An additional DIN socket is provided for the connection of Hall sensors, the axial/tangential magnetic field sensor (U8533997).

Inputs:	4 mm safety sockets, BNC socket, DIN socket
Outputs:	4 mm safety sockets
Measuring ranges:	199.9 µV – 199.9 mV AC /DC, 4 ranges each
Gain factors:	10 – 10000, 4 decades
AC frequency range:	10 Hz – 1 kHz
Input resistance:	100 kΩ(DC), 900 kΩ(AC)
Upper frequency limit:	1 Hz – 1 kHz, 4 decades
Precision:	5%
Sampling rate:	3 measurements/s
Output signal:	0 – ±2 V, max. 1 mA
Dimensions:	approx. 235x250x180 mm³
Weight:	approx. 3.3 kg



U8530501

U8530501-230
Microvoltmeter (230 V, 50/60 Hz)

U8530501-115
Microvoltmeter (115 V, 50/60 Hz)

Additionally recommended:
U8533997 Magnetic Field Sensor, Axial/Tangential



U8532161



U8531401

U8532161

Measuring Amplifier S

Measuring amplifier for measuring small voltages and current in conjunction with an ordinary voltmeter in the course of student experiments.
Measuring range with reference to 1 V output voltage:

Voltage (AC/DC):	1 mV – 1 V
Current (AC/DC):	100 nA – 100 µA
Frequency range:	0 – 20 kHz (v = 1)
	0 – 500 Hz (v =1000)
Input impedance:	10 kΩ
Input U:	BNC socket
Input I:	BNC socket
Max input voltage:	10 V
Output:	4 mm safety sockets
Max output voltage:	10 V
Limiting frequency:	100 Hz
Gain factor:	106
Accuracy:	2 %

Additionally required:
U8475430-230 Transformator 12 V, 25 VA (230 V, 50/60 Hz)
or
U8475430-115 Transformator 12 V, 25 VA (115 V, 50/60 Hz)

U17450 Analogue Multimeter AM50

Measuring Amplifier

Measuring amplifier for recording very small voltage, current and charge. For display purposes, any DC meter capable of measuring in the range up to 10 V can be used with no additional configuration. Including offset correction and polarity switch.
Additional outputs are provided so that the -15 V and +15 V operating voltage can be tapped for use in external circuitry, e.g. bridge circuits.

Input:	BNC sockets
Measuring range with reference to 1 V output voltage:	
Voltage:	0.1 mV – 100 V, 7 ranges
Current:	10 pA – 10 µA, 7 ranges
Charge:	10 pAs – 100 nAs, 5 ranges
Input resistance:	10 Ω (voltage), compensated 0 Ω (charge, current)
Overvoltage protection:	up to 300 V
Precision:	typically 3%
Signal output:	0 – 10 V, configurable zero point, polarity switch
Fixed voltage output:	±15 V, max. 50 mA
Dimensions:	approx. 235x230x180 mm³
Masse:	approx. 2.8 kg

U8531401-230

Measuring Amplifier (230 V, 50/60 Hz)

U8531401-115

Measuring Amplifier (115 V, 50/60 Hz)

Additionally required:
U17450 Analogue Multimeter AM50

U8533997

Magnetic Field Sensor, Axial/Tangential

Magnetic field sensor with two built in Hall sensor probes for measuring axial and tangential magnetic fields in conjunction with the microvoltmeter (U8530501-230 or U8530501-115). A slider switch provides for switching between axial and tangential measuring modes.

Sensitivity:	1 mV/mT
Length of probe, not including handle:	approx. 125 mm
Thickness of probe:	4 mm
Hall sensors:	Monocrystalline InAs
Sensor surface:	1 mm²
Connection:	DIN plug

Additionally required:
U8530501-230 Microvoltmeter (230 V, 50/60 Hz)
or
U8530501-115 Microvoltmeter (115 V, 50/60 Hz)



U8533997

Student Timer

Digital counter/timer for measuring duration of motion, transition times, periods, pendulum periods and frequencies, as well as for counting events or Geiger tube pulses. Keyboard operation. Power supply for direct connection to light barriers (U11365). Includes plug in power supply.

Frequency (Input A):
Measuring range: 0.01 Hz – 100 kHz
Resolution 10 mHz – 10 Hz
Type of measurement: Repeated measurement/single measurement

Period of oscillation (Input A):
Measuring range: 0.01 ms – 100 s
Resolution: 0.01 – 10 ms
Type of measurement: Repeated measurement/single measurement

Pulse counting (Input A) / rate measurement (counter tube input):
Measuring range: 0 – 9999 pulses
Resolution: 1 pulse
Type of measurement: Continuous measurement
Single measurement for counting periods of 1 s, 6 s, 10 s, 60 s

Time for motion between A and B:
Measuring range: 0.01 ms – 100 s
Resolution: 0.01 ms
Start: START/STOP button, pulse at A.
Stop: START/STOP button, pulse at B.

Transition times via A and B:
Measuring range: 0.01 ms – 100 s
Resolution: 0.01 ms
Type of measurement: Simultaneous measurement at both inputs

Transition time plus period of motion:
Measuring range: 0.01 ms – 100 s
Resolution: 0.01 ms
Type of measurement: Time for motion from A to B, time for transition at A, time for transition at B



U21001

Display: Graphic LCD display with illumination
Display: 73x38 mm² approx. with 128x64 point resolution
Dimensions: 190x115x40 mm³ approx.
Operating voltage: from plug in power supply
Dimensions: 250x100x160 mm³ approx.

U21001-230
Student Timer (230 V, 50/60 MHz)

U21001-115
Student Timer (115 V, 50/60 MHz)

Digital Counter

Digital counter for measuring duration of motion, transition times, periods, pendulum periods and frequencies, as well as for counting events or Geiger tube pulses. Includes a speaker that can be turned on and off, power supplies for direct connection to light barriers (U11365) or for powering a Geiger-Müller counter (U8533430). For event counting, a fixed counting period can be programmed in a range from 1 s to 99999 s. Counter events (start, stop) can either be triggered by a signal to the input sockets or manually via switches. Includes plug in power supply.



U8533341

Time measurement: 0.1 ms – 99999 s
Resolution: 0.1 ms / 1 ms / 0.1 s
Frequency measurement: 1 – 100 kHz, where voltage > 1.5 VPP
Resolution: 1 mHz (1 – 100 Hz), 1 Hz (1 – 100 kHz)
Counting periods: 1/10/60 s or manually triggered
Input A: miniDIN 8 socket, 4 mm safety sockets
Input B: miniDIN 8 socket, 4 mm safety sockets
Input voltage A: 0.5 V – 15 V AC
Input voltage B: 1 V – 15 V AC
Active edge Rising/falling
Counter tube input: BNC socket
Power supply: 550 V / 1 MΩ
Display: 5 digit LED display
Operating voltage: 9 – 12 V DC via plug in power supply
Dimensions: approx. 250x100x160 mm³
Weight: approx. 0.8 kg

U8533341-230
Digital Counter (230 V, 50/60 MHz)

U8533341-115
Digital Counter (115 V, 50/60 MHz)



U210051

Digital Counter with Interface

Microprocessor controlled digital counter for measuring duration of motion, transition times, periods, pendulum periods and frequencies, as well as for counting events or Geiger tube pulses. Keyboard operated. With adjustable trigger edge, speaker that can be turned on and off, power supply for direct connection to light barriers (U11365) and adjustable low voltage output for supplying a Geiger-Müller tube (U8533430).
With RS 232 interface and supplied cable plus software for graphic depiction of measured data and export to spreadsheet programs.

Frequency (Input A):

Measuring range:	0.01 Hz – 100 kHz
Resolution	10 mHz – 10 Hz
Type of measurement:	Repeated measurement / single measurement

Period of oscillation (Input A):

Measuring range:	1 ms – 100 s
Resolution:	0.01 – 10 ms
Type of measurement:	Repeated measurement / single measurement

Pulse counting (Input A)/rate measurement (counter tube input):

Measuring range:	0 – 9999 pulses
Resolution:	1 pulse
Type of measurement:	Continuous measurement Single measurement for counting periods of 1 s, 6 s, 10 s, 60 s, repeated measurement for a period of 10 s

Time for motion between A and B:

Measuring range:	0.01 ms – 100 s
Resolution:	0.01 ms
Start:	START/STOP button, pulse at A.
Stop:	START/STOP button, pulse at B.

Transition times via A and B:

Measuring range:	0.01 ms – 100 s
Resolution:	0.01 ms
Type of measurement:	Simultaneous measurement at both inputs

Transition time and period of motion:

Measuring range:	0.01 ms – 100 s
Resolution:	0.01 ms
Type of measurement:	Time for motion from A to B, time for transition at A, time for transition at B

Input A:	BNC socket, miniDIN 8 socket, two 4 mm safety sockets
Input B:	BNC socket, miniDIN 8 socket, two 4 mm safety sockets
Tube input:	BNC socket (on reverse)
Power supply:	300 – 625 V DC, continuously adjustable
Measurement display:	7 segment LED, 4 digit
Height of digits:	20 mm
Function display:	LCD with illumination, 2x16 digit
Computer connection:	RS 232
Power consumption:	20 VA approx.
Dimensions:	95x245x185 mm³ approx.
Weight:	5 kg approx.

U210051-230

Digital Counter with Interface (230 V, 50/60 Hz)

U210051-115

Digital Counter with Interface (115 V, 50/60 Hz)



U11804

U11804

Noise Level Meter P8005

Digital noise level meter with circuit for suppressing background noise for measuring all types of sound levels in the environment, including noise levels in schools, offices, factories, traffic noise, household noise or for noise-reduction projects. Allows for manual or automatic selection of levels and measurements of minimum and maximum levels.
Thanks to its built in USB port, the supplied 9 V mains adapter and stand, it is also suitable for permanent or long term measurement. Includes case, USB cable, Windows software, stand, 9 V mains adapter, 9 V battery and instruction manual.

Digital display:	4 digit LCD
Height of digits:	20 mm
Multi-functions display:	58x44 mm² Digital display of measurement, measuring time, bar graphs plus overs and unders
Background lighting:	blue
Applicable standards:	IEC-61672-1 type 2, ANSI S1.4 type 2
Frequency range:	31.5 Hz – 8 kHz
Dynamic range:	50 dB
Level ranges:	30 – 80 dB (low)
50 – 100 dB (medium)	
80 – 130 dB (high)	
30 – 130 dB (automatic)	
Resolution:	0.1 dB
Precision:	±1.4 dB
Response times:	125 ms (fast), 1s (slow)
Microphone:	½-inch, with electret capacitor
Display update:	Twice a second
Analogue output:	AC/DC
Operating voltage:	9 V battery or 9 V mains adapter
Dimensions:	90x280x50 mm³ approx.
Weight:	350 g approx.

Vissza a tartalomjegyzékhez!



U42000, U42001



U42058, U42059

Mechanical Balance 610
- Solid, all-metal construction
- Notched positions for sliding weights on three sliding beams
- Captive sliding weights
- Magnetic damping
- Zero point adjustment
- Extensible scale range

	U42000	U42001
Scale range	0 – 610.0 g	0 – 610.0 g
Scale range with additional weights	2610.0 g	2610.0 g
Readability	0.1 g	0.1 g
Tare range	—	225 g
Sliding weight		
front center rear	0.1 –10 g 100 – 500 g 10 g – 100 g	0.1 –10 g 100 – 500 g 10 g – 100 g
Plate diameter	150 mm	150 mm

Electronic Scales
Universal scales in robust plastic casing, with easy-clean foil keyboard. Menu functions, easy selection using two buttons. High-resolution, easy-to-read LCD display, overload and underload display, battery or mains operation optional. Automatic shutdown after five minutes in battery operation. Batteries included

	U42058	U42059
Scale range	0 – 300.0 g	0 – 2500 g
Accuracy	0.1 g	1 g
Weight units	g/ lb:oz	g/ lb:oz
Counter-balancing range	subtractive, entire weight range	subtractive, entire weight range
Power supply	3 AA alkaline batteries	3 AA alkaline batteries
Dimensions	approx. 193x135x39 mm^3	approx. 193x135x39 mm^3
Weight	approx. 470 g	approx. 470 g



U42010

U42010

Mechanical Balance 311
- Solid, all-metal construction
- Notched positions for sliding weights on four sliding beams
- Captive sliding weights
- Magnetic damping
- Zero point adjustment

Scale range: 0 – 311.00 g
Readability: 0.01 g
Sliding weight ranges: 0.01 – 1 g (1st beam), 1 – 10 g (2nd beam), 10 –100 g (3rd beam), 100 –200 g (4th beam)
Pan diameter: 100 mm

Electronic Scales Scout Pro

Precision scales, multi-function with percentage weighing, totalisation, display hold, and parts counting.
Includes mains adapter and calibrating weight.

	U42048	U42049	U42050
Weight range	0 – 200.00 g	0 – 400.00 g	0 – 600.0 g
Accuracy	0.01 g	0.01 g	0.1 g
Display	LCD, 6 digits, 15 mm		
Weight ranges	g, N, oz, %, unit counter	g, N, oz, %, unit counter	g, kg, N, oz, lb, %, unit counter
Calibration	Automatic using external weight		
Scale pan	120 mm dia.	120 mm dia.	165x140 mm
Dimensions	approx. 192x54x210 mm³		
Weight	approx. 700 g	approx. 700 g	approx. 800 g

Other weight ranges available on request.

U42048-230
Electronic Scale 200 g (230 V, 50/60 Hz)

U42049-230
Electronic Scale 400 g (230 V, 50/60 Hz)

U42050-230
Electronic Scale 600 g (230 V, 50/60 Hz)

U42048-115
Electronic Scale 200 g (115 V, 50/60 Hz)

U42049-115
Electronic Scale 400 g (115 V, 50/60 Hz)

U42050-115
Electronic Scale 600 g (115 V, 50/60 Hz)

Accessories for Scout Pro electronic scales:

U42055
RS232 Interface

U42054
Anti-Theft Device

U42056
USB Interface

Connectivity
You can quickly add either an internal RS232 or a USB port with integrated cable.



U42055



U42056



U42054

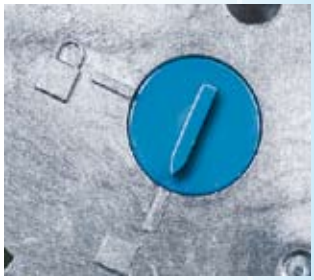
Security Bracket
Each Scout Pro features an integrated security bracket to prevent theft.

Flexible Power
Use either the included AC adapter, or 4 “AA” batteries to power your Scout Pro.



Easy to Clean
Sealed front panel and moulded spill ring.

Easy to View
High contrast LCD quickly displays weight and applications data, as well as indicators for stability, over/underload conditions, and low battery power.



Integral Shipping Lock
Quickly accessible under the weighing pan, the shipping lock allows you to lock and go.

U42048, U42049

Round or Square Stainless Steel Platform
Removable for easy cleaning.



U42050



Lockswitch
The Scout Pro can be locked into a specific configuration using the integral locking switch.



Weigh Below Hook
The integral weigh-below-hook on the bottom of the Scout Pro allows density determination or calculation of the specific gravity of samples.



U42100-230

Microscope not included

U42100-230

Video Flex®

High resolution, desktop colour video camera for a variety of applications.
Thanks to the ball and socket bearing, video head that can pivot and swivel via its flexible gooseneck, the camera can be easily and accurately connected, e.g. to microscopes and telescopes, or directed towards visual material, running processes or items of scientific or technical interest so that they can be viewed on a monitor or TV screen. The heavy, triangular base with integrated controls ensures the necessary stability.
Audio recordings are possible with the microphone integrated in the base. The high quality optics cover a range from 6 mm to infinity, allowing for magnifications of up to 50:1. The camera has normal cinch sockets for video and audio outputs. It can be connected to a video recorder for recording or to a monitor or TV set (PAL) for viewing.
Includes microscope adapter, plug in power supply, connecting leads and Euro-Scart plug.
NTSC version available on request.

U421051

Digital Video Flex®

Robust, ultra high resolution desktop digital colour camera for direct connection to a PC or notebook via a USB interface. The design of the Digital Video Flex® corresponds largely to that of the Video Flex® (U42100-230), and differs only in terms of the optical features. Audio recordings are possible via a microphone equipped computer. An external power supply is not necessary as the camera is powered via the USB connection. Includes microscope adapter, Discovery Scope Kit, Applied Vision™ software and carrying case.
The Applied Vision™ software for picture recording, reproduction and processing is characterized by its user friendliness and features e.g.

- Full screen, real time video
- Still frame recording
- Recording of films in AVI format
- Time-lapse recording
- Internet streaming
- Can be used in local network
- Zoom function
- Image processing
- Brightness, contrast control and positive/negative image display
- Drawing tools
- Organizer/memo function
- Printout of real time images
- Memory function (jpeg, bmp, tiff)
- Choice of background
- Creation of image collages
- Comparison of two adjacent images
- Measurement of the distance between 2 points or the area of a circle
- Exporting data to an Excel spreadsheet



U421051



U42103

U42103

Vision Viewer®

Lighter version of the Digital Video Flex® (U421051) with similar optical properties and for similar applications. The difference is that the video head is directly attached to the gooseneck arm (with no universal joint). Includes a microscope adapter, observation set (Discovery Scope Kit), Applied Vision™ software and carry case.

U42110

PhysicsCAM

High-resolution, hand held camera which can be connected directly via a USB interface to a PC or notebook. For a variety of applications in natural science classes, e.g. in experiments which are difficult to observe or which take place over long periods of time.
The PhysicsCAM is equipped with a flexible adapter and can therefore be mounted on equipment with varying size of eye. The Applied Vision™ software offers a variety of functions for displaying and processing images (see U421051).



U42110

	U42100-230	U421051	U42103	U42110
Photosensitivity	1.5 lux	20 lux	20 lux	3 lux
Image digitization	¼" CCD	digital CMOS	digital CMOS	digital CMOS
Output signal	video	digital / USB 2.0	digital	digital
Exposure	automatic	adjustable via software	adjustable via software	adjustable via software
Resolution	500 lines	1280x960 SXGA	1280x960 SXGA	640x480 VGA
Live video	–	up to 30 images per second	up to 30 images per second	up to 30 images per second
TV system	PAL	–	–	–
Audio	mono	–	–	–
Lens	8 mm glass	8 mm glass, C-mount	6 mm glass	6 mm glass
Focal distance	6 mm to infinity	6 mm to infinity	8 mm to infinity	8 to infinity
Magnification	50:1	50:1	30:1	30:1
Microscope adapter	34.5 mm built-in and 28 mm	34.5 mm built-in and 28 mm	34.5 mm built-in and 28 mm	24 to 32 mm
Power supply	5 V DC/800 mA via plug in power supply	via USB	via USB	via USB
Cable	A/V cable 365 cm	USB connecting cable, approx. 150 cm	USB connecting cable, approx. 150 cm	USB connecting cable, approx. 150 cm
Gooseneck	approx. 650 mm x 15 mm dia	approx. 650 mm x 15 mm dia.	approx. 510 mm x 13 mm dia.	approx. 510 mm x 13 mm dia.
Base	approx. 180x180x180 mm³	approx. 180x180x180 mm³	approx. 180x180x180 mm³	–
Weight	approx. 2.7 kg	approx. 2.7 kg	approx. 1.7 kg	approx. 400 g



U30150



NEW

Overhead Projector
Reliable overhead projector in modern moulded plastic housing with collapsible reflector column. High quality optical system with correction to avoid coloured edges and highly efficient low noise cooling.

Lamp:	36 V, 400 W
Aperture:	285x285 mm² approx.
Dimensions of housing:	450x440x320 mm³ approx.
Weight:	9 kg approx.

U30150-230
Overhead Projector (230 V, 50/60 Hz)

U30150-115
Overhead Projector (115 V, 50/60 Hz)

U30151
Replacement Bulb for Overhead Projector
(not illustrated)
Replacement bulb for overhead projector, 36 V, 400 W.



U11875

Magnetic Stirrer with Heater
Magnetic stirrer with stainless steel hotplate and secure safety circuit. Variable heating temperature and smooth starting stirrer motor. Housing resistant to chemicals.

Quantity stirred, max. (H_2O):	10 l
Speed:	100 – 2000 rpm
Heater power:	400 W
Heating temperature range:	Room temperature to 320° C
Work plate:	125 mm dia.
Dimensions:	168x105x220 mm³ approx.
Weight:	2.4 kg approx.

U11875-230
Magnetic Stirrer with Heater (230 V, 50/60 Hz)

U11875-115
Magnetic Stirrer with Heater (115 V, 50/60 Hz)



U11876

U11876
Magnetic Stirrer
Ultra flat magnetic stirrer with non wearing drive featuring no moving parts. With feature for changing direction of stirring automatically every 30 seconds for improved homogenization. Work plate and housing resistant to chemicals, non slip and secure base. Including plug in power supply.

Quantity stirred, max. (H_2O):	0.8 l
Speed:	15 – 1500 rpm
Work plate:	100 mm dia.
Power supply:	power supply unit 100 V– 240 V
Dimensions:	114x12x161 mm³ approx.
Weight:	0.3 kg approx.

Whiteboard Holder

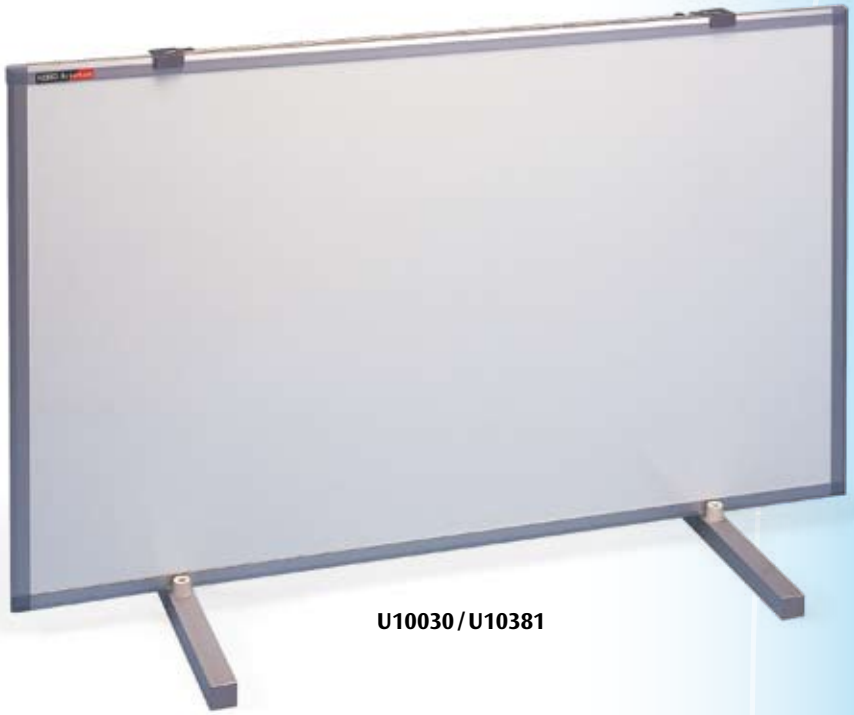
Metal board with enamelled surface for demonstration experiments using magnetic components, e.g., for mechanics or optics. Scratch- and acid resistant steel board that can be written on using water soluble pencils. Can be wall mounted or set up on a stand.

	U10030	U10031
Designation	Whiteboard	Whiteboard
Dimensions	600x900 mm²	900x1200 mm²

U10045



NEW



U10030 / U10381

U10045

Set of Drawing Instruments for Whiteboard

Consisting of a flat profile ruler with decimetre scale divisions, a triangular set square for geometry, circle instrument with centimetre scale, and a pointing baton. With storage case.

Flat profile ruler:	Marked at decimetre intervals, polystyrene, 1000 mm
Set square triangle:	Plexiglas, 600 mm
Circle instrument:	centimetre scale, 520 mm
Pointing baton:	Fibreglass, 1050 mm

U10382



U10381

Whiteboard Holder

Aluminum frame for mounting whiteboards (U10030 / U10031). With two adjusting screws for mounting the board either horizontally or vertically. The horizontal frame consists of profile rails suitable for mounting standard experiment panels of DIN A4 size. T-stands ensure stability on the workbench.

U10381

Holder for Whiteboard, Small

For holding 2 experiment panels of DIN A4 size.

Dimensions: 625x600 mm² approx.

U10382

Holder for Whiteboard, Large

For holding 8 experiment panels of DIN A4 size.

Dimensions: 925x900 mm² approx.

Vissza a tartalomjegyzékhez!

U15020



U15021/22



Laboratory Jacks
Height adjustable table with continuously variable extension mechanism for raising experiment equipment. May be fixed in place via wing nuts.

Art. Nr.	Designation	Maximum load	Tabletop	Height of table	Weight
U15022	Laboratory Jack I	30 kg	320x220 mm²	65 – 250 mm	2.6 kg
U15020	Laboratory Jack II	40 kg	200x200 mm²	70 – 260 mm	2.3 kg
U15021	Laboratory Jack III	50 kg	160x130 mm²	60 – 250 mm	1.2 kg



U8611130

U8611130

Stand with H-Shaped Base
Provides a firm base for large and extensive structures, with six clamping positions for stand rods up to 12 mm diameter.
Max. stand area: 350x250 mm²
Weight: 1 kg approx.



U8611160

Stand Base, A-Shaped
Levelable duplex tripod base, extremely stable, for holding two rods of 4 up to 15 mm diameter. Made of grey cast iron.

Art. Nr.	Leg length	Weight
U8611160	200 mm	1.5 kg
U8611150	280 mm	3.7 kg



U13270

Tripod Stand
Levelable duplex tripod base, extremely stable, for holding two rods of up to 16 mm diameter. Distance between rods 135 mm.

Art. Nr.	Leg length	Weight
U13270	150 mm	1450 g
U13271	185 mm	1850 g



U13265

U13265

Barrel Foot, 1 kg
Heavy base for holding rods of up to 13 mm diameter.
Made of powder-coated cast iron.



U8611210



U8611200

Barrel Foot
Heavy base to accommodate stand rods up to 12 mm in diameter and rectangular plates of up to 10 mm or 12 mm thickness. Made of painted cast iron.

Art. Nr.	Weight	Height	Diameter
U8611200	0.9 kg	56 mm	64 mm
U8611210	0.5 kg	47 mm	54 mm

Stainless Steel Rods

Constructed from straight, non-corrosive stainless steel.
Diameter 12 mm.



U15005

U15002

Art. Nr.	Length
U15000	100 mm
U15001	250 mm
U15002	470 mm
U15003	750 mm
U15004	1000 mm
U15005	1500 mm



U11055

U11055

Drilled Rod

Plastic rod with six lateral bore holes and one axial bore hole for the attachment of components with 4 mm plugs.

Length: 250 mm
Diameter: 12 mm
Bore hole spacing: 19 mm and 50 mm
Bore hole diameter: 4 mm



U13250



U13251

U13250

Bosshead

Bosshead for connecting rods of up to 16 mm diameter.
Powder-coated zinc die-casting, 110 g. Nickel-plated steel screws.

U13251

Cross-Bosshead

Cross-bosshead for connecting rods of up to 16 mm diameter.
Powder-coated zinc die-casting, 160 g. Nickel-plated steel screws.



U13252

U13252

Clamp with Hook

Clamp with hook for attaching rods of up to 16 mm diameter.
Powder-coated zinc die-casting, 93 g. Nickel-plated steel screws.

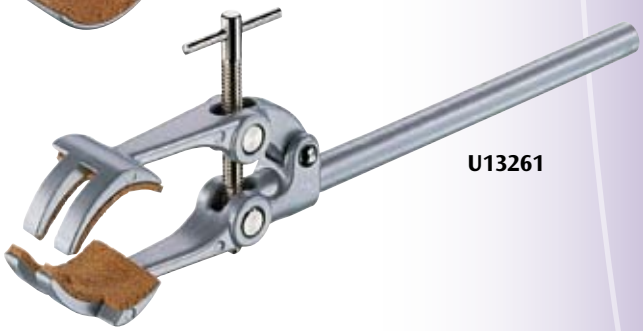


U13253

U13253

Clamp with Jaw Clamp

Stand clamp with jaw clamp for attaching rods up to 16 mm diameter.
Powder-coated zinc die-casting, 190 g. Clamp with cork lining.
Clamping width: 20 – 40 mm



U13261

U13261

Universal Clamp

Clamp with cork lining. Unpainted zinc die-casting, 180 g.
Clamping width: 0 – 80 mm

U13255

Universal Clamp

Universal clamp for attachment of rods up to 13 mm diameter and for holding plates, rulers, etc. of up to 13 mm thickness in a multitude of alignments. Nickel-plated steel screws.



U13255

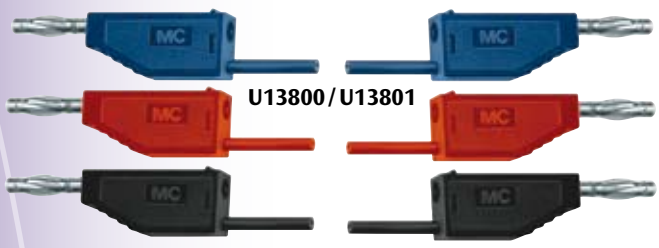


U13260

U13260

Table Clamp

Table clamp for vertically attaching rods of up to 13 mm to tabletops.
Powder-coated aluminum alloy, 350 g
Clamping width: 0 – 60 mm



Set of 15 Experiment Leads, 75 cm

Set of 15 copper leads with highly-flexible PVC insulation, 75 cm long, with stackable 4 mm laminated plugs at both ends. Five leads in each of the colours red, black and blue.

Voltage: Safety extra low voltage
Plugs and sockets: Nickel-plated

Art.-Nr.	Conductor cross-section	Max. continuous current
U13800	1 mm²	19 A
U13801	2.5 mm²	32 A



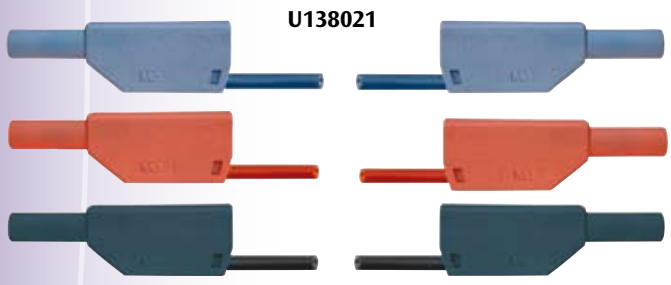
U138101

Set of Experiment Leads for Electron Tube Experiments

Set of 18 copper leads with highly flexible PVC insulation for all connections to series D electron tubes (from U19100).

Wire cross-section: 1 mm²
Max. continuous current: 19 A
Plug and jack: 4 mm (nickel-plated)

Quantity	Length	Colour	Connection
3	75 cm	red	Safety jack/plug
4	75 cm	blue	Plug/plug
2	75 cm	black	Plug/plug
2	50 cm	blue	Plug/plug
5	25 cm	black	Plug/plug
2	25 cm	red	Plug/plug

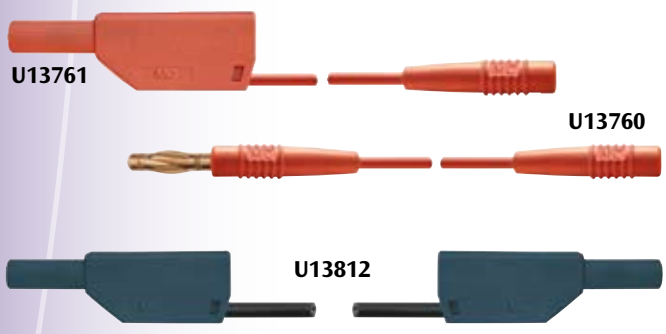


U138021

Set of 15 Safety Experiment Leads, 75 cm

Set of 15 copper leads with highly-flexible PVC insulation, 75 cm long, with stackable 4 mm safety laminated plugs at both ends. Four leads in each of the colours red, black and blue, and one lead in each of the colours green, brown and yellow-green.

Wire cross-section: 2,5 mm²
Voltage: Low voltage
Max. continuous current: 32 A



U13760

Experiment Lead, Plug and Socket

Experiment lead with 4 mm laminated plug and 4 mm socket. 75 cm long, colour red.

Wire cross-section: 1 mm²
Max. continuous current: 19 A

U13761

Experiment Lead, Safety Plug and Socket

Experiment lead with stackable 4 mm safety-grade laminated plug and 4 mm socket. 75 cm long, colour red.

Wire cross-section: 1 mm²
Max. continuous current: 19 A

U13812

Pair of Safety Experiment Leads, 75 cm

Set of two copper leads with highly flexible PVC insulation, 75 cm long, black, with stackable 4 mm safety laminated plugs at both ends.

Conductor cross-section: 2.5 mm²
Voltage: Safety extra low voltage
Max. continuous current: 32 A

U13811

Set of Three Safety Experiment Leads for Free-Fall Apparatus

(not illustrated)

Set of three copper leads with highly flexible PVC insulation for connecting to free-fall apparatus (U8400830), with stackable 4 mm safety laminated plugs at both ends. Two leads 75 cm long, one red and one black. One green lead, 150 cm long.

Wire cross-section: 2,5 mm²
Voltage: Low voltage
Max. continuous current: 32 A

U11255

HF-Patch Cord

Shielded patch cords for low loss, low capacitance transmission of high frequency signals. Equipped at either end with a BNC plug.

Impedance: 50 Ω
Length: 1m

U11257

HF Patch Cord, BNC/4 mm Plug

Shielded patch cord for low loss, low capacitance transmission of high frequency signals. Lead with a BNC plug at one end and two 4 mm plugs at the other end.

Impedance: 50 Ω
Length: 1 m



U11260

Adapter, BNC Jack/4-mm-Plugs

Adapter for crossover from a BNC jack to 4 mm plugs with 19 mm spacing.

U11261

T-Piece, BNC

T-piece for connecting two high-frequency patch cords to one BNC jack.



U11258

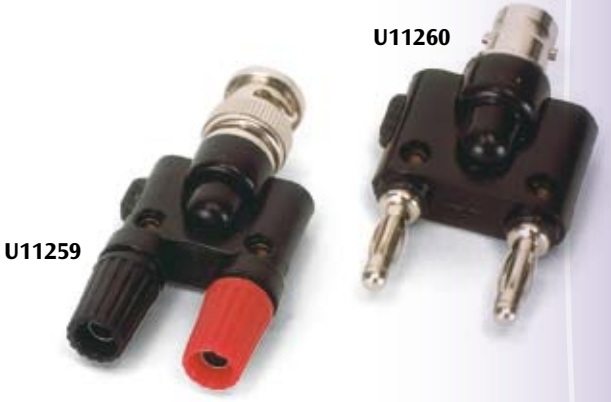
BNC Patch-Cord Connector

Coupling at either end with a BNC jack for connecting high-frequency patch cords.

U11259

Adapter, BNC Plug/4 mm Jacks

Adapter for crossover from a BNC plug to 4 mm jacks.

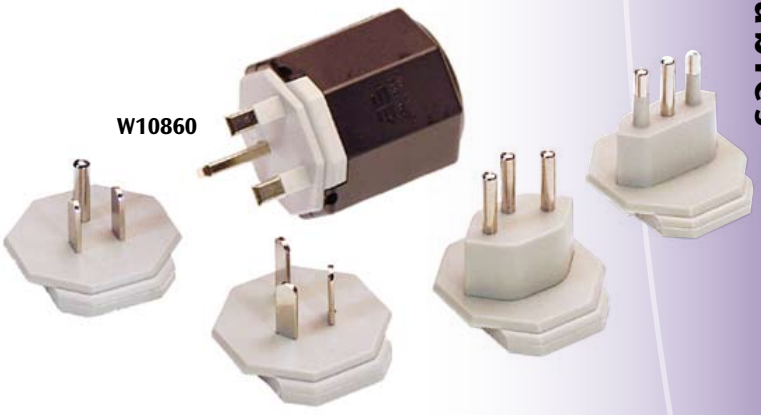


W10860

Universal Plug

Earth-contact socket with various adapters permitting worldwide use. The adapter suitable for the national standard is fitted as the mains contact.

Maximum rated load: 250 V AC, 10 – 16 A



U13805

Crocodile Clip 4 mm, Not Insulated

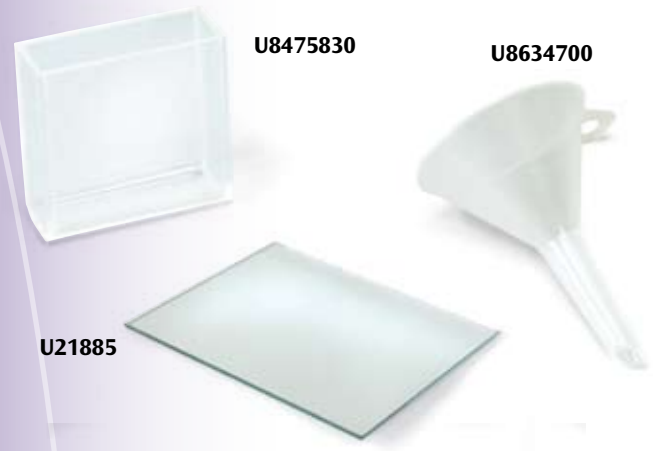
Not insulated test clip with 4 mm sockets for accepting 4 mm-test leads or any other 4 mm-Multilam plug. Connection also possible with screw clamp or soldering.

U13806

Safety Crocodile Clip 4 mm, Black

Fully insulated safety crocodile clip with 4 mm safety socket for accepting 4 mm safety test leads or any other 4 mm Multilam plug.





U8475830

Cuvette, rectangular

Plane-parallel cuvette of plexiglas with highly-polished optical surfaces for investigating the paths of light beams in liquids.

Dimensions: 80x30x80 mm³

U21885

Plane Mirror

Glass mirror, ground edges.

Dimensions: ca. 170x130 mm²

U8634700

Funnel

Funnel, 50 mm diameter, plastic.



Watch Glass Dishes

Made of thin-walled soda-glass, ground rim. Diameter 80 mm or 125 mm.

Art. Nr.	Designation
U14200	Set of 10 Watch Glass Dishes, 80 mm
U14201	Set of 10 Watch Glass Dishes, 125 mm



U8411310

Vessel with Overflow

Vessel with overflow, 275 ml, made of Plexiglas.

U14205

Graduated Cylinder, 100 ml

Graduated cylinder made of Duran glass. Tall form with spout with hexagonal base.

Scale: 100 ml
Divisions: 1 ml

U14206

Free-Standing Cylinder

Non-graduated cylinder made of Duran glass. With round base and coarse ground rim.

Height: 300 mm
Diameter: 40 mm



Beakers, 600 ml

Set of 10 beakers made of Borosilicate glass.
With scale, 100 ml divisions and spout.

Art. Nr.	Designation
U14210	Set of 10 Beakers, low form
U14211	Set of 10 Beakers, tall form

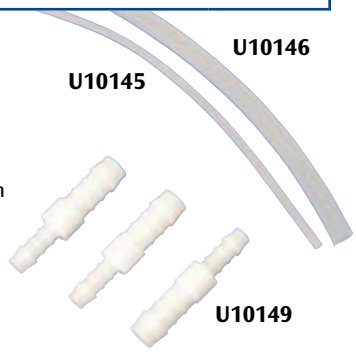


Vacuum Hoses

Our Vacuum hoses are made of natural rubber according to DIN 12865.
Color red.

Temperature range: -30°C – +85°C
Length: 1 m
Wall strength: 5 mm

Art. Nr.	Internal diameter
U10140	8 mm
U10141	10 mm



U10149

Tubing Clamps, Set of 3

Connection adapters, 12 mm to 8 mm diameter, for attachment of hoses.

Tubing

Silicone, transparent, 1 m long.

Art. Nr.	Internal diameter	Wall thickness
U10145	2 mm	1 mm
U10146	6 mm	2 mm

U14350

Pythagorean Cup

Pythagoras is known to most students today as the author of the Pythagorean Theorem ($a^2 + b^2 = c^2$). There was far more to Pythagoras' philosophy than this: he was a deep thinker on religion, the nature of the soul, and the harmony of the cosmos.
With the "Pythagorean Cup" he illustrated to his students the virtues of moderation: when filled halfway, it retains its contents, but if it's too full, all of the liquid drains out through a hole in the bottom.
Our Pythagorean cup is manufactured of clear blown glass. The secret of the construction is a siphon, which is built in the center of the cup. Ideal to explain your students the principle of a siphon with an historical background.

Height: 250 mm
Diameter: 80 mm



U14350



U30000

U30000

Magic Mirror

The Western Han "Light-Transmitting" Mirror known as the magic mirror has a history of more than two thousand years. It is a miracle created by the ingenious Chinese craftsmen in Western Han Dynasty (206 B.C – 24 A.D.) through combining the optical and mechanical principles with superb metallurgical technology. Those wonderful mirrors are able to reflect the decorative pattern cast on their backs onto a white screen when sunlight is shining on their polished fronts.
The fabrication technology of this magic mirror was lost in Song Dynasty (960 – 1279 A.D.) and had remained a mystery until 1975.
With a perfect combination of science and technology, culture and art, the celebrated Magic Mirror is a perfect classroom tool as well as a cherished gift.

Diameter: 75 mm
Thickness: 10 mm

BESTseller



U30001

U30001

Resonance Bowl

Dating from the Song Dynasty (960-1279 A.D.), this bronze basin has two prominent handles and four fish in relief on the bottom, as well as lines emanating from the mouths or tails of the fish. When the handles are rubbed briskly with the palms of the hands, a harmonious sound is heard and standing waves are excited in the four quadrants along the circumference, causing water columns to come alive, spouting more than 30 cm into the air, as if squirting from the fish.

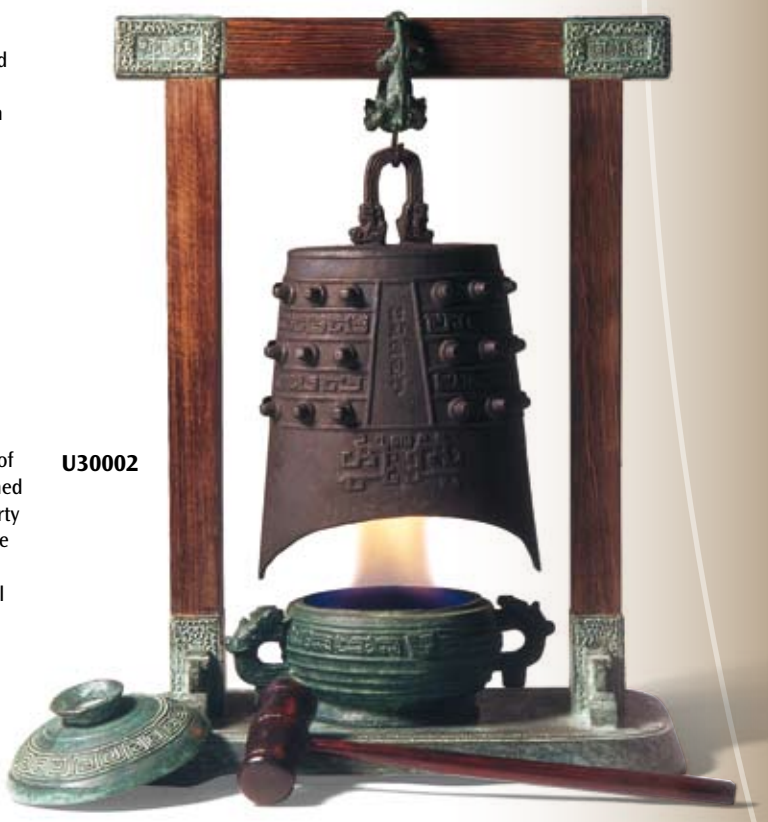
Diameter: 380 mm
Height: 150 mm

U30002

Yi Bell

The "faith bell" is shaped after the two-tone bell unearthed in the tomb of Marquis Yi in 1978. This reproduction has been cast using a newly designed copper alloy containing magnesium and exhibits a unique physical property resulting from a combination of bell design and the effect of temperature on vibrational damping.
At room temperature the bell exhibits excessive damping and gives a dull sound when struck, as though it were made of wood. After being heated with an alcohol burner for several minutes, the bell is restruck and rings beautifully.

Dimensions: approx. 295x210x120 mm³



U30002

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3B Scientific History



The international 3B Scientific group of companies is the world's largest and most experienced manufacturer of anatomical teaching aids. The oldest production site was set up as early as 1819 in Budapest, Hungary. The continuously growing success of 3B Scientific is the result of global expansion, based on the production and sales of high-quality medical and scientific teaching aids available at fair prices. The internationally registered brand name 3B Scientific® can be found around the world in the fields of natural sciences, medical training and patient education. The product range includes artificial skeletons, spines, organs, torsos, charts, medical simulators and software as well as products for lectures in biology and physics. The company has been awarded the DIN EN ISO 9001:2000 certification for the excellent quality of its services, products and organizational structures. This official step towards quality management emphasizes the continuing process of innovation, product improvement and customer orientation that is associated with the brand name 3B Scientific®.

3B stands for: ***Best Quality*** ***Best Value*** ***Best Service***

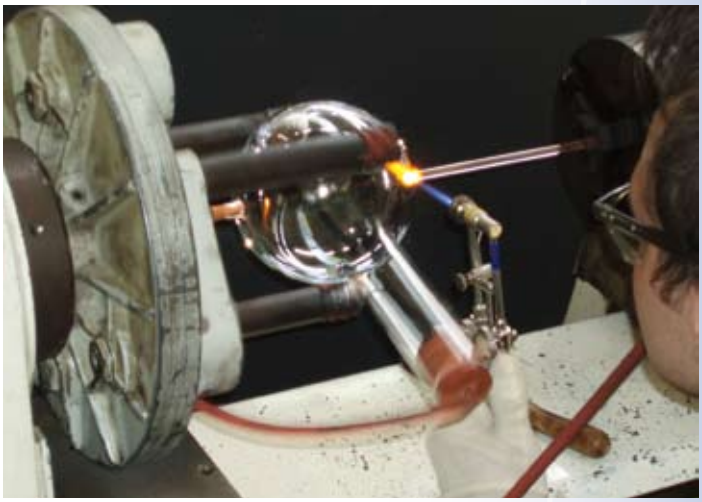


1819 Calderoni founded in Budapest, Hungary
1912 Training Workshops of the German Hygiene Museum founded in Dresden
1948 Paul Binhold Lehrmittelfabrik founded in Hamburg
1950 Production of the first plastic skeleton
1952 First skeleton manufacturing plant opened
1963 New headquarters at Rudorffweg, Hamburg
1965 Introduction of the Torso product line
1970 Introduction of the Binhold company logo
1979 Anatomical models first exported to the USA
1983 First manufacturing of injection moulded skeleton parts
1986 Care simulators added to the product range
1988 Anatomical models first exported to Japan
1991 DHM Lehrmittelfabrik GmbH founded in Dresden
1993 Acquisition of Calderoni and foundation of Biocalderoni in Hungary
1995 American 3B Scientific founded in Atlanta, USA
1996 New logo for the 3B Scientific Group
1997 Nihon 3B Scientific founded in Niigata, Japan
1998 France 3B Scientific founded in Bartenheim, France
1998 Merger of Paul Binhold Lehrmittelfabrik GmbH and DHM Lehrmittelfabrik to form 3B Scientific GmbH
1999 China 3B Scientific founded in Suzhou, China
2000 DIN EN ISO 9001:2000 certification
2001 Introduction of the full 3B Scientific® product range for physics
2002 Italy 3B Scientific founded in Bologna, Italy
2003 España 3B Scientific founded in Valencia, Spain
2003 UK 3B Scientific founded in Weston-super-Mare, United Kingdom
2004 All-European distributor of SEIRIN® acupuncture needles
2004 Acquisition of ELWE Didactic GmbH in Klingenthal
2005 Acquisition of TELTRON® brand name and production
2005 Russia 3B Scientific founded in St. Petersburg.
2006 Brasil 3B Scientific founded in Joinville, Brasil.
2007 Thai 3B Scientific Co Ltd., founded in Bangkok, Thailand

3B Scientific Physics Production

A great deal has been happening at the 3B Scientific production sites in the last few years. In particular, the manufacturing facilities of the two relatively new members of the 3B family, ELWE® and TELTRON®, have been modernised, reorganised, and certified to the standards of ISO 9001:2000, so that we can fulfil your requirements even faster and better. Our promise to you: we are always ready and willing to go the extra distance to meet your needs.

Manufacturing a TELTRON® electron tube at UK 3B Scientific in London
Electron tubes are produced at only a very small number of places in the world. Only specially trained technicians with many years of experience have the skills that are needed for this technologically advanced manufacturing process, which ensures that every TELTRON® electron tube that you receive from us will have the same consistently high quality.



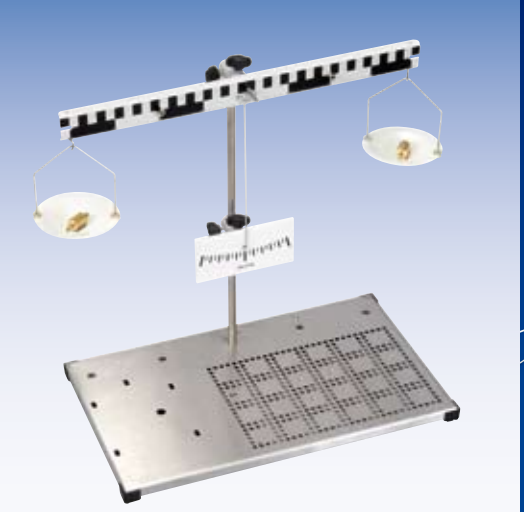
Assembly production at the CNC Processing Centre of ELWE in Klingenthal
The universally recognised high quality of the teaching equipment produced under the ELWE® brand name is achieved through a combination of modern process technology with the best traditional craftsmanship. The skills and facilities of the CNC Processing Centre in Klingenthal guarantee not only the mechanical precision that is essential for high-quality physical instruments, but also cost-effective series production with consistently high quality.



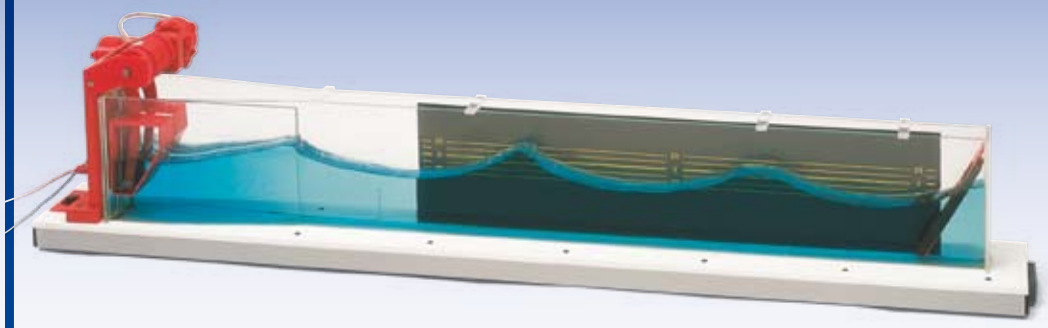
A CAD/CAM workstation at ELWE in Klingenthal
A direct extension from the principles of CAD (Computer Aided Design) is CAM (Computer Aided Manufacturing), here shown being applied to controlling a flat-bed milling machine. This manufacturing technology makes it possible to fulfil special project requirements with speed and with the usual high precision.



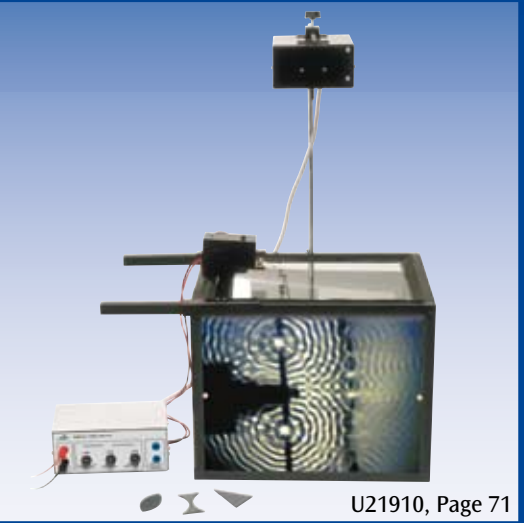
Vissza a tartalomjegyzékhez!



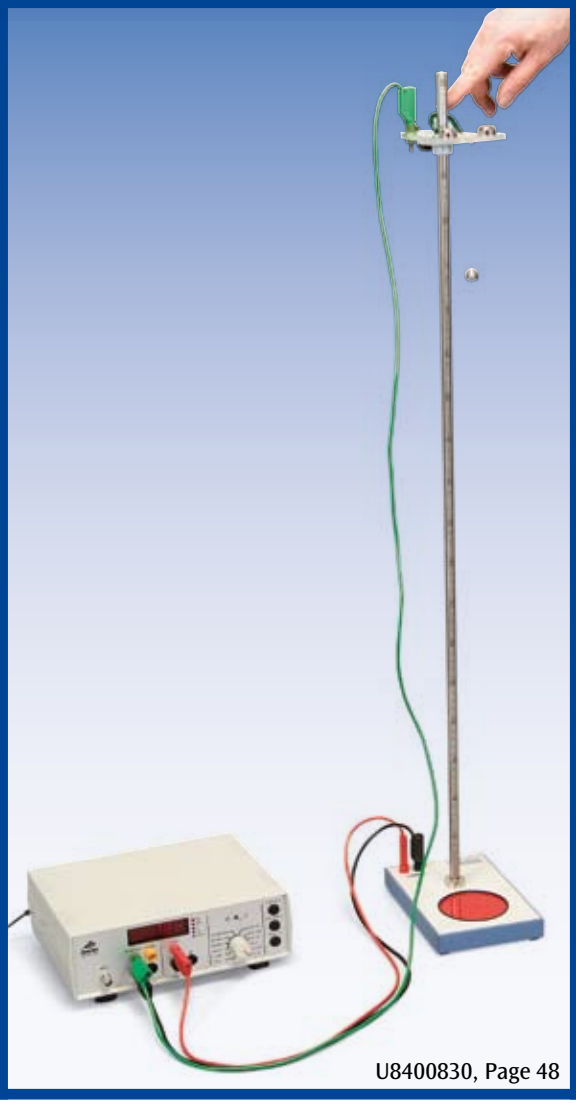
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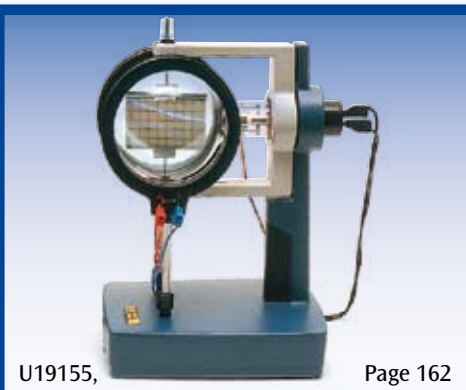
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