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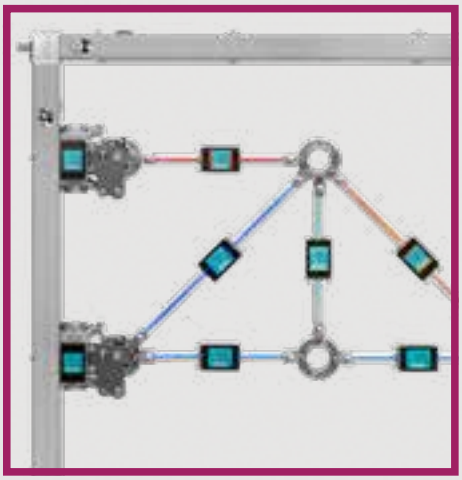





Equipment for engineering education

Entire programme

Innovative sustainable efficient

GUNT Quality Made in Germany

Our excellent product quality, high productivity and extensive know-how means that GUNT is making a significant contribution worldwide in technology education.

At our headquarters in Barsbüttel, near Hamburg 150 highly qualified employees work in a 10,000 m² production and office space. From development and design to production and shipping, everything is located under one roof.

Germany is recognized for its excellent structure for education in technical professions and in engineering. Since 1979 our motto has been:

From Germany to anywhere in the world

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Imprint

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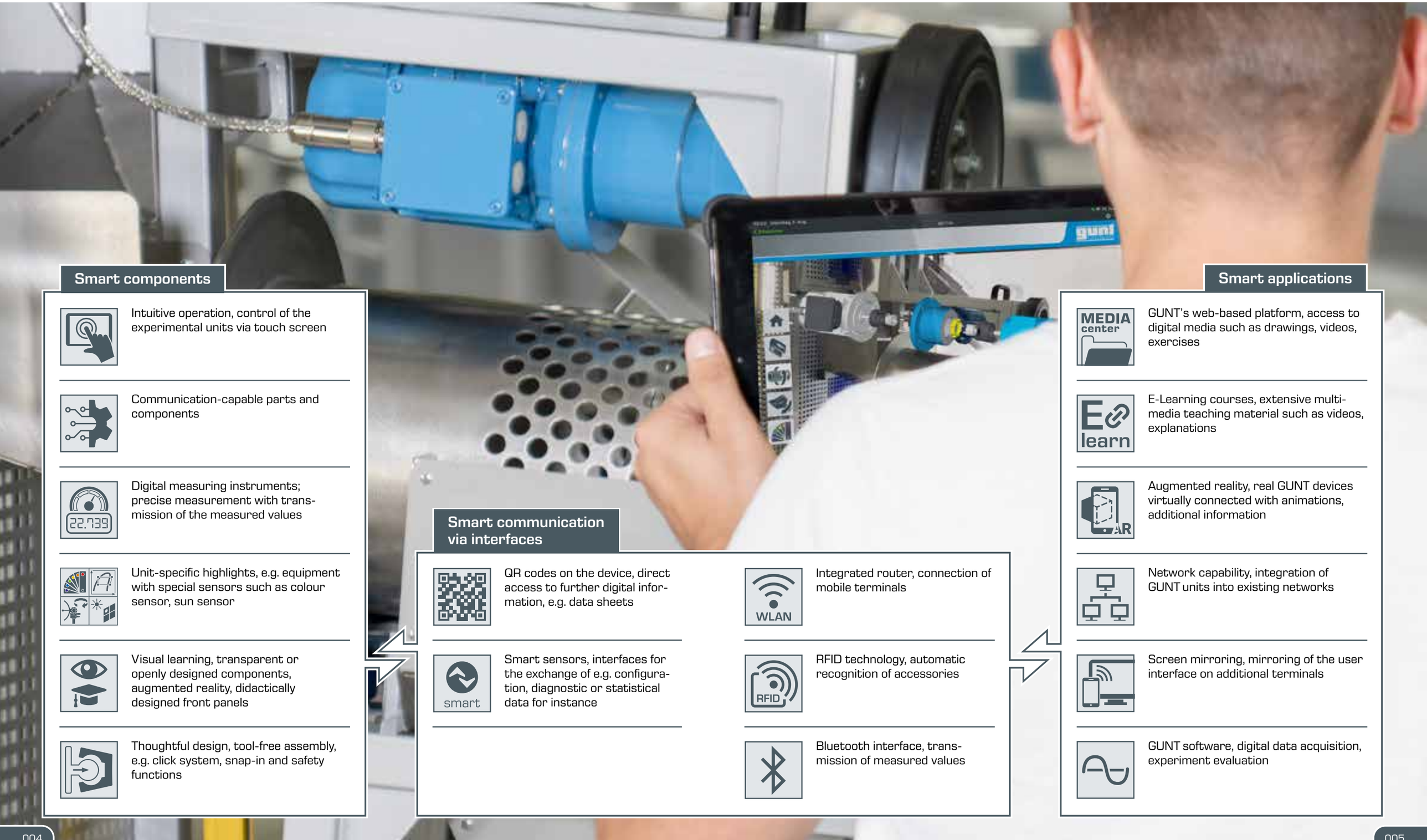
The complete GUNT programme with more than 650 devices from all programme areas

PDF version of the catalogue

Hands-on teaching engineering – with GUNT's SMART features

Digitisation of traditional learning content



Smart components

- Intuitive operation, control of the experimental units via touch screen
- Communication-capable parts and components
- Digital measuring instruments; precise measurement with transmission of the measured values
- Unit-specific highlights, e.g. equipment with special sensors such as colour sensor, sun sensor
- Visual learning, transparent or openly designed components, augmented reality, didactically designed front panels
- Thoughtful design, tool-free assembly, e.g. click system, snap-in and safety functions

Smart communication via interfaces

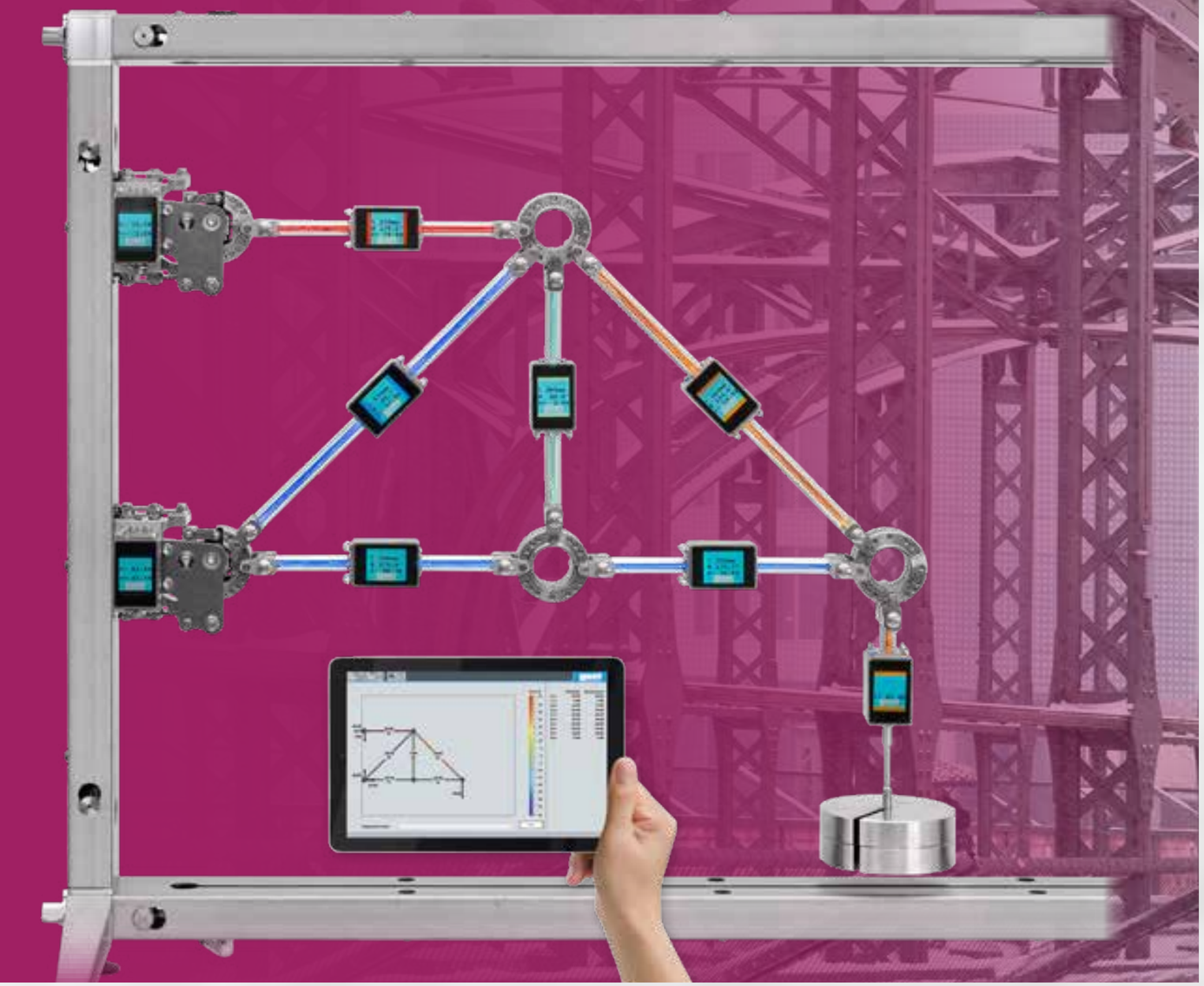
- QR codes on the device, direct access to further digital information, e.g. data sheets
- Smart sensors, interfaces for the exchange of e.g. configuration, diagnostic or statistical data for instance
- Integrated router, connection of mobile terminals
- RFID technology, automatic recognition of accessories
- Bluetooth interface, transmission of measured values

Smart applications

- GUNT's web-based platform, access to digital media such as drawings, videos, exercises
- E-Learning courses, extensive multimedia teaching material such as videos, explanations
- Augmented reality, real GUNT devices virtually connected with animations, additional information
- Network capability, integration of GUNT units into existing networks
- Screen mirroring, mirroring of the user interface on additional terminals
- GUNT software, digital data acquisition, experiment evaluation

Hands-on teaching engineering –

with GUNT's SMART features



About the product:

1 | Engineering mechanics and engineering design

Engineering mechanics and engineering design

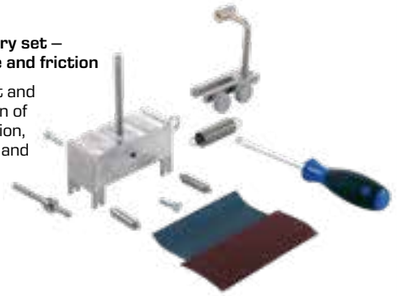
Engineering mechanics – statics
Forces and moments

TM 110
Fundamentals of statics

Demonstration of force and moment equilibrium in a mechanical force system

TM 110.01
Supplementary set – inclined plane and friction

Measurement and demonstration of spring deflection, inclined plane and mechanical friction



TM 110.02
Supplementary set – pulley blocks

Construction and mode of operation of three different pulley blocks

TM 110.03
Supplementary set – gear wheels

Mode of operation of single-stage and multistage toothed gear mechanisms

TM 115
Forces in a crane jib

Graphical and experimental determination of forces in a planar central force system

EM 049
Equilibrium of moments on a two-arm lever

Investigation of applied forces, generated moments and equilibrium

SE 112
Mounting frame

Base unit for clear and simple set-up of experiments on statics, strength of materials and dynamics

SE 110.53
Equilibrium in a single plane, statically determinate system

Experimental investigation of the important principle of free vectors in statics

SE 112 Mounting frame required

TM 121
Equilibrium of moments on pulleys

Clear demonstration of the equilibrium of moments

FL 111
Forces in a simple bar structure

Resolution of forces in a simple bar structure

TM 122
Equilibrium of moments on a differential pulley block

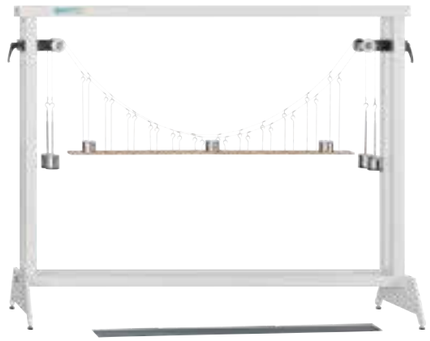
Equilibrium of forces and moments and the demonstration of the force reduction on a differential pulley block

Engineering mechanics – statics
Bridges, beams, arches, cables

SE 110.18
Forces on a suspension bridge

Supporting cable force and demonstration of bending moments between the roadway support and supporting cables

SE 112 Mounting frame required



SE 110.12
Lines of influence on the Gerber beam

Using methods of section and conditions of equilibrium of statics to determine support forces

SE 112 Mounting frame required

Engineering mechanics – statics
Bridges, beams, arches, cables

SE 110.17
Three-hinged arch

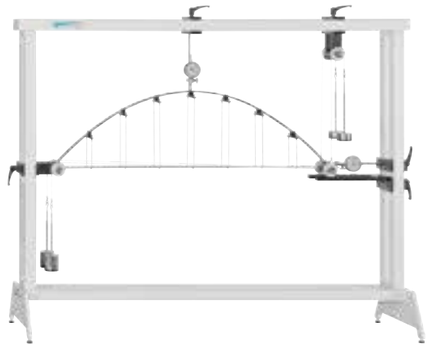
Symmetric and asymmetric arch subjected to point, distributed or moving loads

SE 112 Mounting frame required

SE 110.16
Parabolic arch

Differences between statically determinate and statically indeterminate arches under load

SE 112 Mounting frame required



Engineering mechanics – statics
Internal reactions and methods of section

WP 960
Beam on two supports: shear force & bending moment diagrams

Application of the method of sections to determine internal reactions of the beam

WP 961
Beam on two supports: shear force diagram

Application of the method of sections to determine the shear force

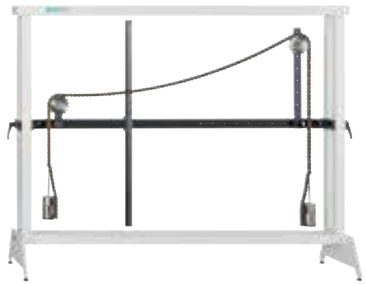
WP 962
Beam on two supports: bending moment diagram

Application of the method of sections to determine the bending moment

SE 110.50
Cable under dead-weight

Catenary of a free-hanging cable under dead-weight

SE 112 Mounting frame required

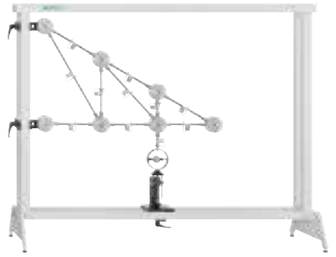


Engineering mechanics – statics
Forces in a truss

SE 110.21
Forces in various single plane trusses

Using strain gauge technology to measure bar forces

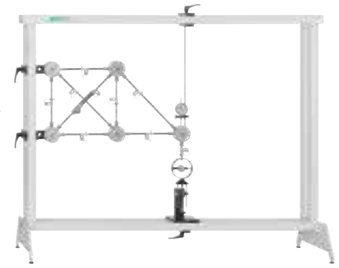
SE 112 Mounting frame required



SE 110.22
Forces in an indeterminate truss

Comparison of forces in statically determinate and statically indeterminate trusses

SE 112 Mounting frame required

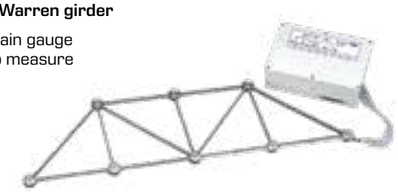


SE 130
Forces in a Howe truss

Investigation of bar forces under different load cases

SE 130.01
Truss beam: Warren girder

Bars with strain gauge full bridges to measure bar stress



FL 152
Multi-channel measuring amplifier

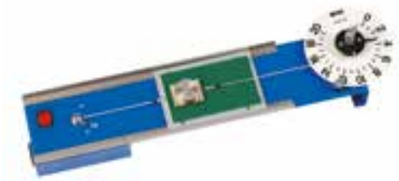
Processing of analogue measuring signals for stress and strain analysis FL 120 – FL 140 and for GUNT trusses

Analysis using the software in FL 152

Engineering mechanics – statics
Static and kinetic friction

TM 200
Fundamentals of mechanical friction

Stationary friction body, uniformly moving friction plate



TM 210
Dry friction

Force gauge with adjustable air damper to determine friction forces; slip / stick effect

TM 225
Friction on the inclined plane

Experiments to understand the fundamentals of mechanical friction on an inclined plane

TM 220
Belt drive and belt friction

Influence of the angle of contact, coefficient of friction and belt force (Eytelwein's belt friction formula)

Engineering mechanics – strength of materials
Elastic deformations

SE 110.14
Elastic line of a beam

Demonstration of Maxwell-Betti theorem

SE 112 Mounting frame required

WP 950
Deformation of straight beams

Elastic lines of statically determinate and indeterminate beams under various clamping conditions

SE 110.47
Methods to determine the elastic line

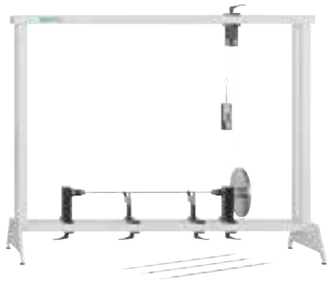
Determination of elastic lines of a beam under load using the principle of virtual work and Mohr's Analogy

SE 112 Mounting frame required

SE 110.29
Torsion of bars

Investigation of elastic torsion of bars with open and closed cross-section

SE 112 Mounting frame required



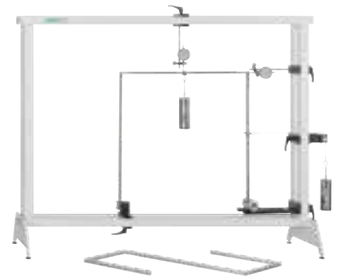
WP 100
Deformation of bars under bending or torsion

Influence of material, cross-section and clamping length on deformation

SE 110.20
Deformation of frames

Elastic deformation of a statically determinate or indeterminate frame under point load

SE 112 Mounting frame required



FL 170
Deformation of curved-axis beams

Principle of virtual forces (the force method) for calculating deformation

SE 110.44
Deformation of trusses

Application of Castigliano's first theorem

SE 112 Mounting frame required

Engineering mechanics – strength of materials
Elastic deformations

TM 262
Hertzian pressure

Demonstration of the resulting characteristics of the contact area as a function of the contact force

TM 400
Hooke's law

Elastic behaviour of tension springs under load

Engineering mechanics – strength of materials
Buckling and stability

SE 110.19
Investigation of simple stability problems

Determination of the buckling load under different conditions

SE 112 Mounting frame required

WP 120
Buckling behaviour of bars

Verification of the Euler theory of buckling: influence of material, cross-section, length, and support

WP 121
Demonstration of Euler buckling

Correlation between buckling length, buckling load and various methods of support

SE 110.57
Buckling of bars

Determination of the buckling load: influence of material, support, and shear force

SE 112 Mounting frame required

Engineering mechanics – strength of materials
Compound stress

FL 160
Unsymmetrical bending

Investigation of symmetrical and unsymmetrical bending on a beam. Combined bending and torsion loading using an eccentric force.

WP 130
Verification of stress hypotheses

Multiaxial loading of samples by bending and torsion

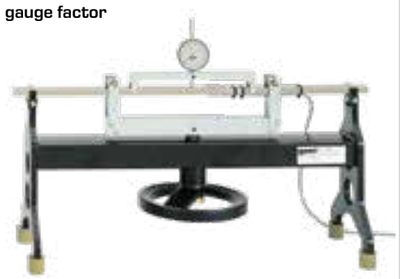
Engineering mechanics – strength of materials
Experimental stress and strain analysis

FL 100
Strain gauge training system

Basic introduction to measurement with strain gauges for tension, bending and torsion

FL 102
Determining the gauge factor of strain gauges

Calibration of a strain gauge: measurement of deflection and strain



FL 101
Strain gauge application set

Complete equipment for practising manual handling of strain gauge technology

Engineering mechanics – strength of materials
Experimental stress and strain analysis

FL 120
Stress and strain analysis on a membrane

Investigation of deflection and strain of a membrane under internal pressure; membrane with strain gauge application

FL 130
Stress and strain analysis on a thin-walled cylinder

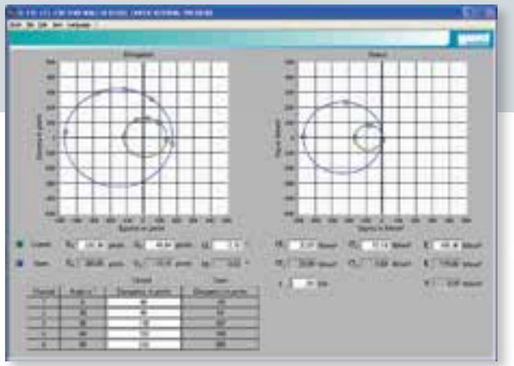
Investigation of axial and circumferential stress in a thin-walled cylinder under internal pressure

FL 140
Stress and strain analysis on a thick-walled cylinder

Triaxial stress state in the cylinder wall; cylinder with strain gauge application on surface and in wall

FL 152
Multi-channel measuring amplifier

Processing of analogue measuring signals for stress and strain analysis FL 120 – FL 140 and for GUNT trusses



Analysis using the software in FL 152

FL 200
Photoelastic experiments with a transmission polariscope

Visualisation of mechanical stresses in models subject to varying loads

FL 210
Photoelastic demonstration

Representation of distribution of stress and stress concentrations in component models.
Can be used in conjunction with an overhead projector.

Engineering mechanics – dynamics
Kinematics

KI 110
Kinematic model: crank mechanism

Conversion of rotary motion into oscillating motion

KI 120
Kinematic model: crank slider

Conversion of a uniform rotary motion into a pure harmonic recipro-cating motion

KI 130
Kinematic model: four-joint link

Conversion of rotary motion into oscillating motion

KI 140
Kinematic model: Whitworth quick return mechanism

Uneven reciprocating motion with slow feed and quick return

KI 150
Kinematic model: Hooke's coupling

Phenomenon of the gimbal error in Hooke's couplings and how to avoid it

KI 160
Kinematic model: Ackermann steering mechanism

Determining the lead angle of a steering trapezoid

GL 105
Kinematic model: gear drive

Investigation of transmission ratios on spur gear units

Engineering mechanics – dynamics
Kinetics: basic experiments on dynamics and moment of inertia

TM 610
Rotational inertia

Moments of inertia of different mass arrangements and bodies

TM 612
Kinetic model: flywheel

Experimental determination of the moment of mass inertia of a flywheel

TM 611
Rolling disk on inclined plane

Determining moment of inertia on rotating masses by rolling down an inclined plane and by performing a pendulum test

GL 210
Dynamic behaviour of multistage spur gears

Investigation of the dynamics of rotation of one-, two- and three-stage spur gear units

GL 212
Dynamic behaviour of multistage planetary gears

Investigation of rotational dynamics of a two-stage epicyclic gear with three planetary gears each

Engineering mechanics – dynamics
Kinetics: dynamics of rotation

TM 600
Centrifugal force

Laws on the behaviour of centrifugal forces on rotating masses

TM 605
Coriolis force

Demonstration of the Coriolis force in rotating reference systems

TM 632
Centrifugal governor

Characteristic curves of different centrifugal force governors

TM 630
Gyroscope

Experimental verification of the laws of gyroscopes

Engineering mechanics – dynamics
Vibrations

TM 150
Vibration trainer

Experiments on damping, resonance and absorber effects in forced vibrations

SE 110.58
Free vibrations in a bending beam

Investigation of the free vibration of a bar and using the Rayleigh method to evaluate the natural frequency of a bar

SE 112 Mounting frame required

TM 161
Rod and gravity pendulum

Comparison of physical and mathematical pendulum

TM 162
Bifilar/trifilar suspension of pendulums

Moments of inertia of different bodies in a rotary pendulum experiment

TM 163
Torsional vibrations

Determination of the oscillation period depending on torsion wire length, diameter and rotating mass

TM 164
Coil spring vibrations

Investigation of vibrations on a spiral spring rotating mass system

Machine dynamics
Vibrations in machines

TM 155
Free and forced vibrations

Basic experiments on mechanical vibration theory

TM 150.02
Free and damped torsional vibrations

Influence of mass, torsional rigidity and damping on the behaviour of a rotary oscillator. Vibrations are recorded on the TM 150 / TM 155 recorder.

TM 140
Free and forced torsional vibrations

Illustrative experiments on a torsion test bar with varying masses; multiple mass oscillator

HM 159.11
Ship vibration apparatus

Dynamic behaviour of a ship structure; experiments in air and in water

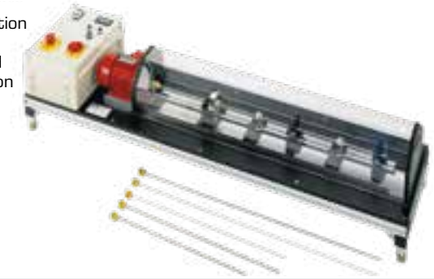
Machine dynamics
Rotor dynamics

TM 620
Bending elasticity in rotors

Investigation of bending vibrations and resonance of a rotating shaft

TM 625
Elastic shafts

Determination of critical speeds and investigation of natural modes of a shaft



Machine dynamics
Balancing

TM 170
Balancing apparatus

Demonstration of the fundamentals of static and dynamic balancing

PT 502
Field balancing

Measurement of imbalance vibrations

Machine dynamics
Mass forces and mass balance

TM 180
Forces in reciprocating engines

Investigation of mass forces on a reciprocating piston machine

GL 112
Investigation of cam mechanisms

Comparison of different cam members; recording elevation curves

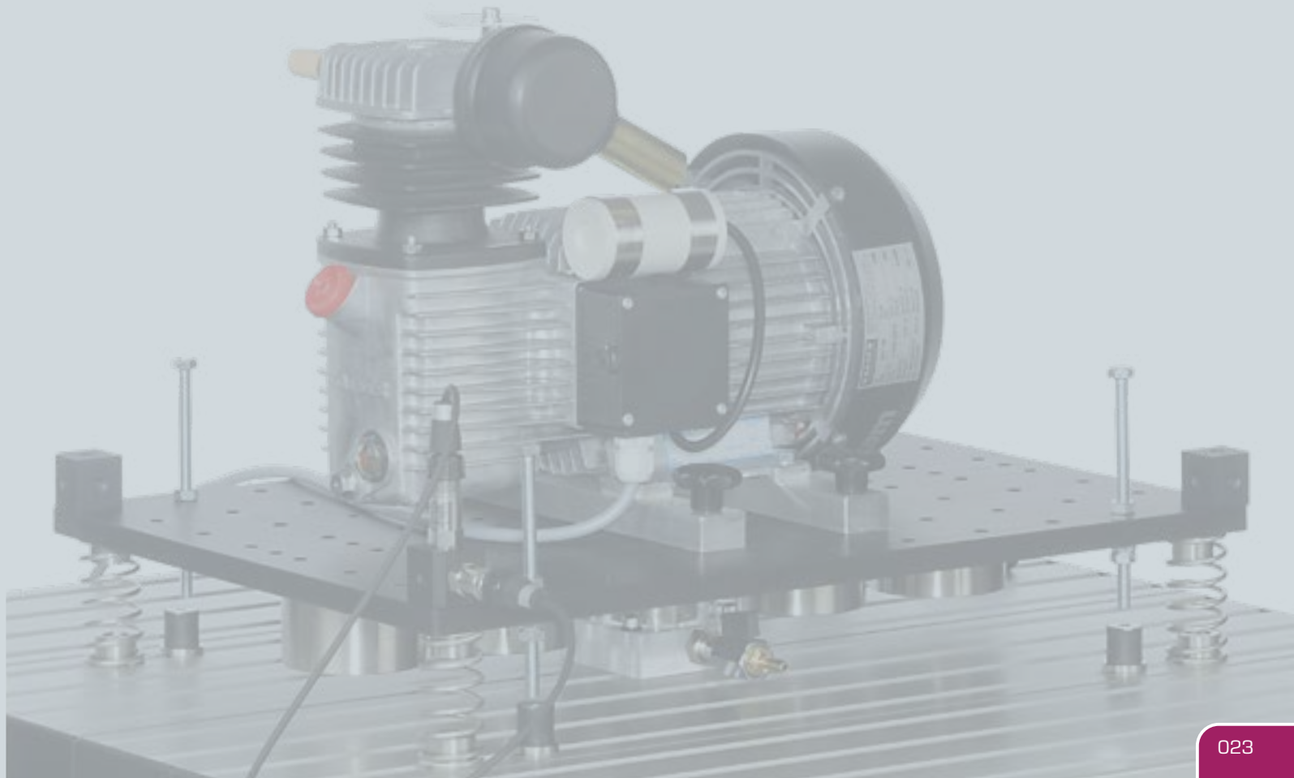
Machine dynamics
Vibration isolation

TM 182
Vibrations on machine foundations

Machine foundation and isolation of vibrations

TM 182.01
Piston compressor for TM 182

Used for generating vibrations for the TM 182



Machine dynamics
Machinery diagnosis

PT 500
Machinery diagnostic system, base unit

Base unit for setting up wide ranging experiments in machinery diagnostics using modular accessory sets

PT 500.10
Elastic shaft kit

Bending vibrations of elastic shaft

PT 500.11
Crack detection in rotating shaft kit

Vibrational behaviour of a shaft with a radial crack

PT 500.12
Roller bearing faults kit

Assessment of bearing condition by vibration analysis

PT 500.13
Couplings kit

Vibration analysis of couplings

PT 500.14
Belt drive kit

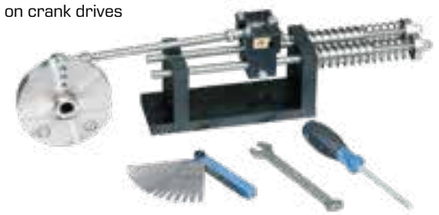
Vibrations in belt drives

PT 500.15
Damage to gears kit

Vibration analysis of gearing damage

PT 500.16
Crank mechanism kit

Vibrations on crank drives



PT 500.17
Cavitation in pumps kit

Observation and measurement of cavitation

PT 500.18
Vibrations in fans kit

Identification of the vibration induced by the blades from the vibration spectrum

PT 500.19
Electromechanical vibrations kit

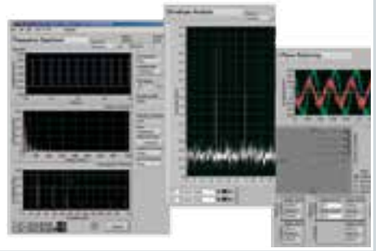
Investigation of vibrational behaviour of an electric motor

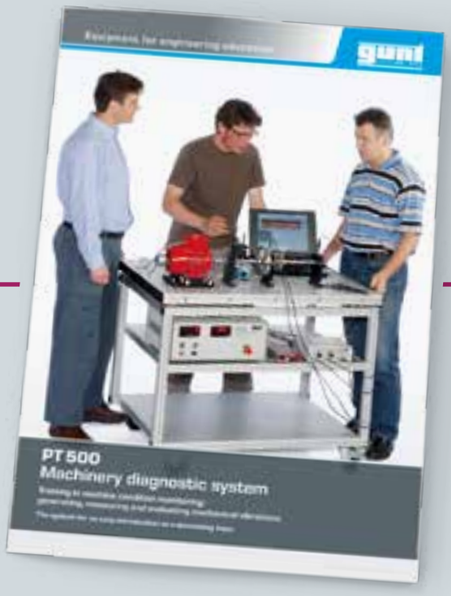
PT 500.05
Brake & load unit

Unit for generating a load torque for use on various PT 500 experiments

PT 500.04
Computerised vibration analyser

Supports all machinery diagnostic experiments of the PT 500 series





PT 501
Roller bearing faults

Investigation of the vibrations of roller bearings

Engineering design
Engineering drawing

TZ 100
Engineering drawing: three-dimensional display

Set of models for fundamentals of technical drawing

Multimedia instructional materials via Internet

TZ 200.61
Engineering drawing: rotationally symmetrical components

Technical drawing course for the representation of rotationally symmetrical parts

TZ 200.02
Engineering drawing: casting

Two workpieces for technical drawing on the topic of cast parts

TZ 200.08
Engineering drawing: safety catch

Practice model providing an introduction to technical drawing

TZ 300
Assembly of lever press

Functional lever press for drawing, measurement and assembly exercises

Multimedia instructional materials via Internet

TZ 200.71
Assembly of lever shears

Complex course for drawing and assembly exercises

Multimedia instructional materials via Internet

TZ 200.11
Assembly of bending device

For drawing, measurement and assembly exercises

Multimedia instructional materials via Internet

Engineering design
Cutaway models

GL 300.01
Cutaway model: worm gear

GL 300.02
Cutaway model: mitre gear

GL 300.03
Cutaway model: spur gear

GL 300.04
Cutaway model: two-stage spur gear

GL 300.05
Cutaway model: planetary gear

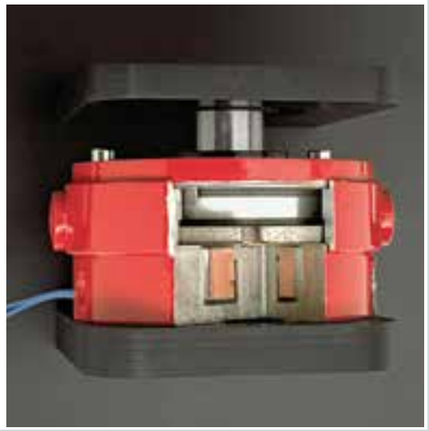
GL 300.06
Cutaway model: variable speed belt drive

GL 300.07
Cutaway model: control gear

GL 300.08
Cutaway model: multiple-disc clutch

Engineering design
Cutaway models

GL 300.10
Cutaway model:
electromagnetic single disk brake



GL 300.12
Cutaway model:
pedestal bearing

TM 320
Screw connections testing

Correlation between tightening torque and tension force on standardised bolts

TM 310
Thread testing

Thread efficiencies for different pairs of materials and thread pitches

Engineering design
Machine elements: fasteners

MG 901
Nuts and bolts kit

Comprehensive instructional kit of the main nuts and bolts used in engineering

MG 905
Thread types kit

Standardised designations, terms and specific applications of different thread types, determination of the thread type with the thread gauge

MG 903
Screw-locking devices kit

Standardised designations, terms and graphical representation of different screw-locking devices

Engineering design
Machine elements: bearings

MG 911
Roller bearings kit

Familiarisation with the most important roller bearing types and their specific applications

Engineering design
Machine elements: transmission elements

GL 100
Principle of gear units

Fundamental principles of belt drives, wheel and disc drives, and gear trains

TM 123
Spur gear unit

Mode of operation and layout of toothed gearing mechanisms

TM 124
Worm gear unit

Mode of operation and layout of a worm gear

TM 125
Cable winch

Using force equilibrium considerations to determine load transmission and efficiency

GL 110
Cam mechanism

Demonstration and measurement of the displacement curves for cam mechanisms

TM 220
Belt drive and belt friction

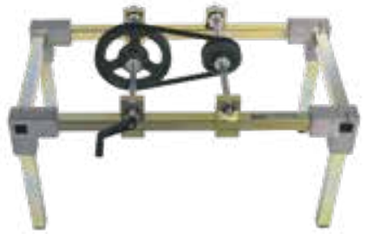
Influence of the angle of contact, coefficient of friction and belt force (Eytelwein's belt friction formula)

AT 200
Determination of gear efficiency

Test system for determining mechanical drive and braking efficiency for spur and worm gears

GL 410
Assembly simple gears

Versatile assembly exercise for simple drives using a belt, chain sprockets or a roller chain

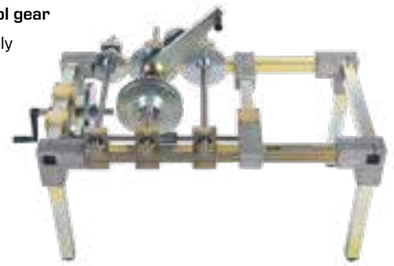


GL 420
Assembly combined gears

Versatile assembly exercise for combined drives

GL 430
Assembly control gear

Versatile assembly exercise for various step and gear units



GL 200
Lathe gear

Safe and clear demonstration of function of the gears on a conventional lathe

Engineering design
Assembly exercises

MT 190
Assembly materials tester

Study project with extensive practical relevance for training in metal working professions by constructing a hydraulic tensile/compression testing device

MT 190.01
Assembly data acquisition for materials tester

Mechanical and electrical engineering assembly kit: fully functional data acquisition for the materials tester MT 190

MT 171
Assembly hydrodynamic journal bearing

Understanding components and function; assembly and maintenance

MT 120
Assembly exercise: spur gear

Design and function of a spur gear with helical gear wheels; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 121
Assembly exercise: mitre gear

Design and function of a mitre gear; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 122
Assembly exercise: planetary gear

Design and function of a planetary gear; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 123
Assembly exercise: spur and worm gear

Design and function of a spur and worm gear; planning, assembly and disassembly

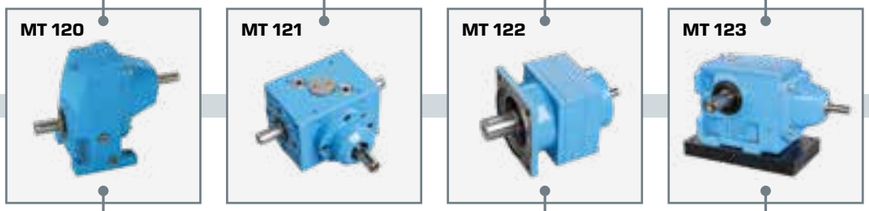
Multimedia instructional materials via Internet

MT 173
Test stand for gears

Test system for determining the mechanical efficiency of different gear types, system control via PLC

Skill Level 1 2 3 4 5
GUNT-DigiSkills

How to achieve the digital transformation to Industry 4.0



MT 174
Sorting plant

Preventive maintenance based on the example of a separation process, system control via PLC

Skill Level 1 2 3 4 5
GUNT-DigiSkills

Materials testing
Tensile, compression, bending and hardness testing

WP 300
Materials testing, 20 kN

Training unit for basic experiments on materials testing: tensile tests, Brinell hardness tests, stress-strain diagrams

WP 310
Materials testing, 50 kN

Direct generation of tensile and compressive forces

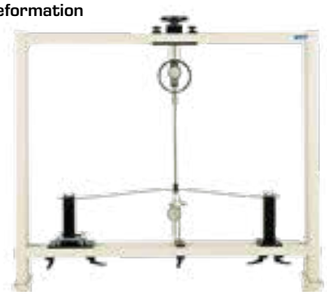
SE 100
Frame for load testing, 400 kN

Load tests on components from steelwork and civil engineering; size allows measurements on real components

SE 110.48
Bending test, plastic deformation

Observation and determination of the transition from elastic to plastic deformation

SE 112 Mounting frame required



Materials testing
Impact bending test

WP 400
Impact test, 25 Nm

Classic Charpy notched-bar impact test; specimens with different cross-sections and materials

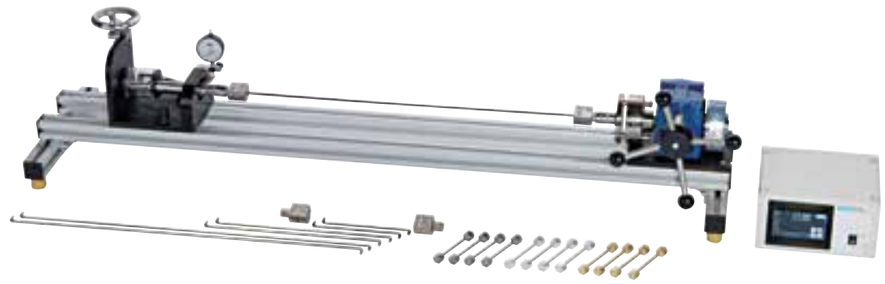
WP 410
Impact test, 300 Nm

Charpy notched-bar impact test with increased work capacity

Materials testing
Torsional test

WP 500
Torsion test, 30 Nm

Manual torsion testing of different materials to fracture



WP 510
Torsion test 200 Nm, motor drive

Motorised torsion testing of different materials to fracture, four different test velocities

Materials testing
Fatigue of materials

WP 140
Fatigue strength test

Fatigue strength of bars subject to cyclic bending load; stress-number (S-N) diagram

WP 600
Creep rupture test

Demonstration of typical creep phenomena in various materials

Materials testing
Tribology and corrosion

TM 260
Drive unit for tribological investigations

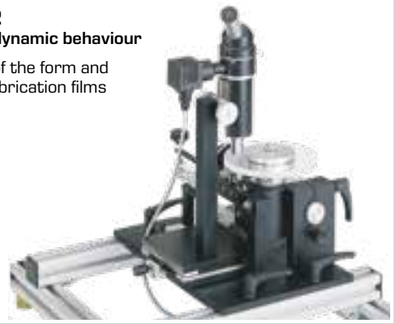
Modular experimental system for sliding and rolling friction

TM 260.01
Rolling friction in friction wheels

Slip forces in two discs rubbing together

TM 260.02
Elasto-hydrodynamic behaviour

Investigation of the form and thickness of lubrication films



TM 260.03
Dynamic friction in pin – disk

Investigations into wear on pairs of friction materials with surface contact

TM 260.04
Frictional vibrations

Differences between static and sliding friction, instability

TM 260.06
Pressure distribution in journal bearings

Demonstration of pressure distribution in a plain bearing with hydrodynamic lubrication

TM 260.05
Dynamic friction in cylindrical pin – roller

Investigation of wear in pairs of friction materials with point of contact

TM 232
Bearing friction

Sliding bearing friction with different bearing material pairings and comparison with rolling bearing friction

TM 282
Friction in journal bearings

Learning the fundamentals of hydrodynamic lubrication by experimen-tation

TM 280
Pressure distribution in journal bearings

Illustrates the principle of hydrodynamic lubrication

TM 290
Journal bearing with hydrodynamic lubrication

Investigation of friction in a hydrodynamically lubricated journal bearing

CE 105
Corrosion of metals

Parallel investigation of different influencing factors on different metal samples

Hands-on teaching engineering –

with GUNT's SMART features

2 | Mechatronics

About the product:

WLAN MEDIA center E learn

Engineering design
Engineering drawing

TZ 100
Engineering drawing: three-dimensional display

Set of models for fundamentals of technical drawing

Multimedia instructional materials via Internet

TZ 110
Cylindrical work samples with cut-outs parallel to axis

Comprehensive collection of models with varying levels of difficulty

Multimedia instructional materials via Internet

TZ 120
Cylindrical work samples with slanted cut-outs

Comprehensive collection of models with varying levels of difficulty

Multimedia instructional materials via Internet

TZ 130
Prismatic work samples with cut-outs parallel to edges

Comprehensive collection of models with varying levels of difficulty

Multimedia instructional materials via Internet

TZ 140
Prismatic work samples with slanted cut-outs

Comprehensive collection of models with varying levels of difficulty

Multimedia instructional materials via Internet

TZ 200.01
Bending device

Steel bending device as the basis for extensive technical drawing course

Multimedia instructional materials via Internet

TZ 200.07
Lever shear

Functional lever shear: drawing, measurement, assembly

Multimedia instructional materials via Internet

TZ 200.04
Drilling jig for a casting

Steel drilling jig as the basis for extensive technical drawing course

TZ 200.06
Drilling jig for an annular disc

Steel drilling jig as the basis for extensive technical drawing course

TZ 200.09
Drilling jig for flat part

Complete technical drawing course using a drilling jig as an example

TZ 200.08
Engineering drawing: safety catch

Practice model providing an introduction to technical drawing

TZ 200.02
Engineering drawing: casting

Two workpieces for technical drawing on the topic of cast parts

Engineering design
Engineering drawing

TZ 200.11
Assembly of bending device

For drawing, measurement and assembly exercises

Multimedia instructional materials via Internet

TZ 200.61
Engineering drawing: rotationally symmetrical components

Technical drawing course for the representation of rotationally symmetrical parts

TZ 200.71
Assembly of lever shears

Complex course for drawing and assembly exercises

Multimedia instructional materials via Internet

TZ 300
Assembly of lever press

Functional lever press for drawing, measurement and assembly exercises

Multimedia instructional materials via Internet

Engineering design
Cutaway models: gear and drive elements

GL 300.01
Cutaway model: worm gear

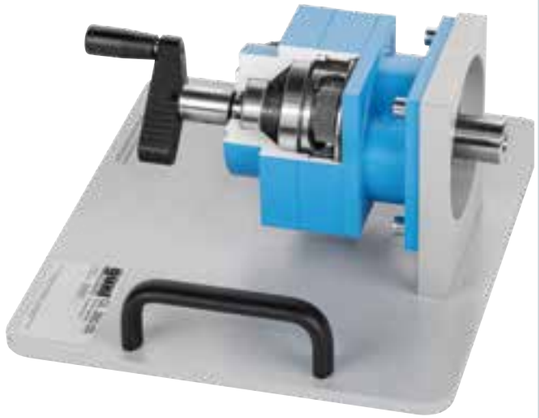
GL 300.02
Cutaway model: mitre gear

GL 300.03
Cutaway model: spur gear

GL 300.04
Cutaway model: two-stage spur gear

Order No.: 030.30004

GL 300.05
Cutaway model: planetary gear

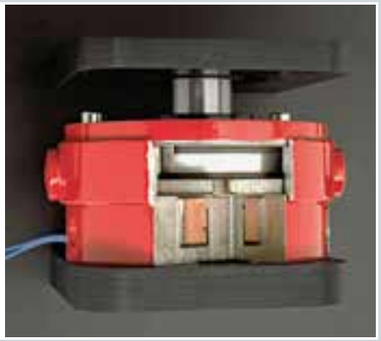


GL 300.06
Cutaway model: variable speed belt drive

GL 300.08
Cutaway model: multiple-disc clutch

GL 300.07
Cutaway model: control gear

GL 300.10
Cutaway model: electromagnetic single disk brake



GL 300.12
Cutaway model: pedestal bearing

Engineering design
Cutaway models: refrigeration components

ET 499.30
Cutaway model:
ceiling air cooler

ET 499.01
Cutaway model:
hermetic refrigerant compressor

ET 499.18
Cutaway model:
thermostatic expansion valve

ET 499.19
Cutaway model:
automatic expansion valve

ET 499.02
Cutaway model:
semi-hermetic refrigerant compressor

ET 499.03
Cutaway model:
open refrigerant compressor, two-cylinder

ET 499.21
Cutaway model:
sight glass with humidity indicator

ET 499.25
Cutaway model:
4-way reversing valve

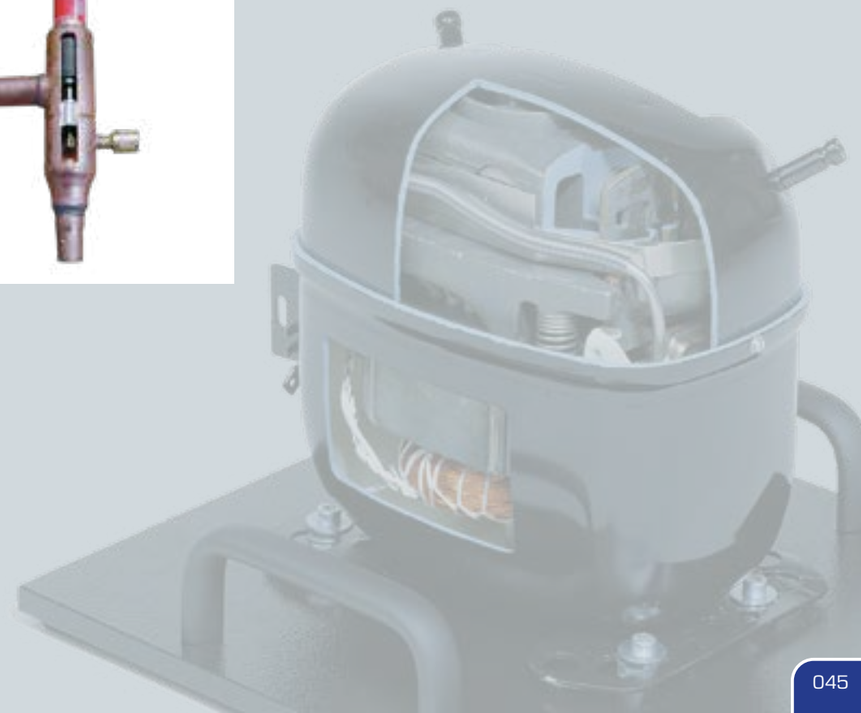
ET 499.12
Cutaway model:
block drier

ET 499.13
Cutaway model:
oil separator

ET 499.26
Cutaway model:
condensation pressure control valve

ET 499.14
Cutaway model:
liquid separator

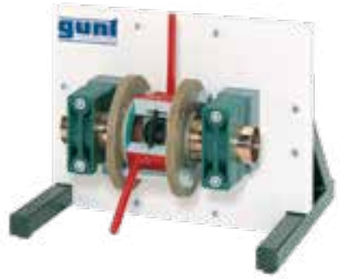
ET 499.16
Cutaway model:
ball valve



Engineering design
Cutaway models: components in piping systems

HM 700.01
Cutaway model:
standard orifice plate

HM 700.02
Cutaway model:
flow nozzle



HM 700.03
Cutaway model:
standard Venturi meter

HM 700.04
Cutaway model:
straight-way valve

HM 700.05
Cutaway model:
corner valve

HM 700.06
Cutaway model:
angle seat valve

HM 700.07
Cutaway model:
non-return valve

HM 700.08
Cutaway model:
pressure reducing valve

HM 700.09
Cutaway model:
strainer

HM 700.10
Cutaway model:
gate valve

HM 700.11
Cutaway model:
straight-way plug valve

HM 700.12
Cutaway model:
three-way plug valve

HM 700.13
Cutaway model:
ball valve

HM 700.14
Cutaway model:
safety valve

HM 700.15
Cutaway models:
various screwed pipe connections

HM 700.16
Cutaway models:
pressure gauges

Engineering design
Cutaway models: components in piping systems

HM 700.17
Cutaway model:
centrifugal pump

HM 700.20
Cutaway model:
piston pump

HM 700.22
Cutaway model:
gear pump

VS 101
Cutaway model:
underground hydrant

VS 102
Cutaway model:
resilient seated
gate valve

VS 103
Cutaway model:
screw down valve

VS 104
Cutaway model:
changeover valve

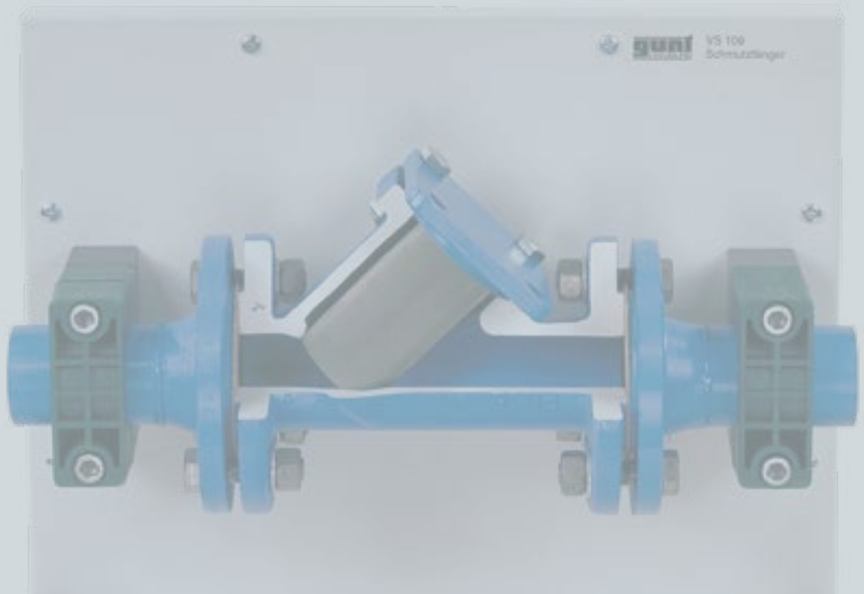
VS 105
Cutaway model:
gas meter

VS 106
Cutaway model:
backflow preventer

VS 107
Cutaway model:
non-return butterfly
valve

VS 108
Cutaway model:
water meter

VS 109
Cutaway model:
strainer



Engineering design
Machine elements: fasteners

MG 100
Instructional kit: assembly with dowel pins

Familiarisation with various pin types, their special features and applications

MG 110
Instructional kit: assembly with keys

Familiarisation with various feather keys, their production, special features and applications

MG 120
Instructional kit: assembly with taper keys

Familiarisation with various taper keys, their production, special features and areas of application

MG 200
Instructional kit: threaded fasteners and lock washers

Practical workshop exercises on the topic of threaded fasteners, tightening and breakaway torques

MG 901
Nuts and bolts kit

Comprehensive instructional kit of the main nuts and bolts used in engineering

MG 903
Screw-locking devices kit

Standardised designations, terms and graphical representation of different screw-locking devices

MG 905
Thread types kit

Standardised designations, terms and specific applications of different thread types, determination of the thread type with the thread gauge

TM 310
Thread testing

Thread efficiencies for different pairs of materials and thread pitches

TM 320
Screw connections testing

Correlation between tightening torque and tension force on standardised bolts

Engineering design
Machine elements: bearings

MG 911
Roller bearings kit

Familiarisation with the most important roller bearing types and their specific applications

Engineering design
Machine elements: transmission elements

GL 100
Principle of gear units

Fundamental principles of belt drives, wheel and disc drives, and gear trains

GL 110
Cam mechanism

Demonstration and measurement of the displacement curves for cam mechanisms

GL 200
Lathe gear

Safe and clear demonstration of function of the gears on a conventional lathe

AT 200
Determination of gear efficiency

Test system for determining mechanical drive and braking efficiency for spur and worm gears

TM 123
Spur gear unit

Mode of operation and layout of a spur gear

TM 124
Worm gear unit

Mode of operation and layout of a worm gear

TM 125
Cable winch

Using force equilibrium considerations to determine load transmission and efficiency

TM 232
Bearing friction

Sliding bearing friction with different bearing material pairings and comparison with rolling bearing friction

TM 220
Belt drive and belt friction

Investigating the influence of the angle of contact, coefficient of friction and belt force on belt drives and belt friction

TM 282
Friction in journal bearings

Learning the fundamentals of hydrodynamic lubrication by experimentation

Assembly technology
Assembly kits

MT 190
Assembly materials tester

Study project with extensive practical relevance for training in metal working professions by constructing a hydraulic tensile / compression testing device

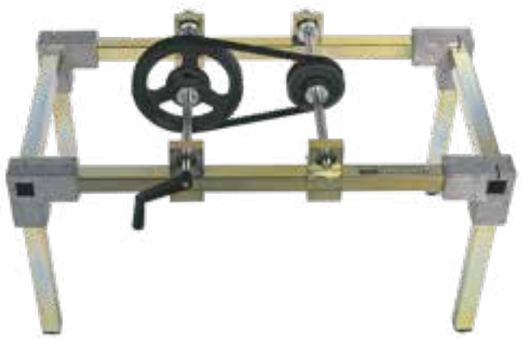
MT 190.01
Assembly data acquisition for materials tester

Mechanical and electrical engineering assembly kit: fully functional data acquisition for the materials tester MT 190

Assembly technology
Drive elements and gears

GL 410
Assembly simple gears

Versatile assembly exercise for simple drives using a belt, chain sprockets or a roller chain

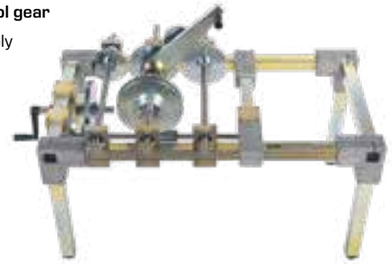


GL 420
Assembly combined gears

Versatile assembly exercise for combined drives

GL 430
Assembly control gear

Versatile assembly exercise for various step and gear units



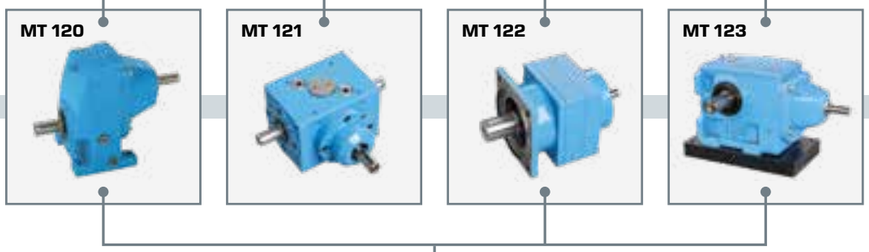
Assembly technology
Drive elements and gears

MT 173
Test stand for gears

Test system for determining the mechanical efficiency of different gear types, system control via PLC

Skill Level 1 2 3 4 5
GUNT-DigiSkills

How to achieve the digital transformation to Industry 4.0



MT 174
Sorting plant

Preventive maintenance based on the example of a separation process, system control via PLC

Skill Level 1 2 3 4 5
GUNT-DigiSkills

Assembly technology
Drive elements and gears

MT 171
Assembly hydro-dynamic journal bearing

Understanding components and function; assembly and maintenance

MT 110.10
Cutaway model: spur and worm gear

Manually operated cutaway model of a spur and worm gear

MT 120
Assembly exercise: spur gear

Design and function of a spur gear with helical gear wheels; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 121
Assembly exercise: mitre gear

Design and function of a mitre gear; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 122
Assembly exercise: planetary gear

Design and function of a planetary gear; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 123
Assembly exercise: spur and worm gear

Design and function of a spur and worm gear; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 136
Assembly exercise: gear pump

Design and function of a gear pump; planning, assembly and disassembly

Multimedia instructional materials via Internet

Assembly technology
Fittings

MT 154
Assembly exercise: shut-off valve

Planning, assembly, disassembly: function and design of a shut-off valve

MT 156
Assembly exercise: wedge gate valve and angle seat valve

Assembly, disassembly and maintenance of industrial fittings

MT 157
Assembly exercise: butterfly valve and non-return valve

Assembly, disassembly and maintenance of industrial fittings

MT 158
Assembly exercise: ball valve and shut-off valve

Assembly, disassembly and maintenance of industrial fittings

MT 101
Assembly exercise: pneumatically driven control valve

Design and function of a pneumatically driven control valve; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 162
Hydraulic valves and fittings test stand

Pressure test for GUNT assembly kits MT 154, MT 156, MT 157 and MT 158

MT 102
Assembly exercise: electrically driven control valve

Design and function of an electrically driven control valve; planning, assembly and disassembly

Multimedia instructional materials via Internet

Assembly technology
Compressors

MT 141
Assembly exercise: piston compressor

Function and design of a piston compressor; planning, assembly, disassembly

Multimedia instructional materials via Internet

MT 140.01
Assembly exercise piston compressor: functional test

Installation of the compressor MT 141 for operational check

Assembly technology
Piping

HL 960
Assembly station pipes and valves and fittings

Assembly of real piping and plant installations; together with HL 960.01: operational testing on a pipe network

HL 960.01
Assembly and alignment of pumps and drives

Installation and removal of pumps in plants; water supply for HL 960

Maintenance
System components: valves, pumps, pipes

MT 180
Assembly & maintenance exercise: centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 181
Assembly & maintenance exercise: multistage centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 182
Assembly & maintenance exercise: screw pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 183
Assembly & maintenance exercise: diaphragm pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 184
Assembly & maintenance exercise: piston pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 185
Assembly & maintenance exercise: in-line centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 186
Assembly & maintenance exercise: gear pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 136
Assembly exercise: gear pump

Design and function of a gear pump; planning, assembly and disassembly

Multimedia instructional materials via Internet

Maintenance
System components: valves, pumps, pipes

HL 962
Assembly stand for pumps

Base unit when constructing a complex piping system

HL 962.01
Standard chemicals pump

Typical pump as used in process engineering

HL 962.02
Canned motor pump

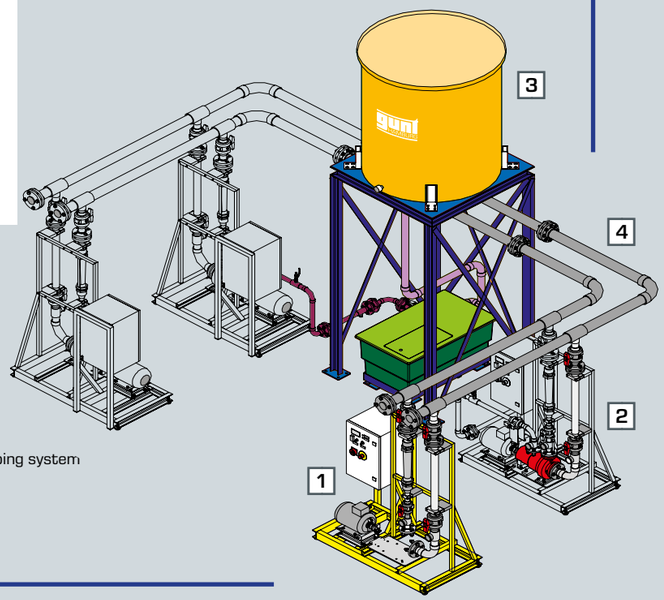
Hermetic centrifugal pump, particularly suitable for pumping liquid gases

HL 962.03
Side channel pump

Self-priming three-stage pump

HL 962.04
Standard chemicals pump with magnetic clutch

Hermetic centrifugal pump according to ISO 5199



Possible combination of individual components into a functional pumping system

1 assembly stand for pumps (HL 962)
2 pumps, various types (HL 962.01 – HL 962.04)
3 tank installation (HL 962.30)
4 piping system to interconnect the plant components (HL 962.32)

Maintenance
Test stands for valves and fittings and actuators

RT 396
Pump and valves and fittings test stand

Recording characteristic curves of industrial fittings and a centrifugal pump

RT 395
Maintenance of valves and fittings and actuators

Maintenance and operational check: four different fittings and actuators

Maintenance
Complex projects on experimental plants

MT 210
Assembly & maintenance exercise: refrigeration

Study project with high practical relevance for training in metal and electrical professions: assembly of a refrigeration system from individual components

MT 174
Sorting plant

Preventive maintenance based on the example of a separation process, system control via PLC

GUNT-DigiSkills

Maintenance
Machinery diagnosis

PT 500
Machinery diagnostic system, base unit

Base unit for setting up wide ranging experiments in machinery diagnostics using modular accessory sets

PT 500.10
Elastic shaft kit

Bending vibrations of elastic shaft

PT 500.11
Crack detection in rotating shaft kit

Vibrational behaviour of a shaft with a radial crack

PT 500.12
Roller bearing faults kit

Assessment of bearing condition by vibration analysis

PT 500.13
Couplings kit

Vibration analysis of couplings

PT 500.14
Belt drive kit

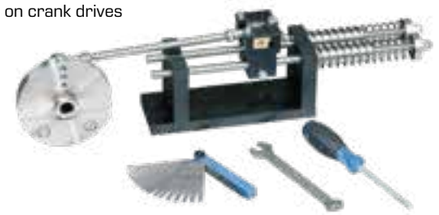
Vibrations in belt drives

PT 500.15
Damage to gears kit

Vibration analysis of gearing damage

PT 500.16
Crank mechanism kit

Vibrations on crank drives



PT 500.17
Cavitation in pumps kit

Observation and measurement of cavitation

PT 500.18
Vibrations in fans kit

Identification of the vibration induced by the blades from the vibration spectrum

PT 500.19
Electromechanical vibrations kit

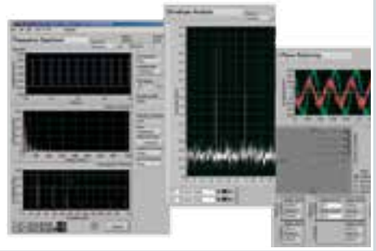
Investigation of vibrational behaviour of an electric motor

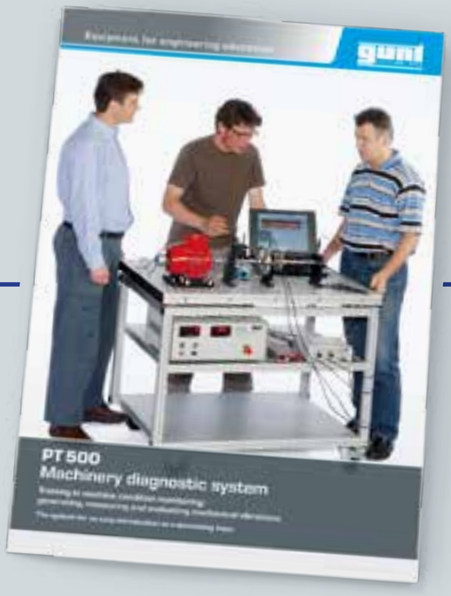
PT 500.05
Brake & load unit

Unit for generating a load torque for use on various PT 500 experiments

PT 500.04
Computerised vibration analyser

Supports all machinery diagnostic experiments of the PT 500 series





PT 501
Roller bearing faults

Investigation of the vibrations of roller bearings

Production technology
Dimensional metrology

PT 102
Dimensional metrology, spacer plate

Measurement exercises on 10 spacer plates with digital and analog calliper, depth calliper and depth micrometer

PT 104
Dimensional metrology, angle piece

Measurement exercises on 10 angle pieces with analog calliper, depth calliper, universal goniometer and radius gauge

PT 105
Dimensional metrology, shaft

Measurement exercises on 10 shafts with calliper, depth calliper, external micrometer, slip gauges and thread gauge

PT 107
Dimensional metrology, flange housing

Measurement exercises on a real-world machine element; testing of a flange housing with calliper, three-point internal micrometer, thread limit plug gauge and surface comparison plates

PT 108
Dimensional metrology, output shaft

Measurement exercises on a real-world machine element; testing of an output shaft with calliper, depth calliper, digital external micrometer and surface comparison plates

PT 109
Dimensional metrology, hub

Measurement exercises on 10 hubs with analog calliper, depth calliper, three point internal micrometer and limit plug gauge

Skill Level 1 2 3 4 5

PT 102 – PT 109 are part of the **GUNT DigiSkills 2 learning project**.
In addition to versatile learning objectives of dimensional metrology, comprehensive digital skills are developed with GUNT-DigiSkills 2.

How to achieve the digital transformation to Industry 4.0

Production technology
Tools

FT 901
Drilling kit

Various drilling tools: cutting geometry, incorrect cutter profiles

FT 903
Countersinking kit

Collection of countersinking tools: standard designations

FT 905
Reaming kit

Checking a hole with the limit plug gauge; various reaming tools

FT 907
Grinding kit

Teaching collection of traditional grinding tools and abrasives

Order No.: 054.90700

FT 909
Turning kit

Familiarisation with different lathe tools (shape, application) and reversible carbide tips (cutting geometry)

FT 913
Milling kit

Familiarisation with various types of milling cutters

Production technology
Technological experiments

FT 100
Cutting forces during drilling

Measurement of feed force and torque

FT 102
Cutting forces during turning

Measuring the forces acting on a lathe tool; three-component force measuring device

FT 200
Forming by bending

Vice experiment: permanent deformation of flat bars

Automation and process control engineering
Sensors / measurement technology

IA 120
Principles of industrial sensors

Familiarisation with key sensors: mode of operation and application

IA 110
Calibrating a pressure sensor

Test-pressure generated with dead-weight piston manometer

RT 306
Adjustment of level sensors

Familiarisation with different industry standard components with a 4-20 mA current loop interface using the example of level measurement

WL 202
Fundamentals of temperature measurement

Experimental introduction to temperature measurement: methods, areas of application, characteristics

FL 100
Strain gauge training system

Basic introduction to measurement with strain gauges for tension, bending and torsion

Automation and process control engineering
PLC and PLC applications

RT 800
PLC application: mixing process

Experiments using PLC to control discontinuous mixing processes

IA 210
PLC application: materials handling process

Basic system of automation: transporting and sorting workpieces

IA 130
PLC module

Self-contained PLC module for basic exercises; also suitable for IA 210 and RT 800

Automation and process control engineering
Fundamentals of pneumatics and hydraulics

RT 770
Training system: pneumatics, electro-pneumatics and PLC

Complete training system providing an experimental introduction to the fundamentals of pneumatics and electro-pneumatics, also with PLC

RT 700
Training system: fundamentals of hydraulics

Complete training system providing an experimental introduction to the fundamentals of hydraulics

RT 710
Hydraulic servo system

Hydraulic position control circuit with adjustable load conditions

Automation and process control engineering
Controllers, controlled systems, networking

RT 350
Operation of industrial controllers

Simulation of controlled systems; digital controller with freely selectable parameters

RT 380
Optimization of control loops

Tuning the controller to the controlled system; software simulation of the most common controlled systems

Automation and process control engineering
Process control systems with simple controlled variables

RT 010
Training system level control, HSI

Fundamentals of control engineering using the example of a level control system with integral behaviour

RT 020
Training system flow control, HSI

Fundamentals of control engineering using the example of a rapid flow control system

RT 030
Training system pressure control, HSI

Fundamentals of control engineering using the example of a pressure control system with first order lag

RT 040
Training system temperature control, HSI

Fundamentals of control engineering using the example of a temperature control system with dead time

RT 050
Training system speed control, HSI

Fundamentals of control engineering using the example of a speed control system with first order lag

RT 060
Training system position control, HSI

Fundamentals of control engineering using the example of a position control system with integral behaviour

RT 614
Level control demonstration unit

Experimental introduction to control engineering using an example of level controlled system

RT 624
Flow control demonstration unit

Experimental introduction to control engineering using an example of flow controlled system

RT 634
Pressure control demonstration unit

Experimental introduction to control engineering using an example of second order pressure controlled system

RT 644
Temperature control demonstration unit

Experimental introduction to control engineering using an example of temperature controlled system

RT 674
Flow / level control demonstration unit

Experimental introduction to control engineering using an example of a controlled system for flow rate, level and level via flow rate (cascade control)

Automation and process control engineering
Process control systems with simple controlled variables

RT 451
Level control

Level controlled system based on standard industrial components, smart level sensor, system control via PLC

RT 452
Flow control

Flow controlled system based on standard industrial components, smart flow rate sensor, system control via PLC

RT 453
Pressure control

First order and second order pressure controlled system based on standard industrial components, smart pressure sensors, system control via PLC

RT 454
Temperature control

Temperature controlled system based on standard industrial components, controller configurable as a continuous or a switching device, smart temperature sensors, system control via PLC

RT 455
pH value control

pH value controlled system based on standard industrial components, smart pH sensors, system control via PLC

Automation and process control engineering
Process control systems with multiple controlled variables

RT 586
Control of water quality

Control of pH-value, redox potential, oxygen concentration and electrical conductivity

RT 578
Control of four variables from process engineering

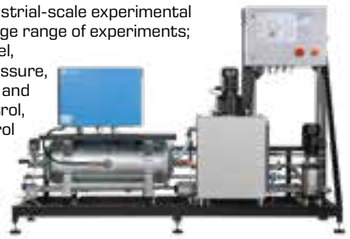
Practical control of level, flow rate, pressure and temperature

RT 580
Fault finding in control systems

Control of level, flow rate, temperature and cascade control; plant control and configuration via touch screen and PLC

RT 590
Process control engineering experimental plant

Complex industrial-scale experimental plant with large range of experiments; control of level, flow rate, pressure, temperature and cascade control, system control via PLC



Automation and process control engineering
Modular process automation training system

The image shows a fully assembled pressure control system after planning and execution of the piping and wiring.

RT 450
Process automation training system: base module

Basis for the modular setup of the different process automation experiments, including electrical power supply and water supply with tank and pump

RT 450.01
Controlled system module: level

Together with further components this is the main element for the setup of a level control loop

RT 450.02
Controlled system module: flow

Together with further components this is the main element for the setup of a flow control loop

RT 450.03
Controlled system module: pressure

Together with further components this is the main element for the setup of a pressure control loop

RT 450.04
Controlled system module: temperature

Together with further components this is the main element for the setup of a temperature control loop

Automation and process control engineering
CNC and robotics

IA 520
Computer integrated manufacturing and handling system

Two CNC machines, one robot and one magazine as the main elements;
PLC and process control software for process monitoring in an automated manufacturing process

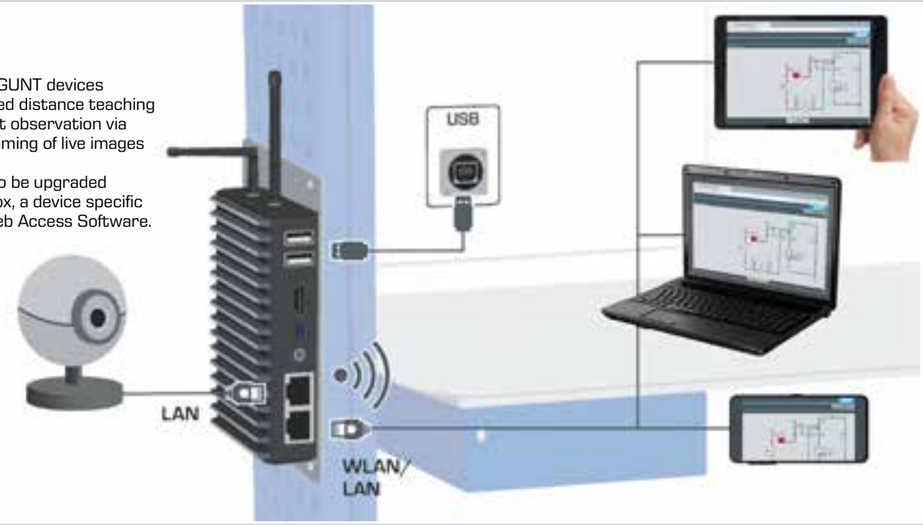
Automation and process control engineering
Remote Learning with GUNT

GU 100
Web Access Box

Accessory for selected GUNT devices enables practice-oriented distance teaching and learning: experiment observation via web browser with streaming of live images

For each GUNT device to be upgraded with the Web Access Box, a device specific software is available: Web Access Software. The software must be purchased separately for each device.

Information on this you will find on our
>> website



Hands-on teaching engineering –

with GUNT's SMART features

About the product:

WLAN RFID E learn

3 | Thermal engineering

Thermal engineering

Fundamentals of thermodynamics
Thermodynamic state variables

WL 201
Fundamentals of humidity measurement

Climatic chamber with adjustable humidity; comparison of four measuring methods

WL 203
Fundamentals of pressure measurement

Measurement of positive and negative pressure with different measuring devices

WL 202
Fundamentals of temperature measurement

Experimental introduction to temperature measurement: methods, areas of application, characteristics

WL 103
Expansion of ideal gases

Determination of the adiabatic exponent according to Clément-Desormes

WL 102
Change of state of gases

Isothermal and isochoric change of state of air

WL 920
Temperature measurement

Investigation of transient temperature behaviour and defined temperature jumps

Fundamentals of thermodynamics
Phase transition

WL 210
Evaporation process

Different forms of evaporation in an externally heated pipe

WL 204
Vapour pressure of water – Marcet boiler

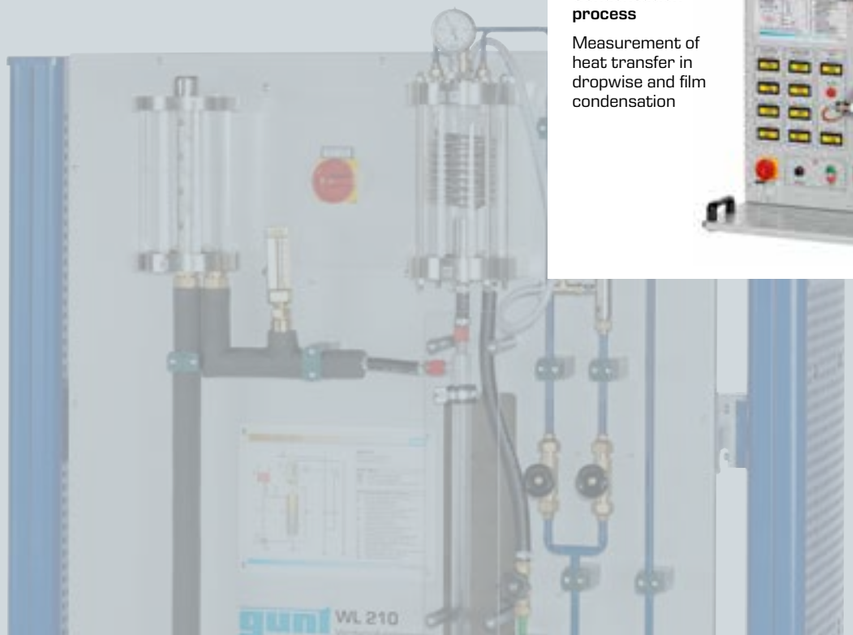
Pressure and temperature measurement in a steam boiler

WL 220
Boiling process

Visualisation of different forms of evaporation in a transparent pressure vessel

WL 230
Condensation process

Measurement of heat transfer in dropwise and film condensation



Fundamentals of thermodynamics
Principles of heat transfer

WL 362
Energy transfer by radiation

Investigation of thermal and light radiation; thermal radiator and thermopile for the investigation of thermal radiation

WL 460
Heat transfer by radiation

Effect of different surfaces on heat transfer

WL 372
Radial and linear heat conduction

Study of heat conduction in solids

WL 900
Steady-state and non-steady-state heat conduction

Linear heat conduction in metals; non-steady state temperature distribution

WL 377
Convection and radiation

Heat transport between heating element and vessel wall by convection and radiation

WL 440
Free and forced convection

Calculation of convective heat transfer at different geometries: flat plate, cylinder, tube bundle

WL 420
Heat conduction in metals

Investigation of the thermal conductivity of different metals

WL 430
Heat conduction and convection

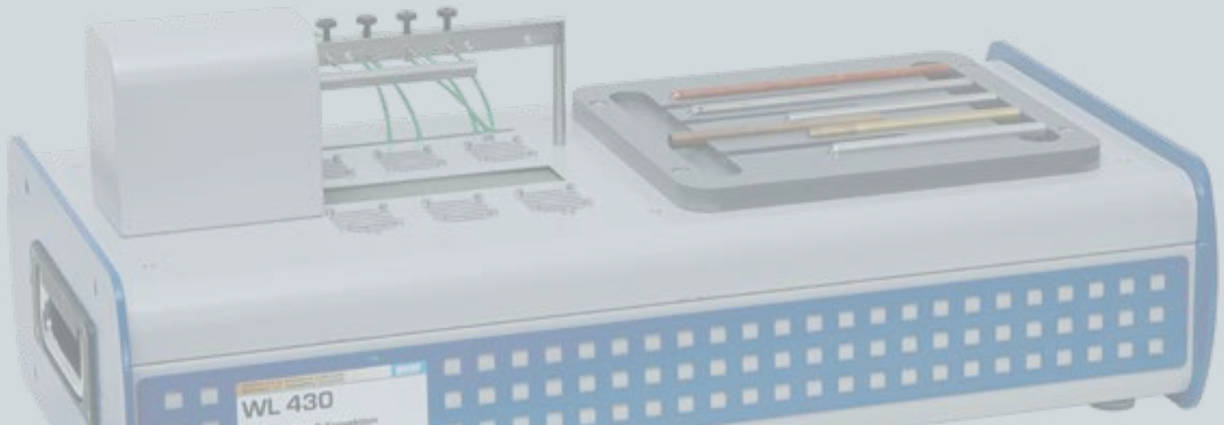
Investigation of heat conduction and convection using the example of a cooling fin

WL 422
Heat conduction in fluids

Determination of the coefficient of thermal conductivity for gaseous and liquid fluids

WL 376
Thermal conductivity of building materials

Investigation of the insulation properties of typical materials from the building materials sector



Heat exchangers
Heat transfer

WL 314
Convective heat transfer in air flow

Convective heat transfer in heat exchangers with different geometries

WL 314.01
Heat transfer in pipes in parallel flow

Heat transfer from the tube wall to the flowing medium

WL 314.02
Heat transfer in pipes in mixed flow

Heat transfer in a shell and tube heat exchanger in cross-flow operation

WL 314.03
Heat transfer in a tube

Tubular heat exchanger, heat transfer in the inner pipe

Heat exchangers
Recuperators

WL 110
Heat exchanger supply unit

Measuring the transfer characteristics of five different heat exchanger models, system control via PLC

WL 110.01
Tubular heat exchanger

Transparent heat exchanger with additional temperature measuring point after half of the transfer section; parallel flow and counterflow operation

WL 110.02
Plate heat exchanger

Typical plate heat exchanger in parallel flow and counterflow operation

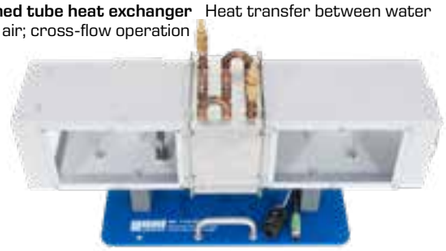
WL 110.03
Shell & tube heat exchanger

Transparent shell and tube heat exchanger in cross parallel flow and cross counterflow operation

WL 110.04
Stirred tank with double jacket and coil

Heating using jacket or coiled tube; stirrer for improved mixing of medium

WL 110.05
Finned tube heat exchanger Heat transfer between water and air; cross-flow operation



WL 308
Heat transfer in pipe flow

Heat exchanger with measurement of the fluid and wall temperature; operation in parallel flow and counterflow

Heat exchangers
Recuperators

WL 302
Heat transfer in the tubular heat exchanger

Heat transfer in pipe flows and determination of heat flux;
parallel flow and counterflow operation

WL 315.01
Shell & tube heat exchanger steam/water

Heat transfer process between steam and water, determination of heat flux of steam and water

ET 300
Finned tube heat exchanger water/air

Function of the heat exchanger as an air heater or water cooler

WL 312
Heat transfer in air flow

Convective heat transfer using shell & tube and finned tube heat exchangers

WL 315C
Comparison of various heat exchangers

Comparison of plate heat exchanger, tubular heat exchanger, shell and tube heat exchanger, finned cross-flow heat exchanger, and stirred tank with double jacket and coiled tube

Heat exchangers
Direct-contact heat exchangers

WL 320
Wet cooling tower

Principle of operation and characteristic variables of a wet cooling tower with forced ventilation

WL 320.01 - WL 320.04
Cooling columns

Cooling columns with different wetting areas

Heat exchangers
Fluidisation and heat transfer

WL 225
Heat transfer in the fluidised bed

Heat transfer from a heating element to the fluidised bed

Thermal fluid energy machines
Steam power plants

ET 860
Safety devices on steam boilers

Familiarisation with boiler safety devices such as pressure and water level monitors

ET 810
Steam power plant with steam engine

Single-cylinder piston steam engine with gas-fired boiler for steam generation

ET 813
Two-cylinder steam engine

Single-acting steam engine with condensation for determining mechanical power and efficiency

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

Experimental plant with two-cylinder steam engine ET 813, steam generator ET 813.01 and brake unit HM 365

ET 850
Steam generator

Laboratory scale gas-fired steam generator for wet or superheated steam; integrated condenser

ET 851
Axial steam turbine

Single-stage steam turbine with power output measurement; steam supply via ET 850, gas-fired or ET 852, electrical

ET 852 Steam generator, electrical

Laboratory scale electrical steam generator for superheated steam; integrated condenser; alternative to the gas-fired steam generator ET 850 for the supply of the steam turbine ET 851

ET 830
Steam power plant, 1,5 kW

Oil-fired boiler, single-stage small industry turbine, condenser and feed water treatment and monitoring via PLC

ET 830.01/02, ET 833.01/02
Cooling tower

Wet cooling tower for steam power plant ET 830 / ET 833 for re-cooling the cooling water (115 kW or 140 kW)

ET 805.50
Determination of the vapour content

Determination of the vapour content using a separating calorimeter with cyclone water separator or a throttling calorimeter with vapour depressurisation

ET 833
Steam power plant 1,5 kW with process control system

Steam turbine system like ET 830, with additional monitoring and control via control station with touch screen panel

ET 805
Steam power plant 20 kW with process control system

Steam turbine with synchronous generator for grid-connected or stand-alone operation. Fully equipped with oil-fired or gas-fired boiler, condenser, cooling tower, feed water treatment and modern synchronisation device (PPU)

Thermal fluid energy machines
Gas turbines

ET 792
Gas turbine

Operation with power turbine or as jet engine with propelling nozzle using liquid gas

ET 794
Gas turbine with power turbine

Two-shaft arrangement with high-pressure turbine and power turbine using liquid gas

ET 796
Gas turbine jet engine

Small single-shaft gas turbine with thrust measurement using either kerosene or petroleum

Thermal fluid energy machines
Piston compressors

ET 500
Two-stage piston compressor

Recording the characteristic of an industrial two-stage compressor, system control via PLC

ET 508
Simulation of a two-stage air compressor

Simulated operation of a two-stage compressor plant with intermediate and aftercooling

Single-stage compressor ET 513 with drive unit HM 365

ET 513
Single-stage piston compressor

Investigations on an air compressor including the determination of the mechanical power consumption

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

ET 512
Compressed air generation plant with piston compressor

Function test on a single-stage piston compressor

ET 432
Behaviour of a piston compressor

Investigations in an open two-cylinder piston compressor from refrigeration

Thermal fluid energy machines
Internal combustion engines

Modular test stand for single cylinder test engines CT 159, test engine CT 151 and brake unit HM 365

CT 159
Modular test stand for single-cylinder engines, 3 kW

Mounting the engine, supply with fuel and air; measurement of characteristic engine data

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

CT 150
Four-stroke petrol engine for CT 159

Air-cooled overhead valve four-stroke petrol engine

CT 151
Four-stroke diesel engine for CT 159

Air-cooled four-stroke diesel engine with direct injection

CT 153
Two-stroke petrol engine for CT 159

Air-cooled two-stroke petrol engine

CT 110
Test stand for single-cylinder engines, 7,5 kW

Control and load unit, supply with fuel and air; measurement of characteristic engine data

CT 100.20
Four-stroke petrol engine for CT 110

Air-cooled four-stroke petrol engine with external carburation

CT 100.21
Two-stroke petrol engine for CT 110

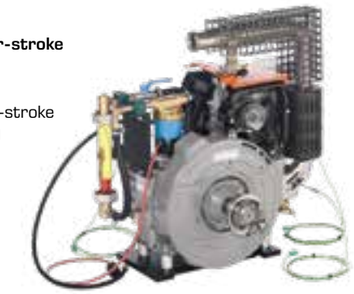
Air-cooled two-stroke petrol engine with reverse scavenging

CT 100.22
Four-stroke diesel engine for CT 110

Air-cooled four-stroke diesel engine with direct injection

CT 100.23
Water-cooled four-stroke diesel engine for CT 110

Water-cooled four-stroke diesel engine using the swirl chamber principle



Thermal fluid energy machines
Internal combustion engines

CT 300
Engine test stand, 11 kW

Test stand for industrial two-cylinder engines

CT 300.04
Two-cylinder petrol engine for CT 300

Air-cooled four-stroke petrol engine with external carburation

CT 300.05
Two-cylinder diesel engine for CT 300

Water-cooled four-stroke diesel engine with indirect injection

CT 400
Load unit, 75 kW, for four-cylinder engines

Load unit with air-cooled eddy-current brake and instruments

CT 400.01
Four-cylinder petrol engine for CT 400

Water-cooled petrol engine with controlled catalytic converter, max. 75 kW

CT 400.02
Four-cylinder diesel engine for CT 400

Diesel engine with direct injection, max. 41 kW

Fundamentals of refrigeration
Principles of cold production

ET 400
Refrigeration circuit with variable load

Compression refrigeration system with water-cooled evaporator

ET 352
Vapour jet compressor in refrigeration

Cold production using thermal energy. Transparent condenser and evaporator allow the view into the inner workings.

ET 120
Cooling using the Peltier effect

Demonstration of the thermo-electric effect

ET 122
Vortex cooling device

Cooling and heating using compressed air

ET 480
Absorption refrigeration system

Thermally driven refrigeration system without compressor that can be heated with either gas or electrically

Fundamentals of refrigeration
Compression refrigeration system

ET 350
Changes of state in the refrigeration circuit

Energetic analyses of the refrigeration cycle; transparent components offer insights into the changes of state

ET 102
Heat pump

Utilisation of ambient heat for water heating

Fundamentals of refrigeration
Refrigeration applications

ET 915.01
Refrigerator model

Simple model of a domestic refrigerator for connection to ET 915

ET 915.02
Model of a refrigeration system with refrigeration and freezing stage

Series and parallel connection of evaporators; connection to ET 915

ET 915
HSI training system refrigeration and air conditioning technology, base unit

Modern learning environment through hardware/software integration (HSI)

HSI training system refrigeration with ET 915 and ET 915.02

Thermodynamic applications in supply engineering: HVAC
Hot water generation

HL 352
Test stand for oil, natural gas and propane gas burners

Design and operating behaviour of a heating boiler with hot water storage

ET 202
Principles of solar thermal energy

Determining characteristic parameters of a solar thermal system; model fitted with artificial radiation source

ET 262
Geothermal probe with heat pipe principle

Transparent components allow observing how the state of the heat transfer medium changes

HL 313
Domestic water heating with flat collector

Demonstration of the conversion of the sun's radiation energy into heat and the storing of that heat

HL 314
Domestic water heating with tube collector

Familiarisation with the functions of the evacuated tube collector and the solar circuit

Operating the solar controller via web browser

ET 203
Parabolic trough collector with solar tracking

Function and operating behavior of a parabolic trough collector, astronomical and sensor-based sun tracking, system control via PLC

Thermodynamic applications in supply engineering: HVAC
Hot water generation

ET 102
Heat pump

Utilisation of ambient heat for water heating

ET 264
Geothermal energy with two-well system

Use of geothermal energy in an open system without thermal repercussion

ET 405
Heat pump for cooling and heating operation

Heat pump with various heat exchangers for air and water

ET 420
Ice stores in refrigeration

Industrial refrigeration system with ice store, dry cooling tower and wet cooling tower

Thermodynamic applications in supply engineering: HVAC
Air conditioning technology and ventilation

ET 915.06
Model of a simple air conditioning system

Model of a simple air conditioning system for room cooling; connection to ET 915

ET 915.07
Air conditioning model

Model of a full air conditioning system with outer and recirculating air operation; connection to ET 915

ET 915
HSI training system refrigeration and air conditioning technology, base unit

Modern learning environment through hardware/software integration (HSI)

HSI training system air conditioning technology with ET 915 and ET 915.07

ET 605
Air conditioning system model

Climatic chamber with latent and sensitive heat source as cooling load; recirculating and outer air operation

HL 720
Ventilation system

Design and operation of a ventilation system; measuring the pressure curve within the ventilation system

ET 620
Air conditioning and ventilation system

Manual or automatic operation by PLC; use of real components

Thermodynamic applications in supply engineering: HVAC
GUNT-RHLine Renewable Heat

HL 320.01
Heat pump

Heat pump for operation with different sources, operating the heating controller via web browser

HL 320.02
Conventional heating

Electric complementary heater for the HL 320 modular system

HL 320.03
Flat collector

Pivotable flat collector for converting solar energy into heat

HL 320.04
Evacuated tube collector

Conversion of solar energy into heat in the evacuated tube collector

HL 320.05
Central storage module with controller

Module with buffer storage and bivalent storage for heating systems with renewable energies, operating the heating controller via web browser

HL 320.07
Underfloor heating / geothermal energy absorber

Can be used as heat sink or heat source

HL 320.08
Fan heater / air heat exchanger

Can be used as heat sink or heat source

Heating
Fundamental experiments on heating – training panels

HL 101
Thermal expansion training panel

Investigation of thermal expansion of different pipe sections (PVC, PE, Cu, steel)

HL 105
Three-way mixing valve training panel

Effect of mixing ratio on feed flow and circulating flow temperature

HL 104
Temperature measurement training panel

Investigation of four different temperature measuring methods

HL 106
Four-way mixing valve training panel

Effect of mixing ratio on feed flow and circulating flow temperature

HL 107
Circulating pumps training panel

Series and parallel operation of two pumps

HL 110
Expansion vessel training panel

Displacement volume of an expansion vessel as a function of the pressure

HL 109
Safety devices training panel

Function of safety valves against excess pressure and excess temperature

Heating
Fundamental experiments on heating – training panels

HL 112
Radiator training panel

Familiarisation with a hot water heating system

HL 108
Domestic heating circuit training panel

Model of a central heating system with radiators, circulating pump and four-way mixing valve

Heating
Heating systems in buildings

HL 620
Domestic heating system control training panel

Operation of a modern heating controller

HL 360
Oil tank safety trainer

Investigation of tank safety devices and their function

HL 350
Oil burner demonstrator

Heating boiler with viewing window for observing the flame

HL 351
Domestic heating boiler

Heating boiler with an oil burner; hot water generator for other trainers from the HL series

HL 353
Hot water generator

Setup of a complete domestic heating system together with HL 353.01 and / or HL 353.02

HL 353.02
Heat distribution and control in heating systems

Two independent heating circuits with control devices: heating circuit with one subcircuit and with two subcircuits

HL 353.01
Comparison of different heating types

Two independent heating circuits: floor heating or forced convector with fan and two radiators

HL 300
Central heating system

Function and operating behaviour of a hot water heating system with digital heating controller

HL 392C
Safety & control in heating systems

Function and operating behaviour of safety valve, safety pressure cut-out, temperature controller, flow switch and much more

Heating
Heating systems in buildings

HL 510
Domestic gas supply training panel

Simulation of leaks in pipes

HL 500
Instantaneous gas heater

Methods of gas burner adjustment; simulation of twelve faults

Order No.: 065.50000

HL 358
Forced air gas burner training panel

Nominal load adjustment and fault finding on a gas burner; hazard-free due to operation with air

HL 356
Demo unit, gas burner

Electronic simulation of the operation of a forced air gas burner

HL 530
Training panel function of gas heater

Functioning of a typical combination boiler; separate circuits for room heating and domestic water heating

Sanitary systems

ST 210
Sanitation fittings training panel

Investigation of function and operating behaviour: two handle mixers, flushing valve

ST 320
Pipe cleaning training panel

Pipe flushing according to DIN 1988 standards; contaminants can be introduced

ST 330
Protection of drinking water training panel

Safety and hygiene of drinking water pipes

ST 310
Drinking water installation demonstrator

Drinking water installation in domestic setting with all common components

ST 510
Full-scale sewerage system

Demonstration of key aspects of wastewater technology. Transparent piping system allows view of the inside to observe the flow conditions.

Hands-on teaching engineering –

with GUNT's SMART features

About the product:

WLAN

3a | Refrigeration and air conditioning technology

Refrigeration

Air conditioning technology

Electrical engineering in refrigeration and air conditioning technology

Refrigeration and air conditioning technology

Refrigeration
Principles of refrigeration: principles of cold production

ET 101
Simple compression refrigeration circuit

Cooling and heating of the heat exchangers directly tangible

ET 120
Cooling using the Peltier effect

Demonstration of the thermo-electric effect

ET 352
Vapour jet compressor in refrigeration

Cold production using thermal energy. Transparent condenser and evaporator allow the view into the inner workings.

ET 122
Vortex cooling device

Cooling and heating using compressed air

ET 480
Absorption refrigeration system

Thermally driven refrigeration system without compressor that can be heated with either gas or electrically

Refrigeration
Principles of refrigeration: compression refrigeration system

ET 411C
Compression refrigeration system

Comparison of different expansion elements, investigation of the effects of over- and underfilling with refrigerant

ET 400
Refrigeration circuit with variable load

Compression refrigeration system with water-cooled evaporator

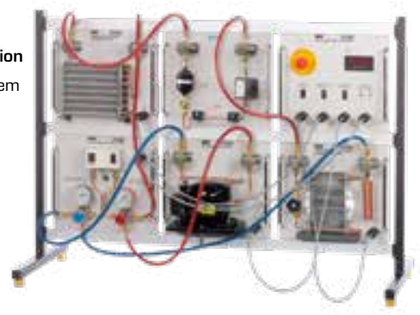
ET 350
Changes of state in the refrigeration circuit

Energetic analyses of the refrigeration cycle; transparent components offer insights into the changes of state

Refrigeration
Principles of refrigeration: training systems

ET 900
Introduction to refrigeration

Training system with inter-changeable modules



ET 910
Refrigeration training system, base unit

Set-up of various refrigeration circuits using modular component kits; includes refrigeration chamber and condensing unit

ET 910.10
Refrigeration components for basic experiments

Accessories to set up simple refrigeration circuits

ET 910.11
Refrigeration components for advanced experiments

Accessories to set up complex refrigeration circuits

Experimental setup capacity control with post injection with ET 910, ET 910.10 and ET 910.11

ET 915.01
Refrigerator model

Simple model of a domestic refrigerator for connection to ET 915

ET 915
HSI training system refrigeration and air conditioning technology, base unit

Modern learning environment through hardware/software integration (HSI)

ET 915.02
Model of a refrigeration system with refrigeration and freezing stage

Series and parallel connection of evaporators; connection to ET 915

HSI training system refrigeration with ET 915 and ET 915.02

Refrigeration
Thermodynamics of the refrigeration cycle

ET 441
Refrigeration chamber and defrosting methods

Climatic investigations in cooling and freezing chambers; frosting and defrosting of the evaporator

ET 351C
Thermodynamics of the refrigeration circuit

Compression refrigeration system for thermodynamic investigations, measurement of the mechanical compressor output

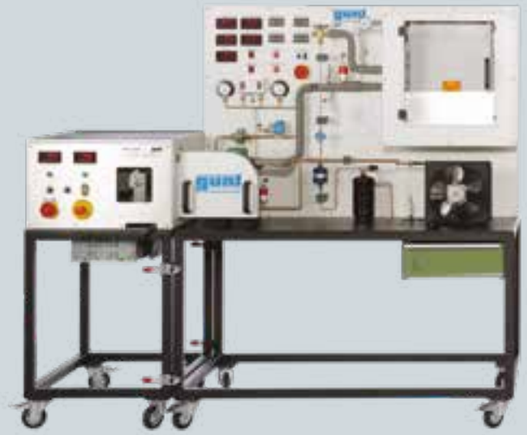
ET 430
Refrigeration system with two-stage compression

Low temperature refrigeration system; compression with injection intercooler and additional refrigerant supercooling

ET 412C
Refrigeration system with refrigeration and freezing chamber

Simulation of 18 electrical and hydraulical faults

Refrigeration
Components of refrigeration: compressors



Compression refrigeration system ET 165 with drive unit HM 365

ET 165
Refrigeration system with open compressor

Capacity measurement at the open compressor with variable speed; refrigeration chamber with adjustable cooling load

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

ET 432
Behaviour of a piston compressor

Investigations in an open two-cylinder piston compressor from refrigeration

ET 428
Energy efficiency in refrigeration systems

Refrigeration system with three compressors in interconnected operation; adaptation to the capacity requirement

Refrigeration
Components of refrigeration: evaporators and condensers

ET 431
Heat exchangers in the refrigeration circuit

Properties of different heat exchangers and their use in refrigeration; effect of superheating and supercooling

ET 405
Heat pump for cooling and heating operation

Heat pump with various heat exchangers for air and water

Refrigeration
Components of refrigeration: piping

ET 460
Oil return in refrigeration systems

Transport of lubricants soluble in refrigerant in refrigeration systems; transparent pipes

Refrigeration
Components of refrigeration: primary and secondary controllers

ET 182
Secondary controllers in refrigeration systems

Demonstration of the principle of operation of the various secondary controllers in the refrigeration circuit

ET 180
Pressure switches in refrigeration

Protection against overpressure and negative pressure in the refrigeration circuit; display of switching states via lamps

ET 426
Capacity control in refrigeration systems

Investigation of different capacity control methods

Refrigeration
Components of refrigeration: assembly, fault finding, maintenance

MT 210
Assembly & maintenance exercise: refrigeration

Study project with high practical relevance for training in metal and electrical professions: assembly of a refrigeration system from individual components

ET 192
Replacement of refrigeration components

Service and repair exercises: replacement of compressor, pressure switch, filter/drier, solenoid valve and expansion valve

ET 422
Capacity control and faults in refrigeration systems

Investigation of different methods for capacity control; fault simulation

Refrigeration

Components of refrigeration: cutaway models

ET 499.30
Cutaway model:
ceiling air cooler

ET 499.01
Cutaway model:
hermetic refrigerant compressor

ET 499.18
Cutaway model:
thermostatic expansion valve

ET 499.19
Cutaway model:
automatic expansion valve

ET 499.02
Cutaway model:
semi-hermetic refrigerant compressor

ET 499.03
Cutaway model:
open refrigerant compressor, two-cylinder

ET 499.21
Cutaway model:
sight glass with humidity indicator

ET 499.25
Cutaway model:
4-way reversing valve

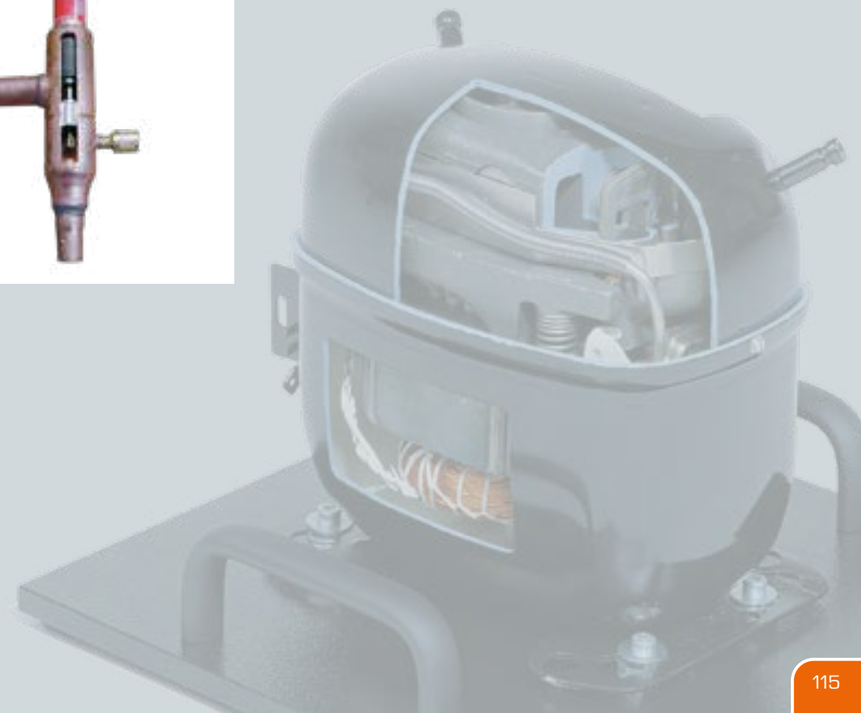
ET 499.12
Cutaway model:
block drier

ET 499.13
Cutaway model:
oil separator

ET 499.26
Cutaway model:
condensation pressure control valve

ET 499.14
Cutaway model:
liquid separator

ET 499.16
Cutaway model:
ball valve



Refrigeration
Heat pumps and ice store

ET 102
Heat pump

Utilisation of ambient heat for water heating

ET 405
Heat pump for cooling and heating operation

Heat pump with various heat exchangers for air and water

ET 420
Ice stores in refrigeration

Industrial refrigeration system with ice store, dry cooling tower and wet cooling tower

HL 320.01
Heat pump

Heat pump for operation with different sources, operating the heating controller via web browser

HL 320.07
Underfloor heating / geothermal energy absorber

Can be used as heat sink or heat source

HL 320.08
Fan heater / air heat exchanger

Can be used as heat sink or heat source

Refrigeration
Solar cooling

ET 256
Cooling with solar electricity

Compression refrigeration system for operation with solar current from ET 250

ET 256 together with the optional artificial light source HL 313.01 and solar modules ET 250

ET 352.01
Solar heat for refrigeration

Solar thermal operation of a vapour jet compressor

ET 352
Vapour jet compressor in refrigeration

Cold production using thermal energy. Transparent condenser and evaporator allow the view into the inner workings.

HL 313
Domestic water heating with flat collector

Demonstration of the conversion of the sun's radiation energy into heat and the storing of that heat, operating the solar controller via web browser

HL 314
Domestic water heating with tube collector

Familiarisation with the functions of the evacuated tube collector and the solar circuit, operating the solar controller via web browser

ET 480
Absorption refrigeration system

Thermally driven refrigeration system without compressor that can be heated with either gas or electrically

Air conditioning technology
States of the air

WL 320
Wet cooling tower

Principle of operation and characteristic variables of a wet cooling tower with forced ventilation

WL 320.01 - WL 320.04
Cooling columns

Cooling columns with different wetting areas

WL 201
Fundamentals of humidity measurement

Climatic chamber with adjustable humidity; comparison of four measuring methods

Air conditioning technology
Principles of air conditioning technology

ET 605
Air conditioning system model

Climatic chamber with latent and sensitive heat source as cooling load; recirculating and outer air operation

ET 915
HSI training system refrigeration and air conditioning technology, base unit

Modern learning environment through hardware/ software integration (HSI)

ET 915.06
Model of a simple air conditioning system

Model of a simple air conditioning system for room cooling; connection to ET 915

ET 915.07
Air conditioning model

Model of a full air conditioning system with outer air and recirculating operation; connection to ET 915

HSI training system air conditioning technology with ET 915 and ET 915.07

Air conditioning technology
Practical air conditioning systems

ET 611
Air conditioning system with chamber

Chamber for comfort studies, suitable for occupation by test individuals.
Air conditioning system with water chiller and vapour humidifier.

ET 600
Conditioning of room air

Air conditioning system consisting of industrial components including direct evaporator and vapour humidifier

ET 630
Split system air conditioner

Modern air conditioning unit with heat pump function: cooling or heating

ET 450
Vehicle air conditioning

Vehicle air conditioning system for cooling the vehicle interior; use of typical components from automotive technology

ET 620
Air conditioning and ventilation system

Manual or automatic operation by PLC; use of real components

Air conditioning technology
Ventilation

HM 280
Experiments with a radial fan

Operating behaviour and characteristic variables of a radial fan; two interchangeable rotors

HM 282
Experiments with an axial fan

Operating behaviour and parameters of an axial fan

HM 210
Characteristic variables of a radial fan

Determination of flow rate via iris diaphragm or Venturi nozzle

HL 720
Ventilation system

Design and operation of a ventilation system; measuring the pressure curve within the ventilation system

HL 710
Air duct systems

Planning and setup of simple and complex air duct systems

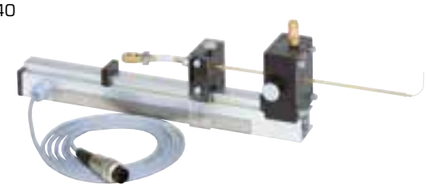
Air conditioning technology
Ventilation

HM 240
Principles of air flow

Determining the fan characteristic curve

HM 240.03
Electronic total pressure sensor

Measurement of the velocity distribution in the intake tube on HM 240



HM 240.04
Pressure distribution on a cylinder

Cylinder in transverse incident flow; record pressure distribution in the wake of the cylinder in conjunction with HM 240.03

HM 240.05
Pressure losses in pipe elements

Measurement of pressure losses in traight pipe sections, in a 90° pipe bend, and in a 90° pipe angle

HM 240.06
Heat transfer at a cylinder in transverse flow

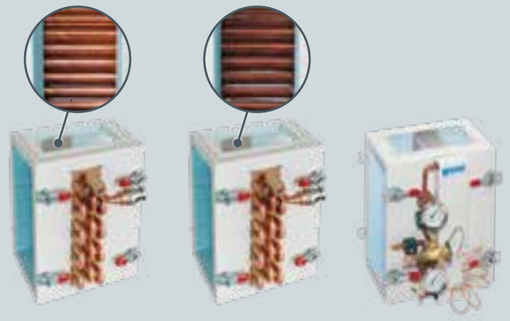
Investigation of heat transfer from a heated rod to an air flow

HM 220
Air flow experimental plant

Determining pressure loss and velocity profiles; different measuring objects

WL 312
Heat transfer in air flow

Convective heat transfer using shell & tube and finned tube heat exchangers



Accessories for the trainer:
WL 312.01 Heat transfer with plain tubes,
WL 312.02 Heat transfer with finned tubes,
WL 312.03 Heat transfer on refrigerant evaporator

Electrical engineering in refrigeration and air conditioning technology
Refrigeration control

ET 144
Electrical installation in refrigeration systems

Design and wiring of typical electrical circuits from refrigeration

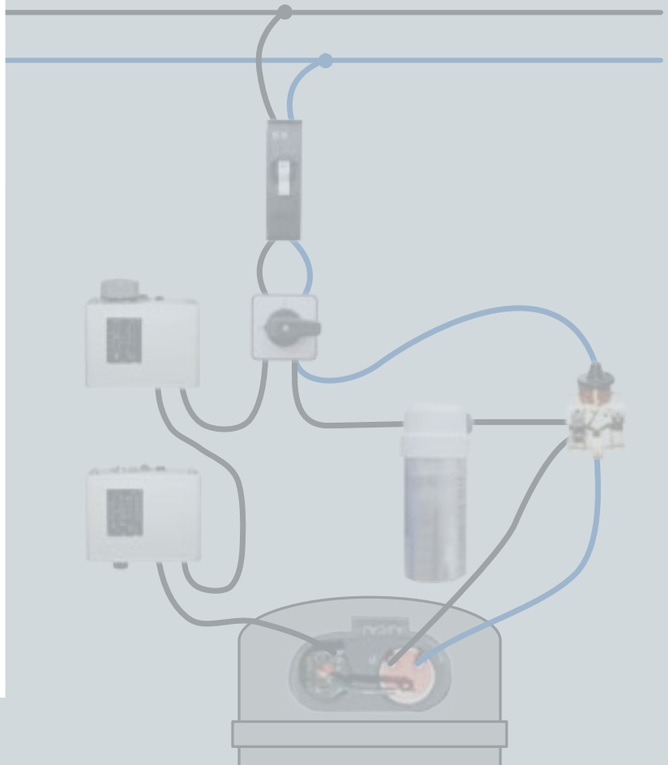
ET 171
Electrical connection of refrigerant compressors

Use of a real refrigerant compressor

Electrical engineering in refrigeration and air conditioning technology
Control of refrigeration systems

ET 930
Evaporator control with electronic expansion valve

Practical programming of a modern refrigeration controller



Electrical engineering in refrigeration and air conditioning technology
Fault finding

ET 172
Electrical faults in refrigerant compressors

Investigation of important electrical components from refrigeration

ET 170
Electrical faults in simple air conditioning systems

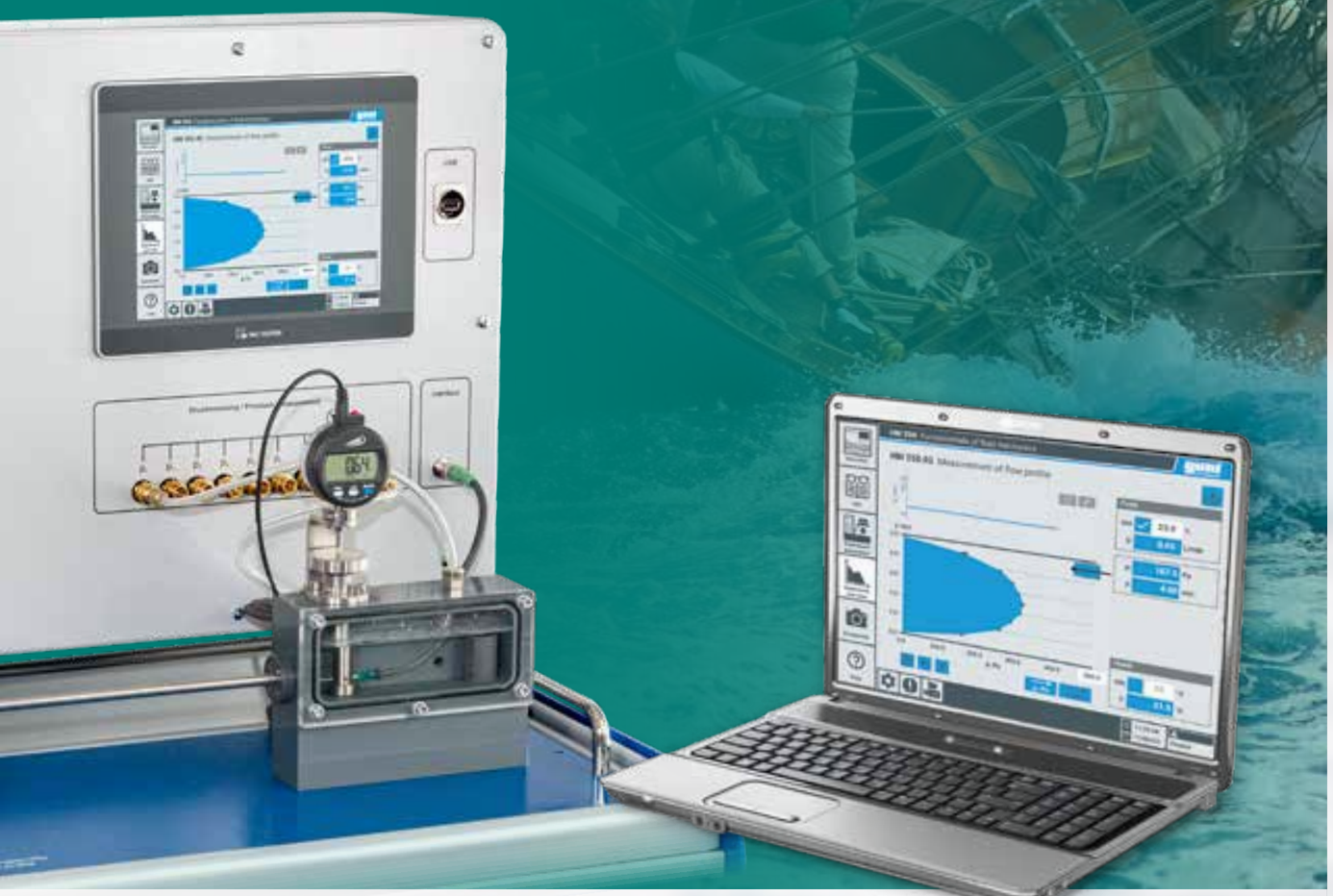
Simulation of a simple air conditioning system with compressor, fan and thermostat

ET 174
Electrical faults in full air conditioning systems

Simulation of the electrical circuit of a complex conditioning system with humidifying and heat pump function

Hands-on teaching engineering –

with GUNT's SMART features



About the product:

WLAN · RFID · E learn

4 | Fluid mechanics

Fundamentals of fluid mechanics
Physics and properties of fluids

WL 202
Fundamentals of temperature measurement

Experimental introduction to temperature measurement: methods, areas of application, characteristics

WL 203
Fundamentals of pressure measurement

Measurement of positive and negative pressure with different measuring devices

HM 150.02
Calibration of pressure gauges

Operation of a Bourdon tube pressure gauge and a piston manometer

WL 102
Change of state of gases

Isothermal and isochoric change of state of air

WL 204
Vapour pressure of water – Marcet boiler

Pressure and temperature measurement in a steam boiler

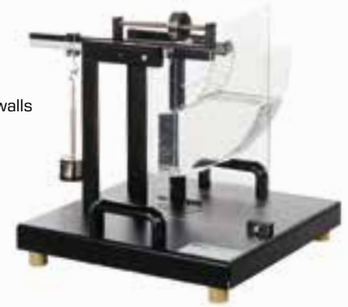
Fundamentals of fluid mechanics
Fundamentals of hydrostatics

HM 115
Hydrostatics trainer

Experiments on buoyancy, density, capillarity etc.; various methods of pressure measurement

HM 150.05
Hydrostatic pressure in liquids

Investigation of fluid pressure on vessel walls



HM 150.06
Stability of floating bodies

Determining metacentre and buoyancy using a rectangular hull cross-section

HM 150.39
Floating bodies for HM 150.06

Comparison of two different frame shapes: hard chine and round bilge

Fundamentals of fluid mechanics
Flow around bodies

HM 150.10
Visualisation of streamlines

Investigation of flow around models in laminar, two-dimensional flow using ink as contrast medium

Recommended for water supply:
HM 150 Base module for experiments in fluid mechanics

HM 135
Determination of the settling velocity

Vertically falling body in liquid using specimens of different sizes and different materials

Fundamentals of fluid mechanics
Fundamentals of hydrodynamics

HM 150.18
Osborne reynolds experiment

Visualisation of laminar and turbulent flow

Recommended for water supply:
HM 150 Base module for
experiments in fluid mechanics

HM 150.07
Bernoulli's principle

Static pressure
and total pressure
distribution along the
Venturi nozzle

Recommended for
water supply:
HM 150 Base module
for experiments
in fluid mechanics

HM 150.08
Measurement of jet forces

Demonstration of the principle of linear momentum and impact forces on interchangeable deflectors with different deflection angles

Recommended for water supply:
HM 150 Base module for
experiments in fluid
mechanics

TM 605
Coriolis force

Demonstration of the
Coriolis force in rotating
reference systems

HM 150.09
Horizontal flow from a tank

Recording the trajectory
of the water jet at different
outlet velocities

Recommended for
water supply:
HM 150 Base module
for experiments in
fluid mechanics

HM 150.12
Vertical flow from a tank

Determination of pressure losses and contraction coefficient for different outlet contours

Recommended for water supply:
HM 150 Base module for
experiments in fluid
mechanics

HM 150.14
Vortex formation

Free and forced vortex; point gauges to detect surface profiles

Recommended for water supply:
HM 150 Base module for
experiments in fluid
mechanics

HM 150
**Base module
for experiments in
fluid mechanics**

Volumetric flow
measurement
for large and small
flow rates

Fundamentals of fluid mechanics
Flow in pipes

HM 150.01
**Pipe friction for
laminar/turbulent flow**

Determining the critical
Reynolds number

Recommended for
water supply:
HM 150 Base module
for experiments in
fluid mechanics

HM 150.11
Losses in a pipe system

Influence of flow velocity
on pressure loss

Recommended for
water supply:
HM 150 Base module
for experiments in
fluid mechanics

HM 150.29
Energy losses in piping elements

Pressure losses in various pipe fittings and in the ball valve

Recommended for water supply: HM 150 Base module
for experiments in fluid mechanics

Fundamentals of fluid mechanics
Methods of flow rate measurement

HM 150.13
Methods of flow measurement

Comparison of different measuring methods and
determining the flow coefficients

Recommended for water supply:
HM 150 Base module
for experiments in fluid mechanics

Fundamentals of fluid mechanics
Compact fluid mechanics: Fluidtutor

HM 241
Fundamentals of water flow

Experiments on water flow in open flumes and in pipes. Transparent design allows observation of the flow processes.

Fundamentals of fluid mechanics
Turbomachines

HM 150.19
Operating principle of a Pelton turbine

Model of an impulse turbine with adjustable nozzle; determination of efficiency

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.20
Operating principle of a Francis turbine

Model of a reaction turbine with adjustable guide vanes and determination of the efficiency

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.04
Centrifugal pump

Determining the characteristics of a typical centrifugal pump

HM 150 Base module required for experiments in fluid mechanics

HM 150.16
Series and parallel configuration of pumps

Characteristic curves and hydraulic power; comparison of operating modes

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

Fundamentals of fluid mechanics
Open-channel flow

HM 150.03
Plate weirs for HM 150

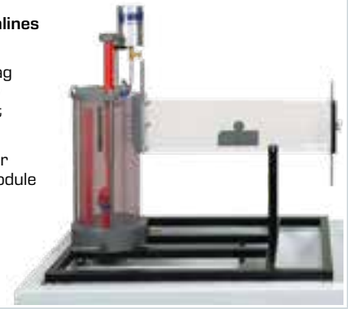
Discharge measurement in open channels using two measuring weirs

HM 150 Base module required for experiments in fluid mechanics

HM 150.21
Visualisation of streamlines in an open channel

Flow around various drag bodies and incident flow of weirs; ink as contrast medium

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics



HM 164
Open channel and closed channel flow

Flow processes on different structures in open and closed channel flows; losses at inlet and outlet

HM 160
Experimental flume 86 x 300 mm

Experimental section lengths of 2,5 m or 5 m available, closed water circuit and inclination adjustment

Fundamentals of fluid mechanics
Compact + digital: HM 250 Fundamentals of fluid mechanics

HM 250
Fundamentals of fluid mechanics

Base module for experiments in fluid mechanics, system control via PLC

Patented

HM 250.01
Visualisation of pipe flow

Visualisation of laminar and turbulent flow

HM 250.02
Measurement of flow profile

Measurement of laminar and turbulent flow

HM 250.04
Continuity equation

Relationship between cross-sectional area traversed and flow velocity

HM 250.05
Measurement of jet forces

Demonstration of the principle of linear momentum; inter-changeable deflectors with different deflection angles

HM 250.03
Visualisation of streamlines

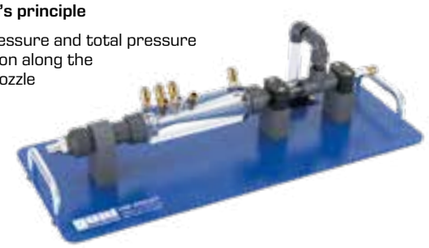
Investigation of cross-sectional changes in laminar, two-dimensional flow; visualisation using electrolytically generated hydrogen bubbles

HM 250.06
Free discharge

Recording the trajectory of the water jet and discharge coefficients at different outlet velocities

HM 250.07
Bernoulli's principle

Static pressure and total pressure distribution along the Venturi nozzle

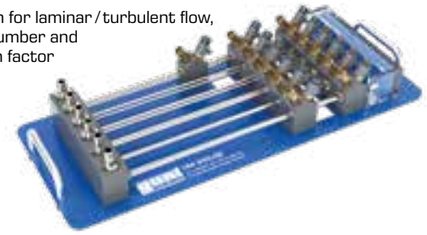


HM 250.08
Losses in pipe elements

Influence of flow velocity on pressure loss, didactically successive pipe sections

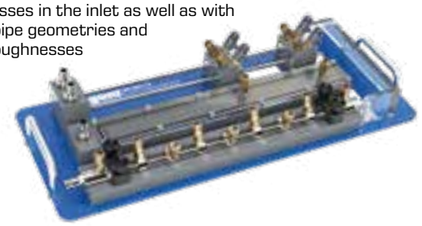
HM 250.09
Fundamentals of pipe friction

Pipe friction for laminar / turbulent flow, Reynolds number and pipe friction factor



HM 250.10
Pressure curve along the inlet section

Friction losses in the inlet as well as with different pipe geometries and surface roughnesses



HM 250.11
Open channel

Flow around various drag bodies and incident flow of weirs

HM 250.90
Laboratory shelf

Shelf with extendable shelves, for stowing accessories for HM 250

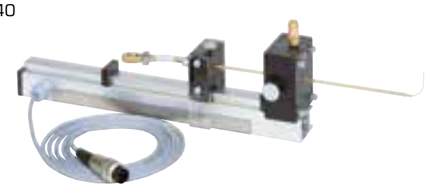
Steady flow
Fundamentals of steady flow

HM 240
Principles of air flow

Recording the fan characteristic

HM 240.03
Electronic total pressure sensor

Measurement of the velocity distribution in the intake tube on HM 240



HM 240.04
Pressure distribution on a cylinder

Cylinder in transverse incident flow; record pressure distribution in the wake of the cylinder in conjunction with HM 240.03

HM 240.06
Heat transfer at a cylinder in transverse flow

Investigation of heat transfer from a heated rod to an air flow

HM 240.05
Pressure losses in pipe elements

Measurement of pressure losses in straight pipe sections, in a 90° pipe bend, and in a 90° pipe angle

HM 241
Fundamentals of water flow

Experiments on water flow in open flumes and in pipes. Transparent design allows observation of the flow processes.

HM 220
Air flow experimental plant

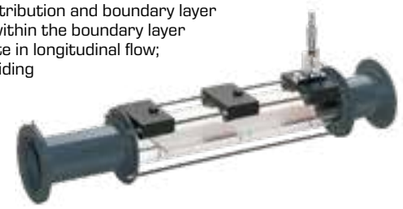
Determining pressure loss and velocity profiles; different measuring objects

HM 220.01
Venturi tube

Examination of the continuity equation and Bernoulli's principle; representation of the pressure curve

HM 220.02
Measurement of boundary layers

Velocity distribution and boundary layer thickness within the boundary layer of a flat plate in longitudinal flow; vertically sliding Pitot tube



HM 225
Aerodynamics trainer

For experiments from the fields of flow around bodies and steady incompressible flow

HM 225.03
Bernoulli's principle

Demonstration of the continuity equation and Bernoulli's equation

HM 225.05
Flow in a pipe bend

Determination of the static pressure at 29 pressure measuring points

HM 225.07
Free jet

Investigation of flow from nozzles

Steady flow
Steady flow of compressible fluids

HM 230
Flow of compressible fluids

Subsonic and sonic flow through different measuring objects

HM 172
Supersonic wind tunnel with Schlieren optics

Schlieren optics for visualisation of Mach lines and shock waves on drag bodies; interchangeable walls in the measuring section produce velocities up to Mach 1,8

HM 260
Characteristics of nozzles

Measuring the impact or thrust force for determining the discharge velocity and the nozzle efficiency

HM 261
Nozzle pressure distribution

Measuring the pressure curves in a convergent nozzle and in Laval nozzles

Steady flow
Flow in pipe systems

HL 102
Installation technology: losses in different pipes

Investigation of the pressure difference in four equal-length pipe sections made of different materials

HL 103
Installation technology: losses in pipe bends

Investigation of the pressure loss at pipe elements with different changes in pipe direction and materials

HL 113
Installation technology: losses in valves and fittings

Investigation of the pressure loss of standard valves and fittings

HL 210
Installation technology: losses in a pipe system

Investigation of pressure losses at contractions, pipe angles, pipe bends, valves and fittings and pipe elements

HL 111
Installation technology: losses in straight pipes

Determining the pressure loss in an open pipe section

HM 222
Air flow in pipes and pipe elements

Resistances and losses in laminar and turbulent pipe flow

HM 120
Losses in pipe elements

Investigation of flow and pressure losses in different pipe sections

HM 112
Fluid mechanics trainer

Interchangeable measuring objects and different pipe sections

Steady flow
Flow in pipe systems

HM 111
Pipe networks

Pressure losses at various piping elements and pipe networks; parallel and series connection of pipe sections

HM 124
Fluid mechanics experimental plant

Investigations on centrifugal pumps, control valves, piping and fittings. Large scale industrial components and high-quality instrumentation deliver realistic measurement results.

HM 122
Pressure losses in pipes

Experimental determination of important coefficients related to pressure loss in various pipe systems

Steady flow
Flow in valves

RT 390
Test stand for control valves

Design and function of control valves; determination of the Kv value

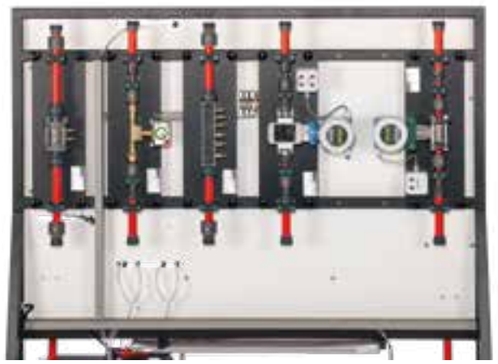
RT 396
Pump and valves and fittings test stand

Recording characteristic curves of industrial fittings and a centrifugal pump

Steady flow
Methods of flow rate measurement

HM 500
Flow meter trainer

Comparison and calibration of different flow meters



Different flow meters HM 500.01-HM 500.16 are available as accessories.

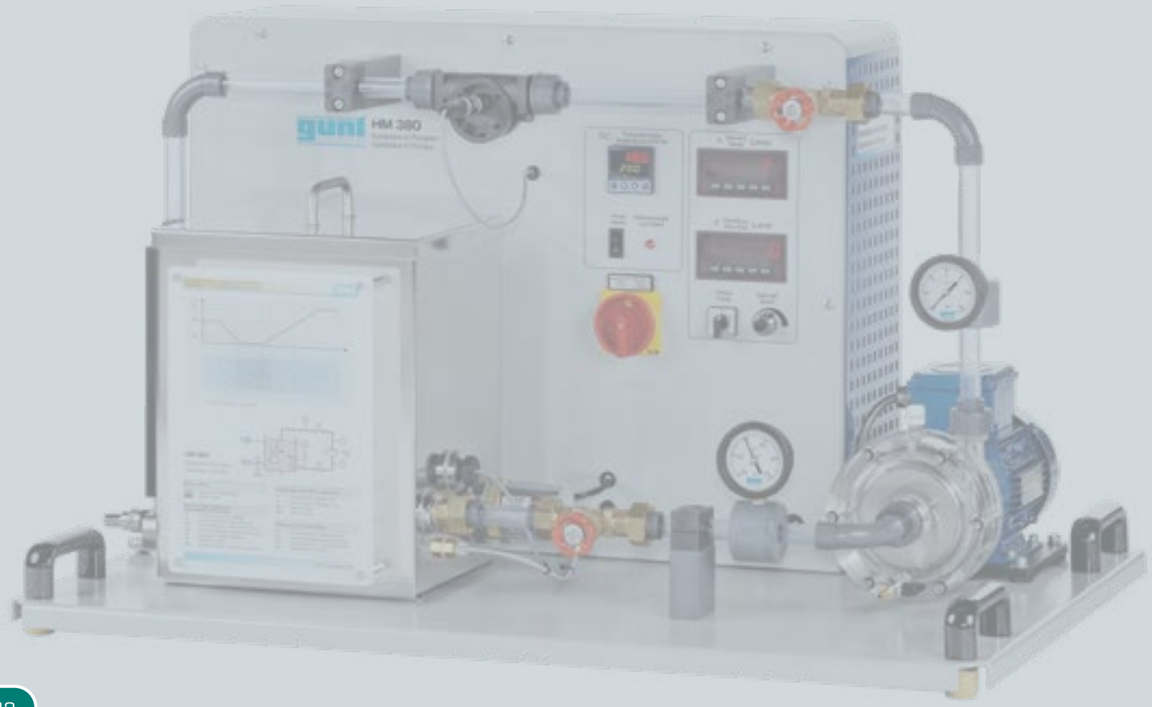
Steady flow
Cavitation

HM 380
Cavitation in pumps

Visualisation of cavitation effects in a transparent pump; how speed, inlet pressure, flow rate and temperature affect cavitation

ST 250
Cavitation

Visualisation of the formation of vapour bubbles in a Venturi nozzle



Examples of transient flow

HM 156
Water hammer and surge chamber

Investigation of formation, effect and function

HM 155
Water hammer in pipes

Water hammer as a function of valve closing time; calculation of the wave propagation velocity in water

HM 150.15
Hydraulic ram – pumping using water hammer

Formation and effect of water hammer

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 143
Transient drainage processes in storage reservoirs

Demonstration of the function of a rainwater retention basin and a storage lake

Flow around bodies

HM 170
Open wind tunnel

Experiments from the field of aerodynamics and fluid mechanics with an “Eiffel” type wind tunnel

HM 170.70
Wind power plant with rotor blade adjustment

Extension to wind tunnel HM 170

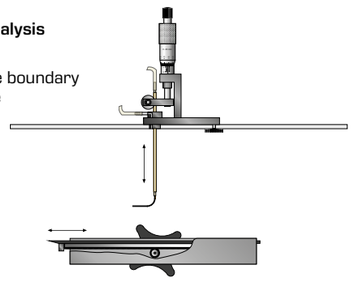
Drag bodies
HM 170.01 – HM 170.11

HM 170.22
Pressure distribution on an aerofoil NACA 0015

Experiments with different aerofoil angles of attack

HM 170.24
Boundary layer analysis with Pitot tube

Investigation of the boundary layer on a flat plate with flow along the plate; two different surfaces



HM 170.28
Wake measurement

Investigation of the pressure distribution behind a cylinder subject to surrounding flow

HM 225
Aerodynamics trainer

For experiments from the fields of flow around bodies and steady incompressible flow

HM 225.02
Boundary layers

Investigation of boundary layers on a flat plate with flow along the plate

HM 225.04
Drag forces

Determining drag forces on models immersed in a flow

HM 225.06
Coanda effect

Investigation of wall-guided airflow and familiarisation with the principle of pneumatic logic elements

HM 225.08
Visualisation of streamlines

Flow patterns in real fluids at different models; visualisation using fog

HM 152
Potential flow

Visualisation of streamlines in a Hele-Shaw cell using ink as contrast medium

HM 153
Visualisation of different flows

Visualisation of flow around bodies and flow phenomena in open channels and pipes

Flow around bodies

HM 226
Wind tunnel for visualisation of streamlines

Illuminated test section, various models, fog generator included

HM 133
Visualisation of flow fields

Visualisation of laminar and turbulent flow processes in a water channel using electrolytically generated hydrogen bubbles

CE 220
Fluidised bed formation

Investigation of fluidised bed formation of solids in air and water

HM 136
Flow through packed columns

Comparison of different modes of operation; water and / or air, parallel flow or counterflow mode

HM 132
Vertical visualisation of flow fields

Visualisation using electrolytically generated hydrogen bubbles

Hydraulic fluid energy machines
Hydraulic turbines

HM 450C
Characteristic variables of hydraulic turbomachines

Determination of output and efficiency of turbines and pumps; demonstration of a pumped storage plant

HM 450.01
Pelton turbine

Model of an impulse turbine with speed and torque measurement

HM 450.02
Francis turbine

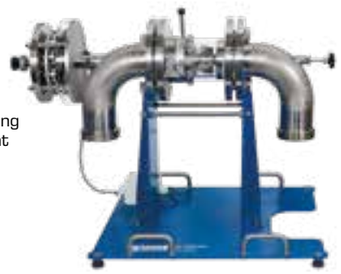
Model of a reaction turbine with speed and torque measurement; adjustable guide vanes

HM 450.03
Propeller type turbine

Six-bladed propeller type turbine with guide vane adjustment for varying power, measurement of speed and torque

HM 450.04
Kaplan turbine

Five-bladed Kaplan turbine with blade and guide vane adjustment for varying power, measurement of speed and torque



HM 287
Experiments with an axial turbine

Record characteristics of an axial reaction turbine

HM 405
Axial-flow turbomachines

Function of a turbomachine; configuration as pump or turbine with interchangeable rotor / impeller and stator / guide vane system

Hydraulic fluid energy machines
Hydraulic turbines

HM 288
Experiments with a reaction turbine

Record characteristics of a turbine based on the reaction force

HM 289
Experiments with a Pelton turbine

Record characteristics of a free jet turbine

HM 291
Experiments with an action turbine

Record characteristics of an axial impulse turbine

HM 290
Base unit for turbines

Water supply for HM 288, HM 289 and HM 291

Hydraulic fluid energy machines
Driven machines

HM 299
Comparison of positive displacement machines and turbomachines

Interchangeable driven machines:
three pump types, two compressor types

Hydraulic fluid energy machines
Centrifugal pumps

HM 283
Experiments with a centrifugal pump

Determination of characteristic pump variables

HM 284
Series and parallel configuration of pumps

Demonstration of series, parallel and the individual operation of centrifugal pumps

HM 332
Pump characteristics for parallel and series configuration

Investigation of the behaviour of two identical centrifugal pumps in operation,
system control via PLC

HM 300
Hydraulic circuit with centrifugal pump

Measurement of pressure conditions in valves and fittings and a pump

Hydraulic fluid energy machines
Positive displacement pumps

HM 285
Experiments with a piston pump

Record characteristics of a reciprocating positive displacement pump

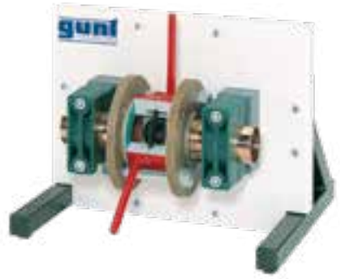
HM 286
Experiments with a gear pump

Record characteristics of a rotary positive displacement pump

Components in piping systems and plant design
Cutaway models

HM 700.01
Cutaway model:
standard orifice plate

HM 700.02
Cutaway model:
flow nozzle



HM 700.03
Cutaway model:
standard Venturi meter

HM 700.04
Cutaway model:
straight-way valve

HM 700.05
Cutaway model:
corner valve

HM 700.06
Cutaway model:
angle seat valve

HM 700.07
Cutaway model:
non-return valve

HM 700.08
Cutaway model:
pressure reducing valve

HM 700.09
Cutaway model:
strainer

HM 700.10
Cutaway model:
gate valve

HM 700.11
Cutaway model:
straight-way plug valve

HM 700.12
Cutaway model:
three-way plug valve

HM 700.13
Cutaway model:
ball valve

HM 700.14
Cutaway model:
safety valve

HM 700.15
Cutaway models:
various screwed pipe connections

HM 700.16
Cutaway models:
pressure gauges

Components in piping systems and plant design
Cutaway models

HM 700.17
Cutaway model:
centrifugal pump

HM 700.20
Cutaway model:
piston pump

HM 700.22
Cutaway model:
gear pump

VS 101
Cutaway model:
underground hydrant

VS 102
Cutaway model:
resilient seated
gate valve

VS 103
Cutaway model:
screw down valve

VS 104
Cutaway model:
changeover valve

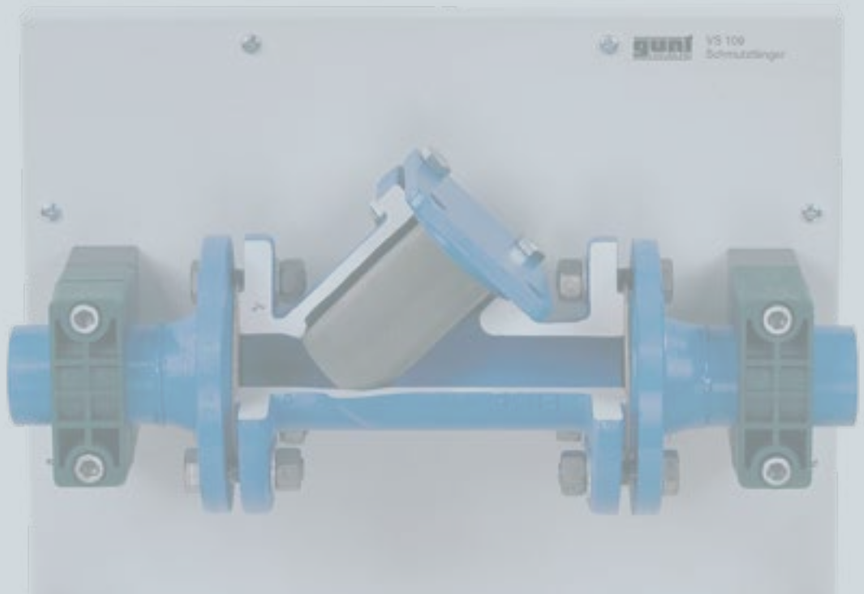
VS 105
Cutaway model:
gas meter

VS 106
Cutaway model:
backflow preventer

VS 107
Cutaway model:
non-return butterfly
valve

VS 108
Cutaway model:
water meter

VS 109
Cutaway model:
strainer



Components in piping systems and plant design
Assembly exercises: valves and fittings

MT 154
Assembly exercise: shut-off valve

Planning, assembly, disassembly: function and design of a shut-off valve

MT 156
Assembly exercise: wedge gate valve and angle seat valve

Assembly, disassembly and maintenance of industrial fittings

MT 157
Assembly exercise: butterfly valve and non-return valve

Assembly, disassembly and maintenance of industrial fittings

MT 158
Assembly exercise: ball valve and shut-off valve

Assembly, disassembly and maintenance of industrial fittings

MT 101
Assembly exercise: pneumatically driven control valve

Design and function of a pneumatically driven control valve; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 102
Assembly exercise: electrically driven control valve

Design and function of an electrically driven control valve; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 162
Hydraulic valves and fittings test stand

Pressure test for GUNT assembly kits MT 154, MT 156, MT 157 and MT 158

Components in piping systems and plant design
Assembly & maintenance exercises: pumps

MT 180
Assembly & maintenance exercise: centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 181
Assembly & maintenance exercise: multistage centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 182
Assembly & maintenance exercise: screw pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 183
Assembly & maintenance exercise: diaphragm pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 184
Assembly & maintenance exercise: piston pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 185
Assembly & maintenance exercise: in-line centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 186
Assembly & maintenance exercise: gear pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

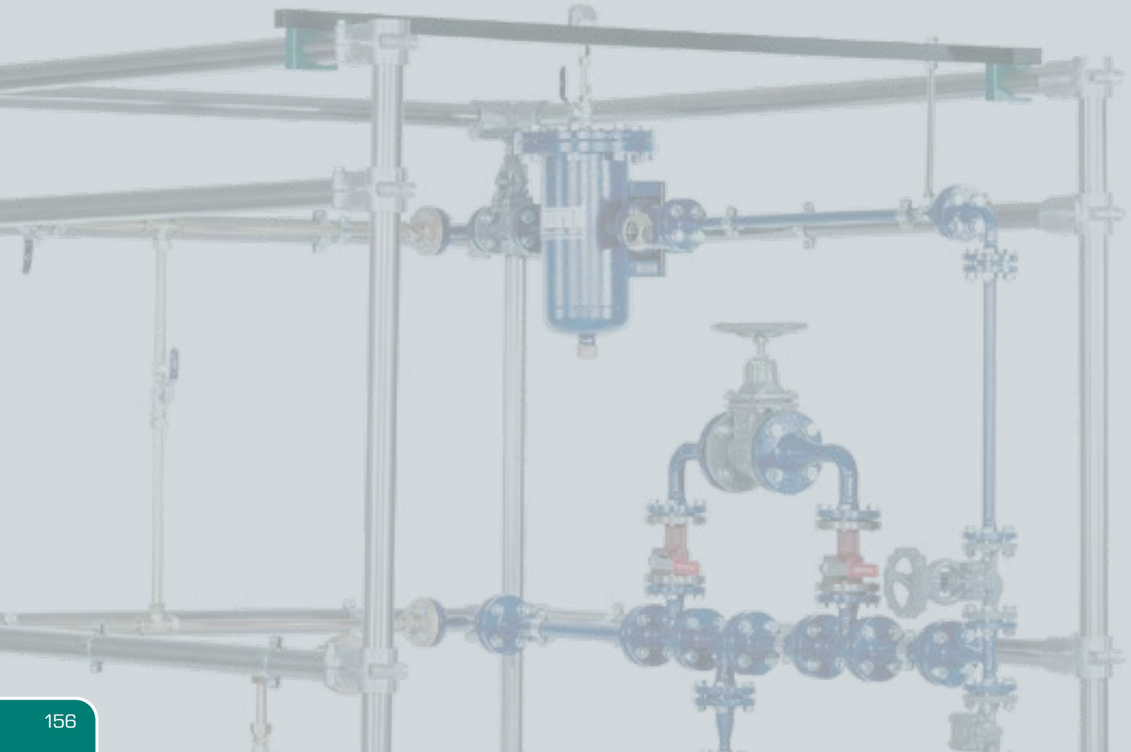
Components in piping systems and plant design
Design of complex piping and plant systems

HL 960
Assembly station pipes and valves and fittings

Assembly of real piping and plant installations; together with HL 960.01: operational testing on a pipe network

HL 960.01
Assembly and alignment of pumps and drives

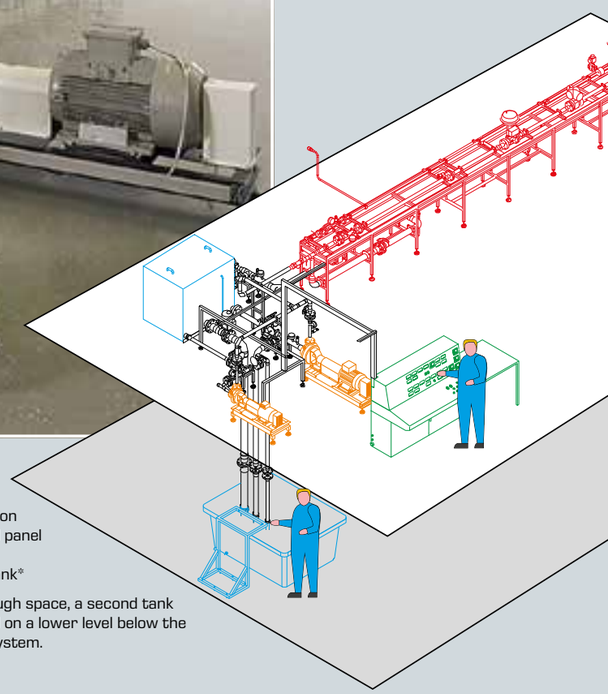
Installation and removal of pumps in plants; water supply for HL 960



Fluidic experimental plants

HM 124
Fluid mechanics experimental plant

Investigations on centrifugal pumps, control valves, piping and fittings. Large scale industrial components and high-quality instrumentation deliver realistic measurement results.



red = pipe section
green = control panel
orange = pump
blue = supply tank*

*if there is enough space, a second tank can be installed on a lower level below the experimental system.

HM 362
Comparison of pumps

Investigate operating behaviour of centrifugal pumps, piston pump and side channel pump, system control via PLC

HM 405
Axial-flow turbomachines

Function of a turbomachine; configuration as pump or turbine with interchangeable rotor/impeller and stator/guide vane system

Fluidic experimental plants

HL 962
Assembly stand for pumps

Base unit when constructing a complex piping system

HL 962.01
Standard chemicals pump

Typical pump as used in process engineering

HL 962.02
Canned motor pump

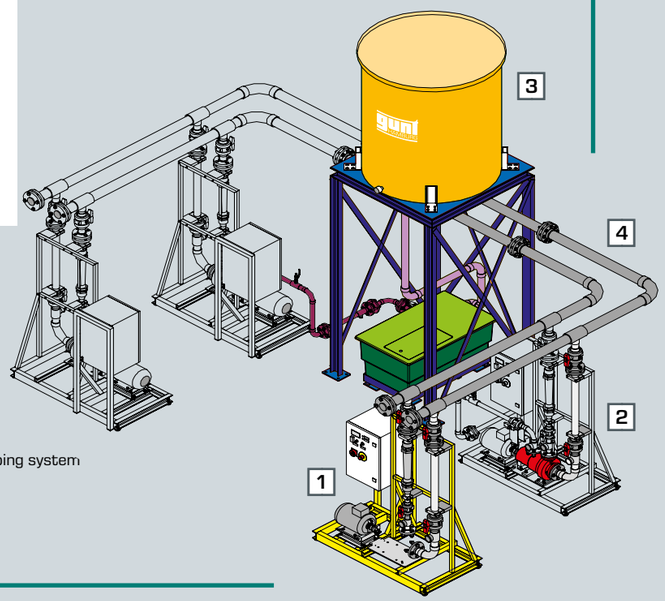
Hermetic centrifugal pump, particularly suitable for pumping liquid gases

HL 962.03
Side channel pump

Self-priming three-stage pump

HL 962.04
Standard chemicals pump with magnetic clutch

Hermetic centrifugal pump according to ISO 5199



Possible combination of individual components into a functional pumping system

1 assembly stand for pumps (HL 962)
2 pumps, various types (HL 962.01 – HL 962.04)
3 tank installation (HL 962.30)
4 piping system to interconnect the plant components (HL 962.32)

HM 215
Two-stage axial fan

Determining the characteristics of a two stage axial fan

HL 710
Air duct systems

Planning and setup of simple and complex air duct systems

ST 510
Full-scale sewerage system

Demonstration of key aspects of wastewater technology. Transparent piping system allows view of the inside to observe the flow conditions.

Hands-on teaching engineering –

with GUNT's SMART features

About the product:

4a | Fluid machinery

Fluid machinery

Fundamentals
Fluid mechanics

HM 115
Hydrostatics trainer

Experiments on buoyancy, density, capillarity etc.; various methods of pressure measurement

HM 112
Fluid mechanics trainer

Interchangeable measuring objects and different pipe sections

HM 230
Flow of compressible fluids

Subsonic and sonic flow through different measuring objects

HM 122
Pressure losses in pipes

Experimental determination of important coefficients related to pressure loss in various pipe systems

HM 380
Cavitation in pumps

Visualisation of cavitation effects in a transparent pump; how speed, inlet pressure, flow rate and temperature affect cavitation

ST 250
Cavitation

Visualisation of the formation of vapour bubbles in a Venturi nozzle

HM 150.09
Horizontal flow from a tank

Recording the trajectory of the water jet at different outlet velocities

Recommended for water supply:
HM 150 Base module for experiments in fluid mechanics

HM 250
Fundamentals of fluid mechanics

Base module for experiments in fluid mechanics, system control via PLC

Extensive selection of accessories enables a complete course in the fundamentals of fluid mechanics

Patented

HM 152
Potential flow

Visualisation of streamlines in a Hele-Shaw cell using ink as contrast medium

HM 133
Visualisation of flow fields

Visualisation of laminar and turbulent flow processes in a water channel using electrolytically generated hydrogen bubbles

HM 260
Characteristics of nozzles

Measuring the impact or thrust force for determining the discharge velocity and the nozzle efficiency

HM 261
Nozzle pressure distribution

Measuring the pressure curves in a convergent nozzle and in Laval nozzles

HM 226
Wind tunnel for visualisation of streamlines

Illuminated test section, various models, fog generator included

HM 241
Fundamentals of water flow

Experiments on water flow in open flumes and in pipes. Transparent design allows observation of the flow processes.

Fundamentals
Thermodynamics

WL 102
Change of state of gases

Isothermal and isochoric change of state of air

ET 351C
Thermodynamics of the refrigeration circuit

Compression refrigeration system for thermodynamic investigations, measurement of the mechanical compressor output

WL 204
Vapour pressure of water – Marcet boiler

Pressure and temperature measurement in a steam boiler

WL 440
Free and forced convection

Calculation of convective heat transfer at different geometries: flat plate, cylinder, tube bundle

WL 372
Radial and linear heat conduction

Study of heat conduction in solids

WL 210
Evaporation process

Different forms of evaporation in an externally heated pipe

WL 220
Boiling process

Visualisation of different forms of evaporation in a transparent pressure vessel

WL 230
Condensation process

Measurement of heat transfer in dropwise and film condensation

WL 110
Heat exchanger supply unit

Measuring the transfer characteristics of five different heat exchanger models, system control via PLC

WL 110.02
Plate heat exchanger

Typical plate heat exchanger in parallel flow and counterflow operation

WL 110.01
Tubular heat exchanger

Transparent heat exchanger with additional temperature measuring point after half of the transfer section; parallel flow and counterflow operation

WL 110.04
Stirred tank with double jacket and coil

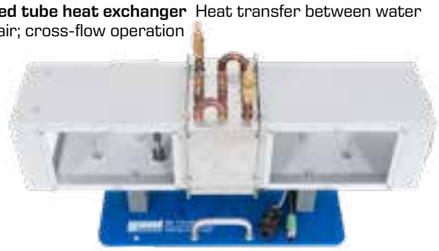
Heating using jacket or coiled tube; stirrer for improved mixing of medium

WL 110.03
Shell & tube heat exchanger

Transparent shell and tube heat exchanger in cross parallel flow and cross counterflow operation

WL 110.05
Finned tube heat exchanger

Heat transfer between water and air; cross-flow operation



WL 320
Wet cooling tower

Principle of operation and characteristic variables of a wet cooling tower with forced ventilation

WL 320.01 - WL 320.04
Cooling columns

Cooling columns with different wetting areas

Fundamentals
Dynamics of machinery

RT 050
Training system speed control, HSI

Fundamentals of control engineering using the example of a speed control system with first order lag

TM 632
Centrifugal governor

Characteristic curves of different centrifugal force governors

TM 180
Forces in reciprocating engines

Investigation of mass forces on a reciprocating piston machine

TM 620
Bending elasticity in rotors

Investigation of bending vibrations and resonance of a rotating shaft

Driving machines
Gas turbines

HM 270
Impulse turbine

Investigation of a compressed air driven axial impulse turbine

HM 272
Reaction turbine

Investigation of a compressed air driven radial reaction turbine

ET 792
Gas turbine

Operation with power turbine or as jet engine with propelling nozzle using liquid gas

ET 794
Gas turbine with power turbine

Two-shaft arrangement with high-pressure turbine and power turbine using liquid gas

Driving machines
Air turbines

ET 220
Energy conversion in a wind power plant

Conversion of kinetic wind energy into electrical energy

ET 220.10
Control unit for wind power plant ET 220.01

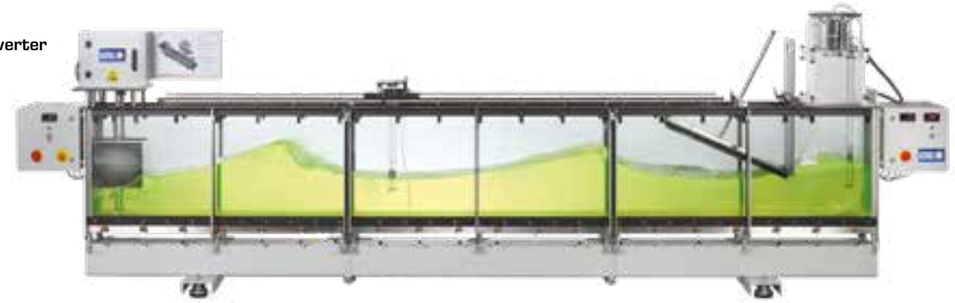
Use of wind energy in stand-alone operation under real weather conditions

ET 220.01
Wind power plant

Connection to ET 220 or ET 220.10; outdoor installation allows practically relevant investigations

ET 270
Wave energy converter

Turbine unit with Wells turbine and electric generator; configurable wave generator



ET 224
Operating behaviour of wind turbines

Characteristic and control on a wind power drive train

ET 210
Fundamentals of wind power plants

Wind power plant with rotor blade adjustment and yaw angle adjustment

ET 222
Wind power drive train

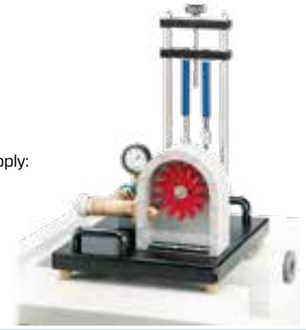
Experiments on conversion of rotational energy into electrical energy

Driving machines
Hydraulic turbines

HM 150.19
Operating principle of a Pelton turbine

Model of an impulse turbine with adjustable nozzle; determination of efficiency

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics



HM 150.20
Operating principle of a Francis turbine

Model of a reaction turbine with adjustable guide vanes and determination of the efficiency

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 287
Experiments with an axial turbine

Record characteristics of an axial reaction turbine

HM 405
Axial-flow turbomachines

Function of a turbomachine; configuration as pump or turbine with interchangeable rotor/impeller and stator/guide vane system

Driving machines
Hydraulic turbines

HM 450C
Characteristic variables of hydraulic turbomachines

Determination of output and efficiency of turbines and pumps; demonstration of a pumped storage plant

HM 450.01
Pelton turbine

Model of an impulse turbine with speed and torque measurement

HM 450.02
Francis turbine

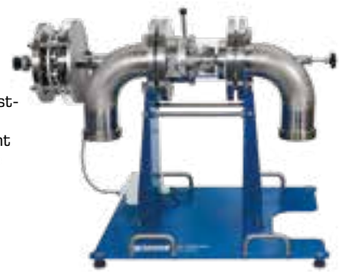
Model of a reaction turbine with speed and torque measurement; adjustable guide vanes

HM 450.03
Propeller type turbine

Six-bladed propeller type turbine with guide vane adjustment for varying power, measurement of speed and torque

HM 450.04
Kaplan turbine

Five-bladed Kaplan turbine with blade and guide vane adjustment for varying power, measurement of speed and torque



HM 430C
Francis turbine trainer

Characteristics of a powerful Francis turbine with adjustable guide vanes

HM 421
Propeller type turbine trainer

Four-bladed propeller type turbine with guide vane adjustment for varying power

HM 288
Experiments with a reaction turbine

Record characteristics of a turbine based on the reaction force

HM 289
Experiments with a Pelton turbine

Record characteristics of a free jet turbine

HM 291
Experiments with an action turbine

Record characteristics of an axial impulse turbine

HM 290
Base unit for turbines

Water supply for HM 288, HM 289 and HM 291

HM 365.31
Pelton and Francis turbine

Comparison of impulse and reaction turbines

HM 365.32
Turbine supply unit

Water supply for HM 365.31

Trainer for turbines with Pelton turbine HM 365.31, supply unit HM 365.32 and brake unit HM 365

Driving machines
Internal combustion engines

Modular test stand for single cylinder test engines CT 159, test engine CT 151 and brake unit HM 365

CT 159
Modular test stand for single-cylinder engines, 3 kW

Mounting the engine, supply with fuel and air; measurement of characteristic engine data

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

CT 150
Four-stroke petrol engine for CT 159

Air-cooled overhead valve four-stroke petrol engine

CT 151
Four-stroke diesel engine for CT 159

Air-cooled four-stroke diesel engine with direct injection

CT 153
Two-stroke petrol engine for CT 159

Air-cooled two-stroke petrol engine

Driven machines
Centrifugal pumps

HM 150.04
Centrifugal pump

Determining the characteristics of a typical centrifugal pump

HM 150 Base module required for experiments in fluid mechanics

HM 150.16
Series and parallel configuration of pumps

Characteristic curves and hydraulic power; comparison of operating modes

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 450C
Characteristic variables of hydraulic turbomachines

Determination of output and efficiency of turbines and pumps; demonstration of a pumped storage plant

HM 283
Experiments with a centrifugal pump

Determination of characteristic pump variables

HM 284
Series and parallel configuration of pumps

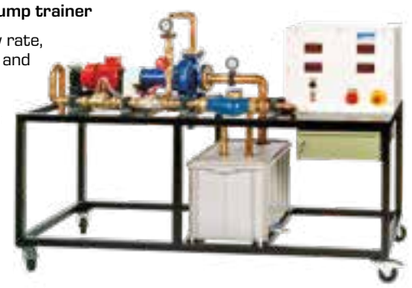
Demonstration of series, parallel and the individual operation of centrifugal pumps

HM 300
Hydraulic circuit with centrifugal pump

Measurement of pressure conditions in valves and fittings and a pump

HM 305
Centrifugal pump trainer

Pressure, flow rate, speed, torque and pump power available as measurement values



Driven machines
Centrifugal pumps

HM 365.11
Centrifugal pump, standard design

Standard pumps are pumps that are designed in accordance with international standards

HM 365.12
Centrifugal pump, self-priming

Self-priming pumps are able to suck in and transport air and water

Trainer for centrifugal pumps with supply unit HM 365.10, centrifugal pump HM 365.11 and drive unit HM 365

HM 365.13
Centrifugal pump, multistage

In centrifugal pumps with multiple stages several impellers are arranged in series

HM 365.14
Centrifugal pumps, series and parallel connected

Investigation of the pump characteristic of series and parallel configurations of two centrifugal pumps

HM 365.15
Side channel pump

Investigation of a self-priming, single-stage side channel pump

HM 365.10
Supply unit for water pumps

Water supply for HM 365.11 to HM 365.19

HM 332
Pump characteristics for parallel and series configuration

Investigation of the behaviour of two identical centrifugal pumps in operation, system control via PLC

HM 362
Comparison of pumps

Investigate operating behaviour of centrifugal pumps, piston pump and side channel pump, system control via PLC

Driven machines
Axial-flow pumps

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

HM 365.45
Axial-flow pump

Operating behaviour of an axial propeller pump

Trainer for an axial pump
with axial pump HM 365.45
and drive unit HM 365

HM 405
Axial-flow turbomachines

Function of a turbomachine;
configuration as pump or turbine with interchangeable rotor/impeller and stator/guide vane system

Driven machines
Positive displacement pumps

HM 285
Experiments with a piston pump

Record characteristics of a reciprocating positive displacement pump

HM 286
Experiments with a gear pump

Record characteristics of a rotary positive displacement pump

Driven machines
Positive displacement pumps

Trainer for positive displacement pumps
with supply unit HM 365.10, piston pump HM 365.17
and drive unit HM 365

HM 365.16
Lobe pump

Lobe pumps are used for delivering highly viscous and highly abrasive media

HM 365.17
Reciprocating piston pump

The most simple type of reciprocating piston pump consists of a piston that moves in a cylinder with one inlet and one outlet valve

HM 365.18
Gear pump

A gear pump is characterised by a steady flow rate

HM 365.19
Vane pump

Vane pumps can be used both for liquid and gaseous media

HM 365.10
Supply unit for water pumps

Water supply for HM 365.11 to HM 365.19

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

Trainer for positive displacement pumps with
supply unit HM 365.20, screw pump HM 365.21
and drive unit HM 365

HM 365.21
Screw pump

Screw pumps are able to provide continuous delivery of even viscous media without pulsation or turbulence

HM 365.22
External gear pump

The pumping medium is transported between the gears and the housing

HM 365.23
Vane pump

Vane pumps can be used both for liquid and gaseous media

HM 365.24
Internal gear pump

Operating behaviour of an internal gear pump

HM 365.20
Oil pump supply unit

Supply of oil pumps HM 365.21 to HM 365.24

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

Driven machines
Fans and compressors

HM 280
Experiments with a radial fan

Operating behaviour and characteristic variables of a radial fan; two interchangeable rotors

HM 210
Characteristic variables of a radial fan

Determination of flow rate via iris diaphragm or Venturi nozzle

HM 292
Experiments with a radial compressor

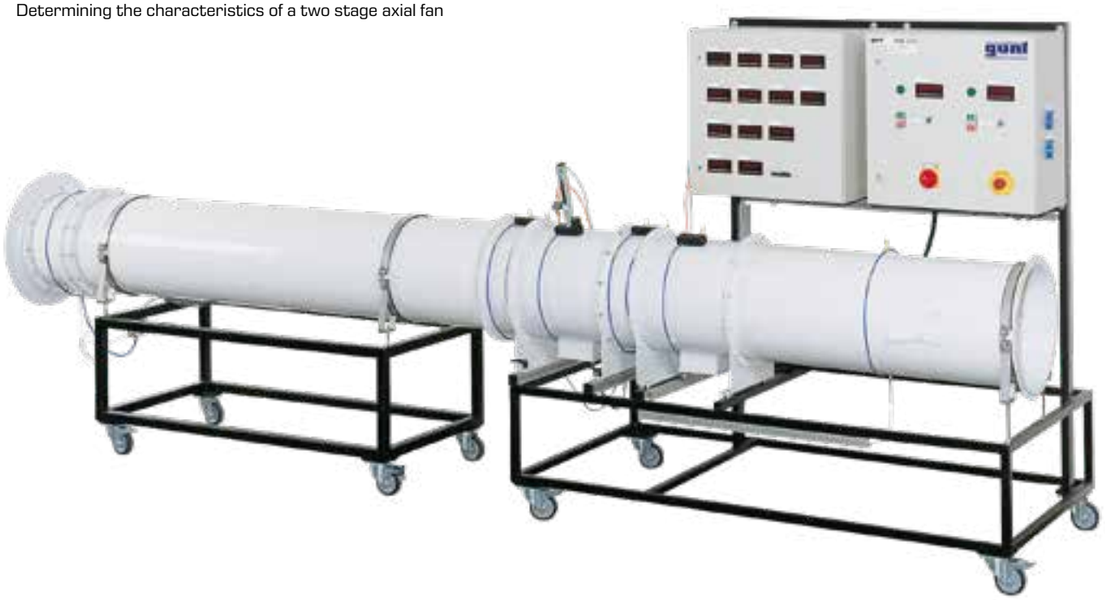
Two-stage compressor: recording of the compressor curve for both stages

HM 282
Experiments with an axial fan

Operating behaviour and characteristic variables of an axial fan

HM 215
Two-stage axial fan

Determining the characteristics of a two stage axial fan



Single-stage compressor ET 513 with drive unit HM 365

ET 513
Single-stage piston compressor

Investigations on an air compressor including the determination of the mechanical power consumption

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

HM 299
Comparison of positive displacement machines and turbomachines

Interchangeable driven machines: three pump types, two compressor types

ET 500
Two-stage piston compressor

Recording the characteristic of an industrial two-stage compressor, system control via PLC

Power plants and applied cyclic processes

ET 810
Steam power plant with steam engine

Single-cylinder piston steam engine with gas-fired boiler for steam generation

ET 850
Steam generator

Laboratory scale gas-fired steam generator for wet or superheated steam; integrated condenser

ET 851
Axial steam turbine

Single-stage steam turbine with power output measurement; steam supply via ET 850, gas-fired or ET 852, electrical

ET 852 Steam generator, electrical
Laboratory scale electrical steam generator for superheated steam; integrated condenser; alternative to the gas-fired steam generator ET 850 for the supply of the steam turbine ET 851

Experimental plant with two-cylinder steam engine ET 813, steam generator ET 813.01 and brake unit HM 365

ET 813
Two-cylinder steam engine

Single-acting steam engine with condensation for determining mechanical power and efficiency

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

ET 830
Steam power plant, 1,5 kW

Oil-fired boiler, single-stage small industry turbine, condenser and feed water treatment and monitoring via PLC

ET 830.01 / 02
Cooling tower

Wet cooling tower for steam power plant ET 830 for re-cooling the cooling water (115 kW or 140 kW)

ET 794
Gas turbine with power turbine

Two-shaft arrangement with high-pressure turbine and power turbine using liquid gas

ET 796
Gas turbine jet engine

Small single-shaft gas turbine with thrust measurement using either kerosene or petroleum

Power plants and applied cyclic processes

Compression refrigeration system ET 165 with drive unit HM 365

ET 165
Refrigeration system with open compressor

Capacity measurement at the open compressor with variable speed; refrigeration chamber with adjustable cooling load

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

ET 352
Vapour jet compressor in refrigeration

Cold production using thermal energy. Transparent condenser and evaporator allow the view into the inner workings.

ET 430
Refrigeration system with two-stage compression

Low temperature refrigeration system; compression with injection intercooler and additional refrigerant supercooling

Training for laboratory and teaching staff

Just as important as reliable and modern equipment

We provide support that is perfectly tailored to your needs:

- **general handling of the equipment**
- **how the equipment and its components work**
- **safety instructions for operating the equipment**
- **aspects of commissioning, starting the equipment and its maintenance**
- **introduction to the software (if available)**
- **explanation of the various experiments and details about the operating manual**

Our experienced team is available at any time, anywhere.

Get in touch!

Equipment series
GUNT-Labline

HM 288
Experiments with a reaction turbine

Record characteristics of a turbine based on the reaction force

HM 289
Experiments with a Pelton turbine

Record characteristics of a free jet turbine

HM 291
Experiments with an action turbine

Record characteristics of an axial impulse turbine

HM 290
Base unit for turbines

Water supply for HM 288, HM 289 and HM 291

HM 287
Experiments with an axial turbine

Record characteristics of an axial reaction turbine

HM 283
Experiments with a centrifugal pump

Determination of characteristic pump variables

HM 284
Series and parallel configuration of pumps

Demonstration of series, parallel and the individual operation of centrifugal pumps

HM 285
Experiments with a piston pump

Record characteristics of a reciprocating positive displacement pump

HM 280
Experiments with a radial fan

Operating behaviour and characteristic variables of a radial fan; two interchangeable rotors

HM 282
Experiments with an axial fan

Operating behaviour and characteristic variables of an axial fan

HM 286
Experiments with a gear pump

Record characteristics of a rotary positive-displacement pump

HM 292
Experiments with a radial compressor

Two-stage compressor: recording of the compressor curve for both stages

Equipment series
GUNT-FEMLine: water pumps

HM 365.11
Centrifugal pump, standard design

Standard pumps are pumps that are designed in accordance with international standards

HM 365.12
Centrifugal pump, self-priming

Self-priming pumps are able to suck in and transport air and water

HM 365.13
Centrifugal pump, multistage

In centrifugal pumps with multiple stages several impellers are arranged in series

HM 365.15
Side channel pump

Investigation of a self-priming, single-stage side channel pump

HM 365.14
Centrifugal pumps, series and parallel connected

Investigation of the pump characteristic of series and parallel configurations of two centrifugal pumps

HM 365.45
Axial-flow pump

Operating behaviour of an axial propeller pump

Trainer for centrifugal pumps with supply unit HM 365.10, centrifugal pump HM 365.11 and drive unit HM 365

HM 365.16
Lobe pump

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Reciprocating piston pump

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HM 365.18
Gear pump

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HM 365.10
Supply unit for water pumps

Water supply for HM 365.11 to HM 365.19

HM 365.19
Vane pump

Vane pumps can be used both for liquid and gaseous media

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

Equipment series
GUNT-FEMLine: oil pumps

Trainer for positive displacement pumps with supply unit HM 365.20, screw pump HM 365.21 and drive unit HM 365

HM 365.21
Screw pump

Screw pumps are able to provide continuous delivery of even viscous media without pulsation or turbulence

HM 365.22
External gear pump

The pumping medium is transported between the gears and the housing

HM 365.23
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HM 365.24
Internal gear pump

Operating behaviour of an internal gear pump

HM 365.20
Oil pump supply unit

Supply of oil pumps HM 365.21 to HM 365.24

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

Equipment series
GUNT-FEMLine: turbines

HM 365.31
Pelton and Francis turbine

Comparison of impulse and reaction turbines

HM 365.32
Turbine supply unit

Water supply for HM 365.31

Trainer for turbines with Pelton turbine HM 365.31, supply unit HM 365.32 and brake unit HM 365

Equipment series
GUNT-FEMLine: engines

Modular test stand for single cylinder test engines CT 159, test engine CT 151 and brake unit HM 365

CT 159
Modular test stand for single-cylinder engines, 3 kW

Mounting the engine, supply with fuel and air; measurement of characteristic engine data

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

CT 150
Four-stroke petrol engine for CT 159

Air-cooled overhead valve four-stroke petrol engine

CT 151
Four-stroke diesel engine for CT 159

Air-cooled four-stroke diesel engine with direct injection

CT 153
Two-stroke petrol engine for CT 159

Air-cooled two-stroke petrol engine

Equipment series
GUNT-FEMLine: plants

Experimental plant with two-cylinder steam engine ET 813, steam generator ET 813.01 and brake unit HM 365

ET 813
Two-cylinder steam engine

Single-acting steam engine with condensation for determining mechanical power and efficiency

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

Equipment series
GUNT-FEMLine: plants

Single-stage compressor ET 513 with drive unit HM 365

ET 513
Single-stage piston compressor

Investigations on an air compressor including the determination of the mechanical power consumption

Compression refrigeration system ET 165 with drive unit HM 365

ET 165
Refrigeration system with open compressor

Capacity measurement at the open compressor with variable speed; refrigeration chamber with adjustable cooling load

First-rate handbooks

GUNT's policy is simple: high quality hardware and clearly developed instructional material ensure successful teaching and learning about an experimental unit.

The core of this material are detailed reference experiments that we have carried out. The description of the experiment contains the actual experimental setup right through to the interpretation of the results and findings. A group of experienced engineers develops and maintains the instructional material.

Nevertheless, we are here to help should any questions remain unanswered, either by phone or – if necessary – on site.

Hands-on teaching engineering –

with GUNT's SMART features

4b | Hydraulics for civil engineering

About the product:

WLAN

learn

Hydraulics for civil engineering

Fundamentals of fluid mechanics
Hydrostatics

HM 115
Hydrostatics trainer

Experiments on buoyancy, density, capillarity etc.; various methods of pressure measurement

HM 150.06
Stability of floating bodies

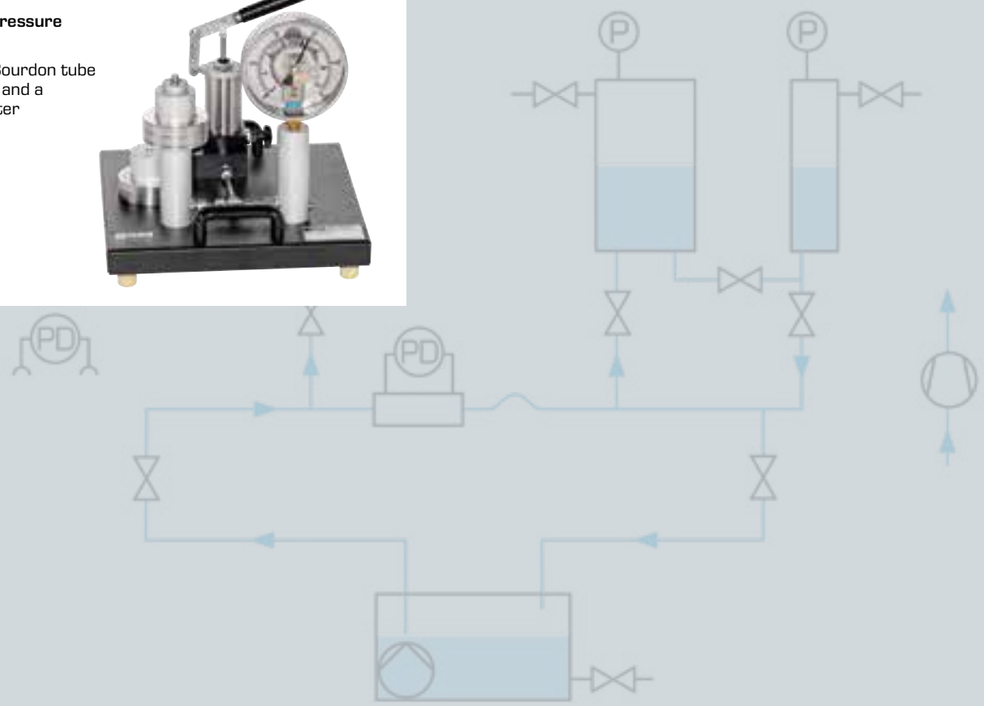
Determining metacentre and buoyancy using a rectangular hull cross-section

HM 150.39
Floating bodies for HM 150.06

Comparison of two different frame shapes: hard chine and round bilge

HM 150.02
Calibration of pressure gauges

Operation of a Bourdon tube pressure gauge and a piston manometer



Fundamentals of fluid mechanics
Discharge

HM 250.06
Free discharge

Recording the trajectory of the water jet and discharge coefficients at different outlet velocities

HM 250
Fundamentals of fluid mechanics

Base module for experiments in fluid mechanics, system control via PLC

Patented

HM 150.09
Horizontal flow from a tank

Recording the trajectory of the water jet at different outlet velocities

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.12
Vertical flow from a tank

Determination of pressure losses and contraction coefficient for different outlet contours

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

Fundamentals of fluid mechanics
Hydrodynamics

HM 150.18
Osborne Reynolds experiment

Visualisation of laminar and turbulent flow

Recommended for water supply:
HM 150 Base Module for experiments in fluid mechanics

HM 150.07
Bernoulli's principle

Static pressure and total pressure distribution along the Venturi nozzle

Recommended for water supply:
HM 150 Base module for experiments in fluid mechanics

HM 150.08
Measurement of jet forces

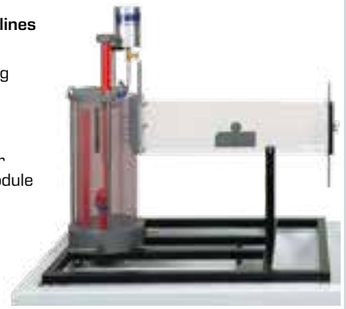
Demonstration of the principle of linear momentum and impact forces on interchangeable deflectors with different deflection angles

Recommended for water supply:
HM 150 Base module for experiments in fluid mechanics

HM 150.21
Visualisation of streamlines in an open channel

Flow around various drag bodies and incident flow of weirs; ink as contrast medium

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics



HM 150.10
Visualisation of streamlines

Investigation of flow around models in laminar, two-dimensional flow using ink as contrast medium

Recommended for water supply:
HM 150 Base module for experiments in fluid mechanics

HM 150
Base module for experiments in fluid mechanics

Volumetric flow measurement for large and small flow rates

HM 250
Fundamentals of fluid mechanics

Base module for experiments in fluid mechanics, system control via PLC

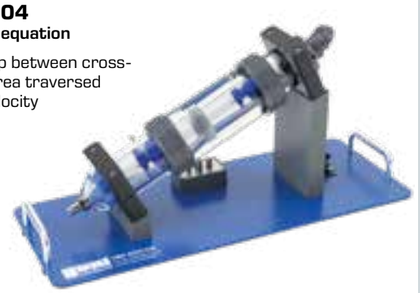
Patented

HM 250.03
Visualisation of streamlines

Investigation of cross-sectional changes in laminar, two-dimensional flow; visualisation using electrolytically generated hydrogen bubbles

HM 250.04
Continuity equation

Relationship between cross-sectional area traversed and flow velocity

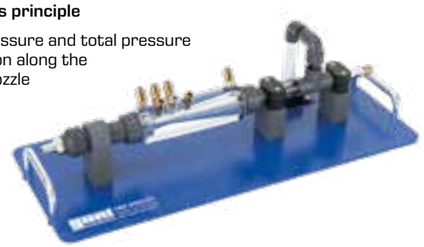


HM 250.05
Measurement of jet forces

Demonstration of the principle of linear momentum; interchangeable deflectors with different deflection angles

HM 250.07
Bernoulli's principle

Static pressure and total pressure distribution along the Venturi nozzle



Fundamentals of fluid mechanics
Pipe flow

HM 250.01
Visualisation of pipe flow

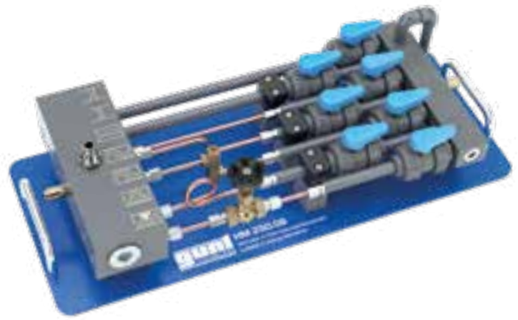
Visualisation of laminar and turbulent flow

HM 250.02
Measurement of flow profile

Measurement of laminar and turbulent flow

HM 250.08
Losses in pipe elements

Influence of flow velocity on pressure loss, didactically successive pipe sections



HM 250.09
Fundamentals of pipe friction

Pipe friction for laminar / turbulent flow, Reynolds number and pipe friction factor

HM 250.10
Pressure curve along the inlet section

Friction losses in the inlet as well as with different pipe geometries and surface roughnesses

HM 150.01
Pipe friction for laminar/turbulent flow

Determining the critical Reynolds number

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.11
Losses in a pipe system

Influence of flow velocity on pressure loss

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 164
Open channel and closed channel flow

Flow processes on different structures in open and closed channel flows; losses at inlet and outlet

HM 111
Pipe networks

Pressure losses at various piping elements and pipe networks; parallel and series connection of pipe sections

Fundamentals of fluid mechanics
Transient flow

HM 156
Water hammer and surge chamber

Investigation of formation, effect and function

HM 143
Transient drainage processes in storage reservoirs

Demonstration of the function of a rainwater retention basin and a storage lake

Fundamentals of fluid mechanics
Turbomachines

HM 150.19
Operating principle of a Pelton turbine

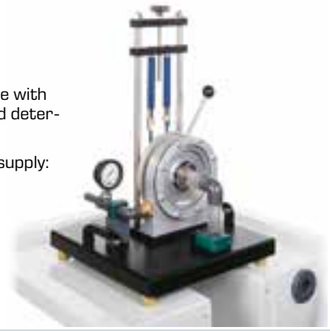
Model of an impulse turbine with adjustable nozzle; determination of efficiency

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.20
Operating principle of a Francis turbine

Model of a reaction turbine with adjustable guide vanes and determination of the efficiency

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics



HM 150.04
Centrifugal pump

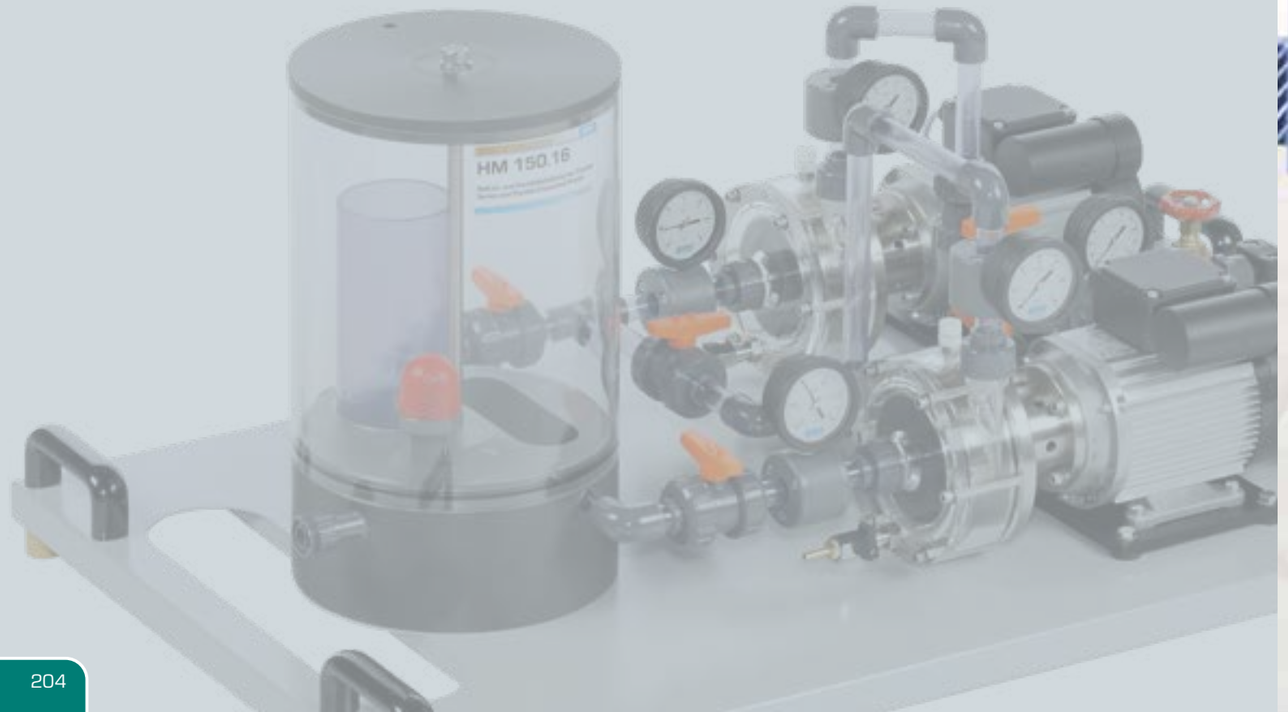
Determining the characteristics of a typical centrifugal pump

HM 150 Base module required for experiments in fluid mechanics

HM 150.16
Series and parallel configuration of pumps

Characteristic curves and hydraulic power; comparison of operating modes

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics



Installation and commissioning

Guaranteed trouble-free by professional GUNT staff

Have your new equipment commissioned by trained expert personnel. Our highly qualified staff will gladly assist you.

Commissioning of the equipment includes the following services:

- **setup of equipment in the laboratory**
- **connection to the laboratory's supply systems**
- **commissioning the equipment**
- **testing the equipment**

Hydraulic engineering
Open-channel flow

HM 160
Experimental flume 86 x 300 mm

Experimental section lengths of 2,5 m or 5 m available, closed water circuit and inclination adjustment

HM 162.30
Set of plate weirs, four types

Flow over different sharp-crested weirs, investigations on an aerated overshoot weir

HM 162 / 163
Experimental flume

Experimental section for performing flow experiments in open flumes with lengths of 5 m, 7,5 m, 10 m or 12,5 m available, closed water circuit and inclination adjustment

Flow cross-section W x H:
309 x 450 mm (HM 162) /
409 x 500 mm (HM 163)

HM 162.32
Ogee-crested weir with two weir outlets

2 ogee-crested weirs for the experimental flume, different weir outlets (chute only and chute with ski jump)

HM 161
Experimental flume 600 x 800 mm

Experimental section for performing flow experiments in open flumes of 16 m length, closed water circuit, inclination adjustment

HM 162.41
Wave generator

Generation of surface waves via paddle swinging back and forth

HM 162.46
Set of piers, seven profiles

Simulation of bridge pillars in a river, lateral reduction of cross-section in the flume

HM 250.11
Open channel

Flow around various drag bodies and incident flow of weirs

HM 250
Fundamentals of fluid mechanics

Base module for experiments in fluid mechanics, system control via PLC

Patented

Hydraulic engineering
Sediment transport

HM 166
Fundamentals of sediment transport

Starting conditions for bed-load transport

HM 140
Open-channel sediment transport

Observation of bed formation; visualisation of flow with contrast medium

HM 142
Separation in sedimentation tanks

Solid/liquid separation in a sedimentation tank, visualisation of flow conditions

HM 144
Formation of river courses

Compact experimental flume for modelling small river courses; inclination of the experimental flume adjustable

HM 168
Sediment transport in river courses

Investigation of sediment migration with and without structures

Hydraulic engineering
Seepage flow

HM 152
Potential flow

Visualisation of streamlines in a Hele-Shaw cell using ink as contrast medium

HM 167
Groundwater flow

Three-dimensional investigations; demonstration of lowering of groundwater; investigation of excavation pits

CE 116
Cake and depth filtration

Fundamentals of filtration: Darcy's equation

HM 165
Studies in hydrology

Investigation of precipitation-discharge relationships, storage capacity of soils, seepage flows and groundwater flows

HM 145
Advanced hydrological investigations

Seepage flows and groundwater flows in soils; sediment transport and obstacles in running waters

HM 141
Hydrographs after precipitation

Correlations between precipitation and seepage; various drainage methods

HM 169
Visualisation of seepage flows

Graphical determination of flow nets; investigation of water pressure on structures

Hands-on teaching engineering –

with GUNT's SMART features

5 | Process engineering

About the product:

WLAN smart 22.739 E learn

Fundamentals of process engineering
Theory: thermodynamics

WL 204
Vapour pressure of water – Marcet boiler

Pressure and temperature measurement in a steam boiler

WL 102
Change of state of gases

Isothermal and isochoric change of state of air

WL 210
Evaporation process

Different forms of evaporation in an externally heated pipe

WL 220
Boiling process

Visualisation of different forms of evaporation in a transparent pressure vessel

WL 230
Condensation process

Measurement of heat transfer in dropwise and film condensation

ET 805.50
Determination of the vapour content

Determination of the vapour content using a separating calorimeter with cyclone water separator or a throttling calorimeter with vapour depressurisation

ET 850
Steam generator

Laboratory scale gas-fired steam generator for wet or superheated steam; integrated condenser

ET 350
Changes of state in the refrigeration circuit

Energetic analyses of the refrigeration cycle; transparent components offer insights into the changes of state

Fundamentals of process engineering
Theory: heat and mass transfer

CE 110
Diffusion in liquids and gases

Use of Fick's law

WL 440
Free and forced convection

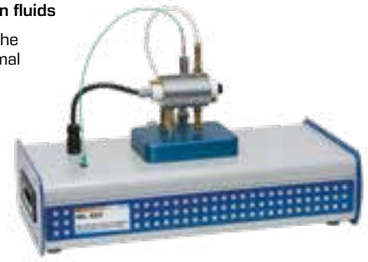
Calculation of convective heat transfer at different geometries: flat plate, cylinder, tube bundle

WL 372
Radial and linear heat conduction

Study of heat conduction in solids

WL 422
Heat conduction in fluids

Determination of the coefficient of thermal conductivity for gaseous and liquid fluids



WL 377
Convection and radiation

Heat transport between heating element and vessel wall by convection and radiation

WL 225
Heat transfer in the fluidised bed

Heat transfer from a heating element to the fluidised bed

WL 320
Wet cooling tower

Principle of operation and characteristic variables of a wet cooling tower with forced ventilation

WL 320.01 - WL 320.04
Cooling columns

Cooling columns with different wetting areas

Fundamentals of process engineering
Theory: heat and mass transfer

WL 110
Heat exchanger supply unit

Measuring the transfer characteristics of five different heat exchanger models, system control via PLC

WL 110.01
Tubular heat exchanger

Transparent heat exchanger with additional temperature measuring point after half of the transfer section; parallel flow and counterflow operation

WL 110.02
Plate heat exchanger

Typical plate heat exchanger in parallel flow and counterflow operation

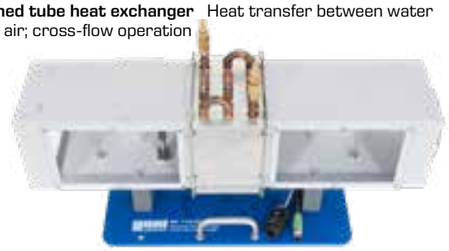
WL 110.03
Shell & tube heat exchanger

Transparent shell and tube heat exchanger in cross parallel flow and cross counterflow operation

WL 110.04
Stirred tank with double jacket and coil

Heating using jacket or coiled tube; stirrer for improved mixing of medium

WL 110.05
Finned tube heat exchanger Heat transfer between water and air; cross-flow operation



Fundamentals of process engineering
Theory: fluid mechanics

HM 115
Hydrostatics trainer

Experiments on buoyancy, density, capillarity etc.; various methods of pressure measurement

HM 135
Determination of the settling velocity

Vertically falling body in liquid using specimens of different sizes and different materials

HM 155
Water hammer in pipes

Water hammer as a function of valve closing time; calculation of the wave propagation velocity in water

HM 136
Flow through packed columns

Comparison of different modes of operation; water and / or air, parallel flow or counterflow mode

Fundamentals of process engineering
Theory: fluid mechanics

HM 150.18
Osborne Reynolds experiment

Visualisation of laminar and turbulent flow

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.07
Bernoulli's principle

Static pressure and total pressure distribution along the Venturi nozzle

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.01
Pipe friction for laminar/turbulent flow

Determining the critical Reynolds number

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.12
Vertical flow from a tank

Determination of pressure losses and contraction coefficient for different outlet contours

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.11
Losses in a pipe system

Influence of flow velocity on pressure loss

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

Fundamentals of process engineering
Theory: fundamentals of control engineering

RT 010
Training system level control, HSI

Fundamentals of control engineering using the example of a level control system with integral behaviour

RT 020
Training system flow control, HSI

Fundamentals of control engineering using the example of a rapid flow control system

RT 030
Training system pressure control, HSI

Fundamentals of control engineering using the example of a pressure control system with first order lag

RT 040
Training system temperature control, HSI

Fundamentals of control engineering using the example of a temperature control system with dead time

RT 800
PLC application: mixing process

Experiments using PLC to control discontinuous mixing processes

RT 050
Training system speed control, HSI

Fundamentals of control engineering using the example of a speed control system with first order lag

IA 130
PLC module

Self-contained PLC module for basic exercises; also suitable for IA 210 and RT 800

Fundamentals of process engineering
Theory: measuring methods

IA 110
Calibrating a pressure sensor

Test-pressure generated with dead-weight piston manometer

WL 201
Fundamentals of humidity measurement

Climatic chamber with adjustable humidity; comparison of four measuring methods

WL 202
Fundamentals of temperature measurement

Experimental introduction to temperature measurement: methods, areas of application, characteristics

WL 203
Fundamentals of pressure measurement

Measurement of positive and negative pressure with different measuring devices

HM 500
Flow meter trainer

Comparison and calibration of different flow meters

Different flow meters HM 500.01-HM 500.16 are available as accessories.

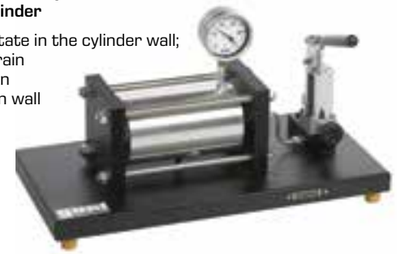
Fundamentals of process engineering
Practice: tanks and materials

FL 130
Stress and strain analysis on a thin-walled cylinder

Investigation of axial and circumferential stress in a thin-walled cylinder under internal pressure

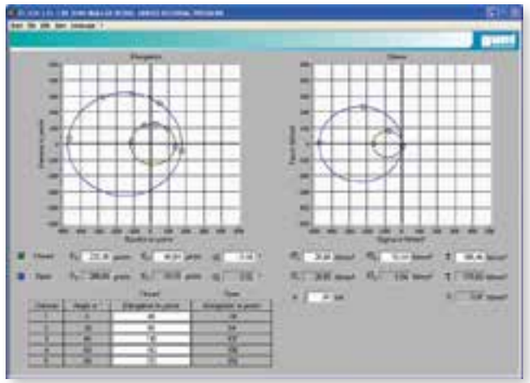
FL 140
Stress and strain analysis on a thick-walled cylinder

Triaxial stress state in the cylinder wall; cylinder with strain gauge application on surface and in wall



FL 152
Multi-channel measuring amplifier

Processing of analogue measuring signals for stress and strain analysis FL 120 – FL 140 and for GUNT trusses



Analysis using the software in FL 152

CE 105
Corrosion of metals

Parallel investigation of different influencing factors on different metal samples

Fundamentals of process engineering
Practice: pumps and compressors

HM 365.11
Centrifugal pump, standard design

Standard pumps are pumps that are designed in accordance with international standards

HM 365.14
Centrifugal pumps, series and parallel connected

Investigation of the pump characteristic of series and parallel configurations of two centrifugal pumps

Trainer for centrifugal pumps with supply unit HM 365.10, centrifugal pump HM 365.11 and drive unit HM 365

HM 365.15
Side channel pump

Investigation of a self-priming, single-stage side channel pump

HM 365.17
Reciprocating piston pump

The most simple type of reciprocating piston pump consists of a piston that moves in a cylinder with one inlet and one outlet valve

HM 365.10
Supply unit for water pumps

Water supply for HM 365.11 to HM 365.19

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

MT 180
Assembly & maintenance exercise: centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 181
Assembly & maintenance exercise: multistage centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 182
Assembly & maintenance exercise: screw pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 183
Assembly & maintenance exercise: diaphragm pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 184
Assembly & maintenance exercise: piston pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 185
Assembly & maintenance exercise: in-line centrifugal pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 186
Assembly & maintenance exercise: gear pump

Understanding design and function of the pump; planning and executing assembly, disassembly and maintenance

MT 136
Assembly exercise: gear pump

Design and function of a gear pump; planning, assembly and disassembly

Multimedia instructional materials via Internet

Fundamentals of process engineering
Practice: pumps and compressors

HL 960.01
Assembly and alignment of pumps and drives

Installation and removal of pumps in plants; water supply for HL 960

CE 271
Multi-head diaphragm pump

Metering pump with three pump heads

CE 272
Rotary vane vacuum pump

Generation of negative pressure over time

ET 500
Two-stage piston compressor

Recording the characteristic of an industrial two-stage compressor, system control via PLC

MT 141
Assembly exercise: piston compressor

Function and design of a piston compressor; planning, assembly, disassembly

Multimedia instructional materials via Internet

MT 140.01
Assembly exercise piston compressor: functional test

Installation of the compressor MT 140 or MT 140.02 for operational check

Fundamentals of process engineering
Practice: piping elements and valves and fittings

HM 700.01
Cutaway model: standard orifice plate

HM 700.02
Cutaway model: flow nozzle

HM 700.03
Cutaway model: standard Venturi meter

HM 700.04
Cutaway model: straight-way valve

HM 700.05
Cutaway model: corner valve

HM 700.06
Cutaway model: angle seat valve

HM 700.07
Cutaway model: non-return valve

HM 700.08
Cutaway model: pressure reducing valve

Fundamentals of process engineering
Practice: piping elements and valves and fittings

HM 700.09
Cutaway model:
strainer

HM 700.10
Cutaway model:
gate valve

HM 700.11
Cutaway model:
straight-way plug valve

HM 700.12
Cutaway model:
three-way plug valve

HM 700.13
Cutaway model:
ball valve

HM 700.14
Cutaway model:
safety valve

HM 700.15
Cutaway models:
various screwed pipe connections

VS 102
Cutaway model:
resilient seated gate valve

VS 103
Cutaway model:
screw down valve

VS 104
Cutaway model:
changeover valve

VS 106
Cutaway model:
backflow preventer

VS 107
Cutaway model:
non-return butterfly valve

VS 109
Cutaway model:
strainer

Fundamentals of process engineering
Practice: piping elements and valves and fittings

MT 156
Assembly exercise: wedge gate valve and angle seat valve

Assembly, disassembly and maintenance of industrial fittings

MT 157
Assembly exercise: butterfly valve and non-return valve

Assembly, disassembly and maintenance of industrial fittings

MT 158
Assembly exercise: ball valve and shut-off valve

Assembly, disassembly and maintenance of industrial fittings

MT 162
Hydraulic valves and fittings test stand

Pressure test for GUNT assembly kits MT 154, MT 156, MT 157 and MT 158

MT 101
Assembly exercise: pneumatically driven control valve

Design and function of a pneumatically driven control valve; planning, assembly and disassembly

Multimedia instructional materials via Internet

MT 102
Assembly exercise: electrically driven control valve

Design and function of an electrically driven control valve; planning, assembly and disassembly

Multimedia instructional materials via Internet

HL 960
Assembly station pipes and valves and fittings

Assembly of real piping and plant installations; together with HL 960.01: operational testing on a pipe network

HL 960.01
Assembly and alignment of pumps and drives

Installation and removal of pumps in plants; water supply for HL 960

RT 395
Maintenance of valves and fittings and actuators

Maintenance and operational check: four different fittings and actuators

RT 396
Pump and valves and fittings test stand

Recording characteristic curves of industrial fittings and a centrifugal pump

Fundamentals of process engineering
Practice: piping elements and valves and fittings

HL 962
Assembly stand for pumps

Base unit when constructing a complex piping system

HL 962.01
Standard chemicals pump

Typical pump as used in process engineering

HL 962.02
Canned motor pump

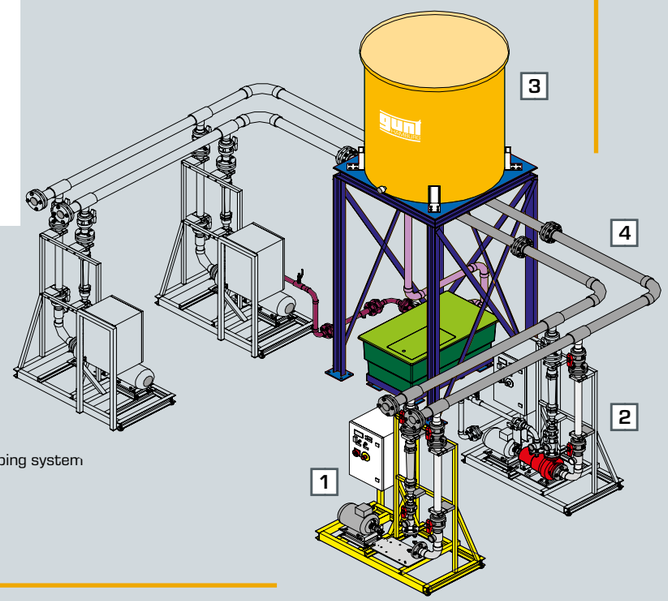
Hermetic centrifugal pump, particularly suitable for pumping liquid gases

HL 962.03
Side channel pump

Self-priming three-stage pump

HL 962.04
Standard chemicals pump with magnetic clutch

Hermetic centrifugal pump according to ISO 5199



Possible combination of individual components into a functional pumping system

1 assembly stand for pumps (HL 962)
2 pumps, various types (HL 962.01 – HL 962.04)
3 tank installation (HL 962.30)
4 piping system to interconnect the plant components (HL 962.32)

Fundamentals of process engineering
Practice: heat exchangers and steam generators

ET 860
Safety devices on steam boilers

Familiarisation with boiler safety devices such as pressure and water level monitors

WL 315C
Comparison of various heat exchangers

Comparison of plate heat exchanger, tubular heat exchanger, shell and tube heat exchanger, finned cross-flow heat exchanger, and stirred tank with double jacket and coiled tube

Fundamentals of process engineering
Practice: applications of control engineering

RT 586
Control of water quality

Control of pH value, redox potential, oxygen concentration and electrical conductivity

RT 682
Multivariable control: stirred tank

Heated stirrer tank with heat recovery as model: coupled level and temperature control

RT 681
Multivariable control: vacuum degassing

Model of “degassing of fluids”: coupled level and pressure control in one vacuum tank

Fundamentals of process engineering
Practice: applications of control engineering

RT 451
Level control

Level controlled system based on standard industrial components, smart level sensor, system control via PLC

RT 452
Flow control

Flow controlled system based on standard industrial components, smart flow rate sensor, system control via PLC

RT 453
Pressure control

First order and second order pressure controlled system based on standard industrial components, smart pressure sensors, system control via PLC

RT 454
Temperature control

Temperature controlled system based on standard industrial components, controller configurable as a continuous or a switching device, smart temperature sensors, system control via PLC

RT 455
pH value control

pH value controlled system based on standard industrial components, smart pH sensors, system control via PLC

RT 304
Calibration trainer

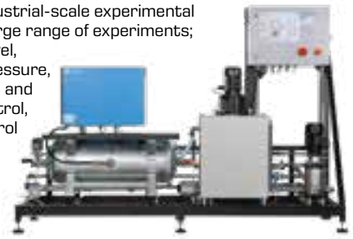
Investigation of the transmission behaviour of actuators and transducers

RT 310
Calibration station

Calibration of control loop components using precision measuring technique

RT 590
Process control engineering experimental plant

Complex industrial-scale experimental plant with large range of experiments; control of level, flow rate, pressure, temperature and cascade control, system control via PLC



RT 580
Control systems and fault finding

Control of level, flow rate, temperature and cascade control; plant control and configuration via touch screen and PLC

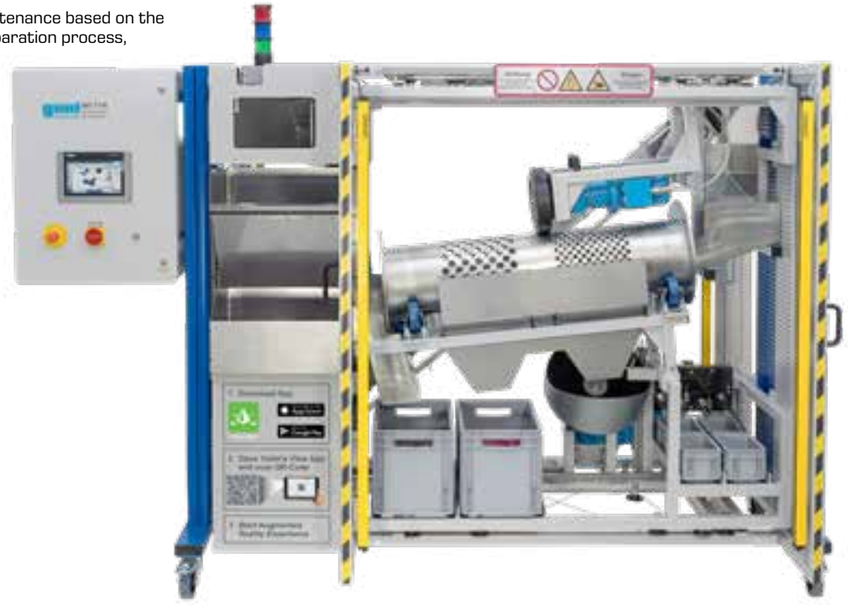
RT 578
Control of four variables from process engineering

Practical control of level, flow rate, pressure and temperature

Mechanical process engineering
Separation methods: classifying and sorting

MT 174
Sorting plant

Preventive maintenance based on the example of a separation process, system control via PLC



CE 275
Gas flow classification

Zigzag sifter to separate solid compounds

CE 280
Magnetic separation

Sorting with a drum-type magnetic separator

Mechanical process engineering
Separation methods: separation in a gravity field

HM 142
Separation in sedimentation tanks

Solid / liquid separation in a sedimentation tank, visualisation of flow conditions

CE 115
Fundamentals of sedimentation

Separation of suspensions

CE 587
Dissolved air flotation

Removal of solids from raw water using dissolved air flotation

Mechanical process engineering
Separation methods: filtration

CE 116
Cake and depth filtration

Fundamentals of filtration: Darcy's equation

CE 117
Flow through particle layers

Investigation of the properties of fixed and fluidised beds subjected to liquid flow

CE 287
Plate and frame filter press

Discontinuous cake filtration for separating solids out of suspensions

CE 283
Drum cell filter

Continuous cake filtration for separating solids from suspensions

CE 284
Nutsche vacuum filter

Discontinuous cake filtration by negative pressure

CE 286
Nutsche pressure filter

Discontinuous cake filtration by positive pressure

CE 285
Suspension production unit

Supply unit for experimental filtration units CE 284 and CE 286

CE 579
Depth filtration

Demonstration of depth filtration and backwashing of filters

Mechanical process engineering
Separation methods: separation in a centrifugal force field

CE 282
Disc centrifuge

Continuous separation of emulsions

CE 225
Hydrocyclone

Separation of solids from liquids by using a centrifugal force

CE 235
Gas cyclone

Solid separation from gases using a cyclone

Mechanical process engineering
Comminution

CE 245
Ball mill

Observation of the milling process: comminution of solids

Mechanical process engineering
Mixing and agglomeration

CE 320
Stirring

Visualization of flow fields when using various stirrer types

CE 322
Rheology and mixing quality in a stirred tank

Stirring machine with direct torque measurement to determine the power curves

CE 255
Rolling agglomeration

Dish granulator with adjustable speed and angle of inclination

Mechanical process engineering
Storage and flow of bulk solids

CE 210
Flow of bulk solids from silos

Influence of wall material and inclination of hopper wall on flow profile and outflow time

CE 200
Flow properties of bulk solids

Using a ring shear tester to record the shear force characteristics of bulk solids; basic principle of silo design

Mechanical process engineering
Fluidised beds and pneumatic transport

CE 220
Fluidised bed formation

Investigation of fluidised bed formation of solids in air and water

CE 250
Pneumatic transport

Pneumatic pressure-lifting of solids in a vertical transparent tube

CE 222
Comparison of fluidised beds

Two transparent columns with different diameters for observation of fluidised bed formation in gases

Chemical process engineering
Thermal activation

CE 310
Supply unit for chemical reactors

Basic unit for investigation and comparison of different reactors during a saponification reaction

CE 310.01
Continuous stirred tank reactor

Tank for continuous or batch operation with agitator, heat exchanger and overflow

CE 310.02
Tubular reactor

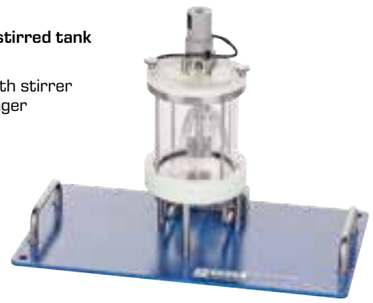
Tube coil as a reaction tube in a water bath for continuous reaction operation

CE 310.03
Stirred tanks in series

Series connection of three stirred tank reactors

CE 310.04
Discontinuous stirred tank reactor

Dewar vessel with stirrer and heat exchanger for isothermal saponification reaction



CE 310.05
Plug-flow reactor

Continuously operated tubular reactor; fixed bed with glass spheres

CE 310.06
Laminar flow reactor

Continuously operated tubular reactor

CE 100
Tubular reactor

Demonstration of the influence of temperature and reaction period on the alkaline saponification reaction

Chemical process engineering
Catalytic and photochemical activation

CE 380
Fixed bed catalysis

Investigation of catalytic reactions

CE 380.01
Flow injection analysis

Professional analysis unit for CE 380: detection of glucose

CE 584
Advanced oxidation

Oxidation of organic substances with hydrogen peroxide and UV light

CE 650
Biodiesel plant

Chemical transesterification of vegetable oils, system control via PLC

Thermal process engineering
Drying and evaporation

CE 715
Rising film evaporation

Concentration of temperature-sensitive solutions

CE 130
Convection drying

Drying curves for granular solids

Thermal process engineering
Distillation / rectification

CE 600
Continuous rectification

Continuous and discontinuous rectification with packed, sieve tray and bubble cap tray column, system control via PLC

CE 602
Discontinuous rectification

Comparison of packed and sieve tray columns in rectification

CE 610
Comparison of rectification columns

PLC controlled continuous rectification with packed and sieve tray column

Thermal process engineering
Absorption and adsorption

CE 400
Gas absorption

Separating a carbon dioxide/air mixture by absorption in counterflow

CE 405
Falling film absorption

Separation of oxygen from an air flow by absorption in a falling film column

CE 540
Adsorptive air drying

Basic principle of adsorption and desorption

CE 583
Adsorption

Adsorption of dissolved substances on activated carbon

Thermal process engineering
Crystallisation and membrane separation processes

CE 520
Cooling crystallisation

Investigation of crystal growth in a fluidised bed

CE 530
Reverse osmosis

Membrane separation process for obtaining solvent from a salt solution, system control via PLC

Thermal process engineering
Extraction

CE 620
Liquid-liquid extraction

Separation of a two-component liquid mixture by extraction in counterflow with a solvent

CE 630
Solid-liquid extraction

Continuous and discontinuous extraction of the soluble components of a solid

Biological process engineering
Aerobic processes

CE 701
Biofilm process

Biological, aerobic water treatment by the biofilm process: trickling filter

CE 730
Airlift reactor

Aerobic submerged reactor

CE 705
Activated sludge process

Wastewater treatment plant in laboratory scale:
aerobic biological degradation of organic substances,
system control via PLC

Biological process engineering
Anaerobic processes

CE 702
Anaerobic water treatment

Anaerobic degradation of organic substances in the stirred tank and UASB reactor for biogas production (UASB: Upflow Anaerobic Sludge Blanket)

CE 640
Biotechnical production of ethanol

Batch conversion of starch-based raw materials into ethanol, system control via PLC

CE 642
Biogas plant

Two-stage continuous degradation of organic substances.
First stage: hydrolysis and acidification, second stage: anaerobic degradation, system control via PLC

Water treatment
Mechanical processes

CE 587
Dissolved air flotation

Removal of solids from raw water using dissolved air flotation

CE 579
Depth filtration

Demonstration of depth filtration and backwashing of filters

HM 142
Separation in sedimentation tanks

Solid/liquid separation in a sedimentation tank, visualisation of flow conditions

CE 588
Demonstration of dissolved air flotation

Basic function and visualisation of the process

Water treatment
Biological processes

CE 701
Biofilm process

Biological, aerobic water treatment by the biofilm process: trickling filter

CE 702
Anaerobic water treatment

Anaerobic degradation of organic substances in the stirred tank and UASB reactor for biogas production (UASB: Upflow Anaerobic Sludge Blanket)

CE 705
Activated sludge process

Wastewater treatment plant in laboratory scale: aerobic biological degradation of organic substances, system control via PLC

CE 704
SBR process

Sequencing batch reactor

Water treatment
Physical / chemical processes

CE 583
Adsorption

Adsorption of dissolved substances on activated carbon

CE 300
Ion exchange

Softening and desalination of water by ion exchange

CE 584
Advanced oxidation

Oxidation of organic substances with hydrogen peroxide and UV light

CE 530
Reverse osmosis

Membrane separation process for obtaining solvent from a salt solution, system control via PLC

CE 586
Precipitation and flocculation

Removal of dissolved substances by precipitation, flocculation and sedimentation of the flocs in the lamella separator

Water treatment
Combined processes

CE 581
Water treatment plant 1

Three basic procedures of water treatment: depth filtration, adsorption and ion exchange, system control via PLC

CE 582
Water treatment plant 2

Two basic procedures of water treatment: depth filtration and ion exchange

Hands-on teaching engineering –

with GUNT's SMART features

About the product:

WLAN

learn

6 | 2E Energy & Environment

Energy

Environment

Energy
Solar energy: photovoltaics

ET 252
Solar cell measurements

Investigation of the properties of solar cells; objective measurements by extensive temperature control of solar cells

ET 255
Using photovoltaics: grid-connected or stand-alone

Electrical components of a real life photovoltaic system

ET 250
Solar module measurements

Determining the characteristic parameters of a photovoltaic system

ET 250.02
Stand-alone operation of photovoltaic modules

Expansion module for ET 250 with components for independent use of electricity from solar panels

ET 250.01
Photovoltaic in grid-connected operation

Expansion module for ET 250 with components for feeding solar power into a public grid

Energy
Solar energy: solar thermal energy

ET 203
Parabolic trough collector with solar tracking

Function and operating behavior of a parabolic trough collector, astronomical and sensor-based sun tracking, system control via PLC

ET 202
Principles of solar thermal energy

Determining characteristic parameters of a solar thermal system; model fitted with artificial radiation source

WL 377
Convection and radiation

Heat transport between heating element and vessel wall by convection and radiation

HL 313
Domestic water heating with flat collector

Demonstration of the conversion of the sun's radiation energy into heat and the storing of that heat

Operating the solar controller via web browser

HL 314
Domestic water heating with tube collector

Familiarisation with the functions of the evacuated tube collector and the solar circuit

HL 320.03
Flat collector

Pivotable flat collector for converting solar energy into heat

HL 320.04
Evacuated tube collector

Conversion of solar energy into heat in the evacuated tube collector

HL 320.05
Central storage module with controller

Module with buffer storage and bivalent storage for heating systems with renewable energies, operating the heating controller via web browser

Energy
Solar energy: solar cooling

ET 256
Cooling with solar electricity

Compression refrigeration system for operation with solar current from ET 250

ET 250
Solar module measurements

Determining the characteristic parameters of a photovoltaic system

ET 352.01
Solar heat for refrigeration

Solar thermal operation of a vapour jet compressor

ET 352
Vapour jet compressor in refrigeration

Cold production using thermal energy. Transparent condenser and evaporator allow the view into the inner workings.

HL 313
Domestic water heating with flat collector

Demonstration of the conversion of the sun's radiation energy into heat and the storing of that heat, operating the solar controller via web browser

HL 314
Domestic water heating with tube collector

Familiarisation with the functions of the evacuated tube collector and the solar circuit, operating the solar controller via web browser

Energy
Geothermal energy: heat exchangers

WL 110
Heat exchanger supply unit

Measuring the transfer characteristics of five different heat exchanger models, system control via PLC

WL 110.02
Plate heat exchanger

Typical plate heat exchanger in parallel flow and counterflow operation

WL 110.01
Tubular heat exchanger

Transparent heat exchanger with additional temperature measuring point after half of the transfer section; parallel flow and counterflow operation

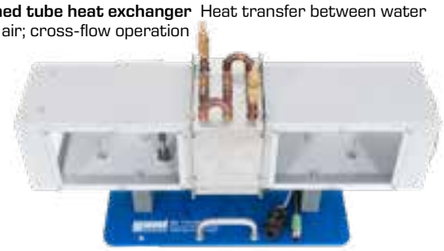
WL 110.04
Stirred tank with double jacket and coil

Heating using jacket or coiled tube; stirrer for improved mixing of medium

WL 110.03
Shell & tube heat exchanger

Transparent shell and tube heat exchanger in cross parallel flow and cross counterflow operation

WL 110.05
Finned tube heat exchanger Heat transfer between water and air; cross-flow operation



WL 315C
Comparison of various heat exchangers

Comparison of plate heat exchanger, tubular heat exchanger, shell and tube heat exchanger, finned cross-flow heat exchanger, and stirred tank with double jacket and coiled tube

Energy
Geothermal energy: shallow geothermal energy

ET 101
Simple compression refrigeration circuit

Demonstration of a heat pump: cooling and heating of the heat exchangers directly tangible

ET 262
Geothermal probe with heat pipe principle

Transparent components allow observing how the state of the heat transfer medium changes

ET 264
Geothermal energy with two-well system

Use of geothermal energy in an open system without thermal repercussion

HL 320.01
Heat pump

Heat pump for operation with different sources, operating the heating controller via web browser

HL 320.07
Underfloor heating / geothermal energy absorber

Can be used as heat sink or heat source

HL 320.08
Fan heater / air heat exchanger

Can be used as heat sink or heat source

Energy
Geothermal energy: deep geothermal energy

ET 850
Steam generator

Laboratory scale gas-fired steam generator for wet or superheated steam; integrated condenser

ET 851
Axial steam turbine

Single-stage steam turbine with power output measurement; steam supply via ET 850, gas-fired or ET 852, electrical

ET 852
Steam generator, electrical

Laboratory scale electrical steam generator for superheated steam; integrated condenser; alternative to the gas-fired steam generator ET 850 for the supply of the steam turbine ET 851

Energy
Wind power: fundamentals of wind energy technology

ET 220
Energy conversion in a wind power plant

Conversion of kinetic wind energy into electrical energy

ET 220.01
Wind power plant

Connection to ET 220 or ET 220.10; outdoor installation allows practically relevant investigations

ET 220.10
Control unit for wind power plant ET 220.01

Use of wind energy in stand-alone operation under real weather conditions

ET 224
Operating behaviour of wind turbines

Characteristic and control on a wind power drive train

ET 210
Fundamentals of wind power plants

Wind power plant with rotor blade adjustment and yaw angle adjustment

ET 222
Wind power drive train

Experiments on conversion of rotational energy into electrical energy

HM 170
Open wind tunnel

Experiments from the field of aerodynamics and fluid mechanics with an “Eiffel” type wind tunnel

HM 170.70
Wind power plant with rotor blade adjustment

Extension to wind tunnel HM 170

HM 170.05
Drag body square plate

HM 170.09
Lift body aerofoil NACA 0015

HM 170.22
Pressure distribution on an aerofoil NACA 0015

Experiments with different aerofoil angles of attack

Energy
Wind power: application technology for wind power plants

GL 210
Dynamic behaviour of multistage spur gears

Investigation of the dynamics of rotation of one-, two- and three-stage spur gear units

GL 212
Dynamic behaviour of multistage planetary gears

Investigation of rotational dynamics of a two-stage epicyclic gear with three planetary gears each

PT 500.11
Crack detection in rotating shaft kit

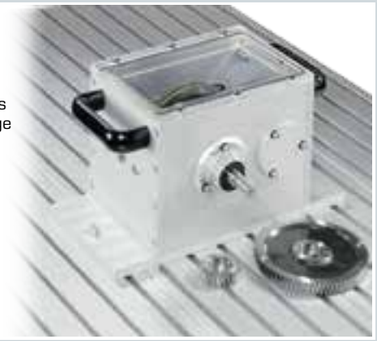
Vibrational behaviour of a shaft with a radial crack

PT 500.12
Roller bearing faults kit

Assessment of bearing condition by vibration analysis

PT 500.15
Damage to gears kit

Vibration analysis of gearing damage



PT 500.19
Electromechanical vibrations kit

Investigation of vibrational behaviour of an electric motor

PT 500
Machinery diagnostic system, base unit

Base unit for setting up wide ranging experiments in machinery diagnostics using modular accessory sets

AT 200
Determination of gear efficiency

Test system for determining mechanical drive and braking efficiency for spur and worm gears

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Energy
Hydropower and ocean energy

HM 150.19
Operating principle of a Pelton turbine

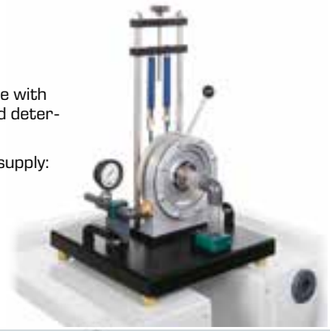
Model of an impulse turbine with adjustable nozzle; determination of efficiency

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics

HM 150.20
Operating principle of a Francis turbine

Model of a reaction turbine with adjustable guide vanes and determination of the efficiency

Recommended for water supply: HM 150 Base module for experiments in fluid mechanics



HM 365.31
Pelton and Francis turbine

Comparison of impulse and reaction turbines

HM 365.32
Turbine supply unit

Water supply for HM 365.31

Trainer for turbines with Pelton turbine HM 365.31, supply unit HM 365.32 and brake unit HM 365

HM 421
Propeller type turbine trainer

Four-bladed propeller type turbine with guide vane adjustment for varying power

HM 430C
Francis turbine trainer

Characteristics of a powerful Francis turbine with adjustable guide vanes

HM 450C
Characteristic variables of hydraulic turbomachines

Determination of output and efficiency of turbines and pumps; demonstration of a pumped storage plant

HM 450.01
Pelton turbine

Model of an impulse turbine with speed and torque measurement

HM 450.02
Francis turbine

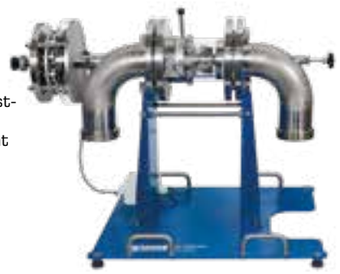
Model of a reaction turbine with speed and torque measurement; adjustable guide vanes

HM 450.03
Propeller type turbine

Six-bladed propeller type turbine with guide vane adjustment for varying power, measurement of speed and torque

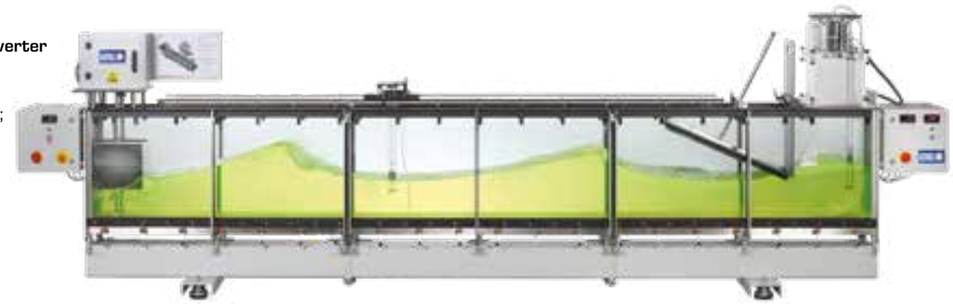
HM 450.04
Kaplan turbine

Five-bladed Kaplan turbine with blade and guide vane adjustment for varying power, measurement of speed and torque



ET 270
Wave energy converter

Turbine unit with Wells turbine and electric generator; configurable wave generator



Energy
Biomass

CE 640
Biotechnical production of ethanol

Batch conversion of starch-based raw materials into ethanol, system control via PLC

CE 642
Biogas plant

Two-stage continuous degradation of organic substances.
First stage: hydrolysis and acidification, second stage: anaerobic degradation, system control via PLC

CE 650
Biodiesel plant

Chemical transesterification of vegetable oils, system control via PLC

Energy
Energy systems: storage in energy systems

Single-stage compressor ET 513 with drive unit HM 365

ET 513
Single-stage piston compressor

Investigations on an air compressor including the determination of the mechanical power consumption

HM 365
Universal drive and brake unit

Core component for experiments on various driving and driven machines

HM 143
Transient drainage processes in storage reservoirs

Demonstration of the function of a rainwater retention basin and a dam

ET 255
Using photovoltaics: grid-connected or stand-alone

Electrical components of a real life photovoltaic system

ET 420
Ice stores in refrigeration

Industrial refrigeration system with ice store, dry cooling tower and wet cooling tower

Energy
Energy systems: storage in energy systems

ET 220
Energy conversion in a wind power plant

Conversion of kinetic wind energy into electrical energy

ET 220.01
Wind power plant

Connection to ET 220 or ET 220.10; outdoor installation allows practically relevant investigations

ET 220.10
Control unit for wind power plant ET 220.01

Use of wind energy in stand-alone operation under real weather conditions

HL 320.03
Flat collector

Pivotable flat collector for converting solar energy into heat

HL 320.05
Central storage module with controller

Module with buffer storage and bivalent storage for heating systems with renewable energies, operating the heating controller via web browser

Energy
Energy systems: conversion in energy systems

ET 292
Fuel cell system

Water-cooled polymer-membrane fuel cell combined heat and power

ET 102
Heat pump

Utilisation of ambient heat for water heating

ET 794
Gas turbine with power turbine

Two-shaft arrangement with high-pressure turbine and power turbine using liquid gas

HL 320.01
Heat pump

Heat pump for operation with different sources, operating the heating controller via web browser

HL 320.07
Underfloor heating / geothermal energy absorber

Can be used as heat sink or heat source

HL 320.05
Central storage module with controller

Module with buffer storage and bivalent storage for heating systems with renewable energies, operating the heating controller via web browser

HL 320.08
Fan heater / air heat exchanger

Can be used as heat sink or heat source

Energy
Energy efficiency in buildings: business and industry

ET 420
Ice stores in refrigeration

Industrial refrigeration system with ice store, dry cooling tower and wet cooling tower

ET 428
Energy efficiency in refrigeration systems

Refrigeration system with three compressors in interconnected operation; adaptation to the capacity requirement

RT 682
Multivariable control: stirred tank

Heated stirrer tank with heat recovery as model: coupled level and temperature control

RT 396
Pump and valves and fittings test stand

Recording characteristic curves of industrial fittings and a centrifugal pump

Energy
Energy efficiency in buildings: heat supply and air conditioning

WL 376
Thermal conductivity of building materials

Investigation of the insulation properties of typical materials from the building materials sector

WL 110
Heat exchanger supply unit

Measuring the transfer characteristics of five different heat exchanger models, system control via PLC

WL 110.02
Plate heat exchanger

Typical plate heat exchanger in parallel flow and counterflow operation

WL 110.01
Tubular heat exchanger

Transparent heat exchanger with additional temperature measuring point after half of the transfer section; parallel flow and counterflow operation

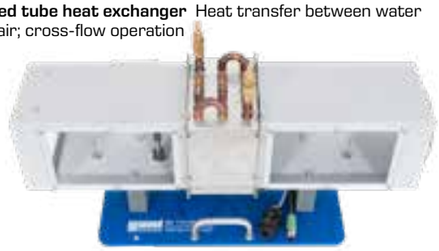
WL 110.04
Stirred tank with double jacket and coil

Heating using jacket or coiled tube; stirrer for improved mixing of medium

WL 110.03
Shell & tube heat exchanger

Transparent shell and tube heat exchanger in cross parallel flow and cross counterflow operation

WL 110.05
Finned tube heat exchanger Heat transfer between water and air; cross-flow operation



Energy
Energy efficiency in buildings: heat supply and air conditioning

HL 305
Hydronic balancing of radiators

Hydronic balancing of a heating system: three heating subcircuits with radiators, thermostatic valves and circulation pump

HL 630
Efficiency in heating technology

Basic principles of energy efficient heating technology with a computer-supported learning process

ET 630
Split system air conditioner

Modern air conditioning unit with heat pump function: cooling or heating

HM 283
Experiments with a centrifugal pump

Determination of characteristic pump variables

Energy
Energy efficiency in buildings: inclusion of renewable energies

HL 320.01
Heat pump

Heat pump for operation with different sources, operating the heating controller via web browser

HL 320.02
Conventional heating

Electric complementary heater for the HL 320 modular system

HL 320.03
Flat collector

Pivotable flat collector for converting solar energy into heat

HL 320.04
Evacuated tube collector

Conversion of solar energy into heat in the evacuated tube collector

HL 320.05
Central storage module with controller

Module with buffer storage and bivalent storage for heating systems with renewable energies, operating the heating controller via web browser

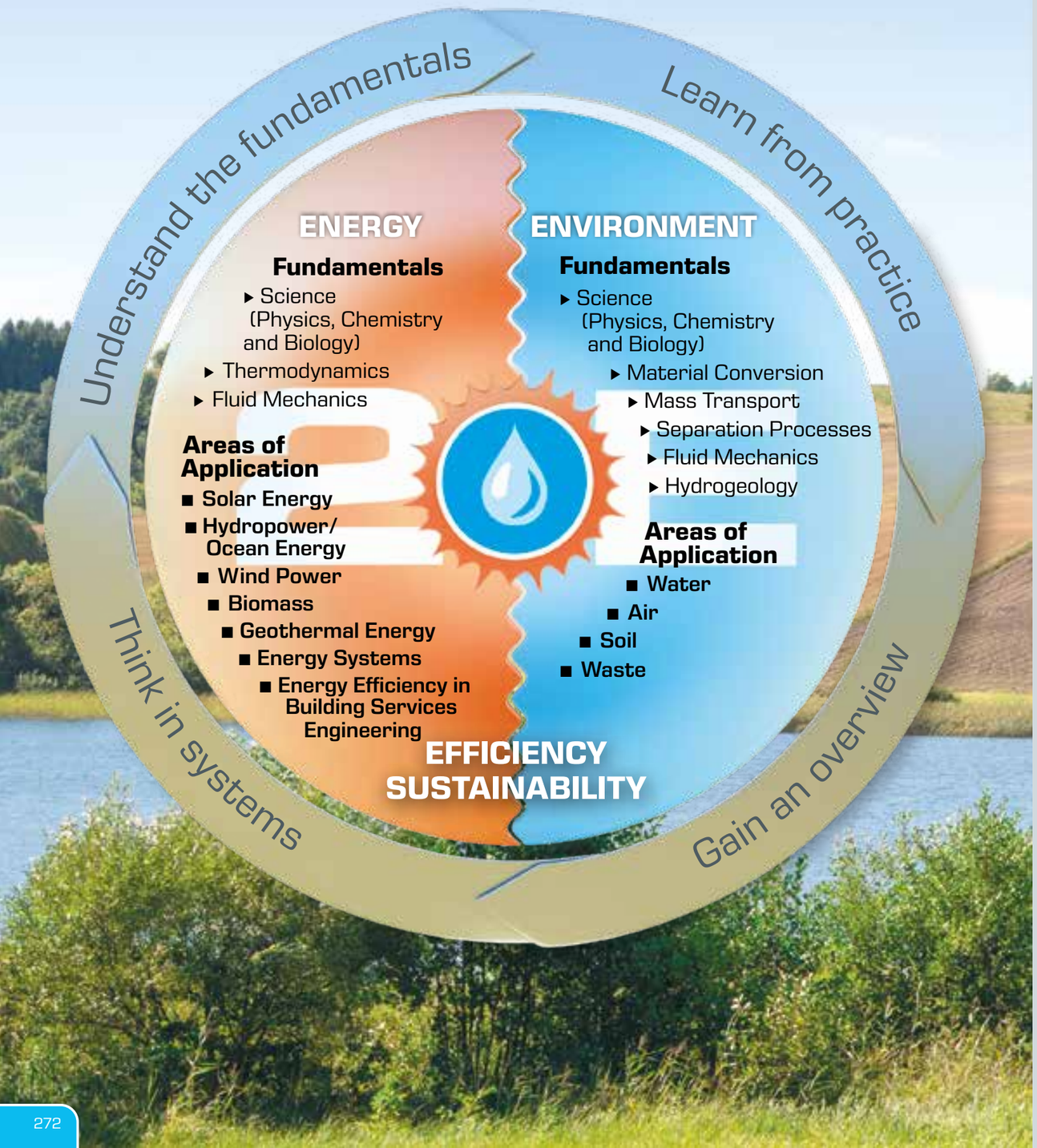
HL 320.07
Underfloor heating / geothermal energy absorber

Can be used as heat sink or heat source

HL 320.08
Fan heater / air heat exchanger

Can be used as heat sink or heat source

The 2E Curriculum



Environment
Air: mechanical waste air purification

CE 235
Gas cyclone

Solid separation from gases using a cyclone

Environment
Air: thermal waste air purification

CE 400
Gas absorption

Separating a carbon dioxide/air mixture by absorption in counterflow

CE 540
Adsorptive air drying

Basic principle of adsorption and desorption

Environment
Water: mechanical water treatment

CE 587
Dissolved air flotation

Removal of solids from raw water using dissolved air flotation

CE 579
Depth filtration

Demonstration of depth filtration and backwashing of filters

HM 142
Separation in sedimentation tanks

Solid / liquid separation in a sedimentation tank, visualisation of flow conditions

CE 588
Demonstration of dissolved air flotation

Basic function and visualisation of the process

Environment
Water: biological water treatment

CE 705
Activated sludge process

Wastewater treatment plant in laboratory scale: aerobic biological degradation of organic substances, system control via PLC

CE 701
Biofilm process

Biological, aerobic water treatment by the biofilm process: trickling filter

CE 702
Anaerobic water treatment

Anaerobic degradation of organic substances in the stirred tank and UASB reactor for biogas production (UASB: Upflow Anaerobic Sludge Blanket)

CE 730
Airlift reactor

Aerobic submerged reactor

CE 704
SBR process

Sequencing batch reactor

Environment
Water: physical / chemical water treatment

CE 583
Adsorption

Adsorption of dissolved substances on activated carbon

CE 300
Ion exchange

Softening and desalination of water by ion exchange

CE 584
Advanced oxidation

Oxidation of organic substances with hydrogen peroxide and UV light

CE 530
Reverse osmosis

Membrane separation process for obtaining solvent from a salt solution,
system control via PLC

CE 586
Precipitation and flocculation

Removal of dissolved substances by precipitation, flocculation and sedimentation of the flocs in the lamella separator

Environment
Water: multistage water treatment

CE 581
Water treatment plant 1

Three basic procedures of water treatment: depth filtration, adsorption and ion exchange, system control via PLC

CE 582
Water treatment plant 2

Two basic procedures of water treatment: depth filtration and ion exchange

Environment
Soil: hydrogeology

HM 165
Studies in hydrology

Investigation of precipitation-discharge relationships, storage capacity of soils, seepage flows and groundwater flows

HM 141
Hydrographs after precipitation

Correlations between precipitation and seepage; storage capacity and drainage methods

HM 167
Groundwater flow

Three-dimensional investigations; demonstration of lowering of groundwater; investigation of excavation pits

HM 169
Visualisation of seepage flows

Graphical determination of flow nets; investigation of water pressure on structures

Environment
Soil: soil treatment

CE 225
Hydrocyclone

Separation of solids from liquids by using a centrifugal force

CE 630
Solid-liquid extraction

Continuous and discontinuous extraction of the soluble components of a solid

Environment
Waste: separation processes

MT 174
Sorting plant

Preventive maintenance based on the example of a separation process, system control via PLC

CE 275
Gas flow classification

Zigzag sifter to separate solid compounds

CE 280
Magnetic separation

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Waste: comminution

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