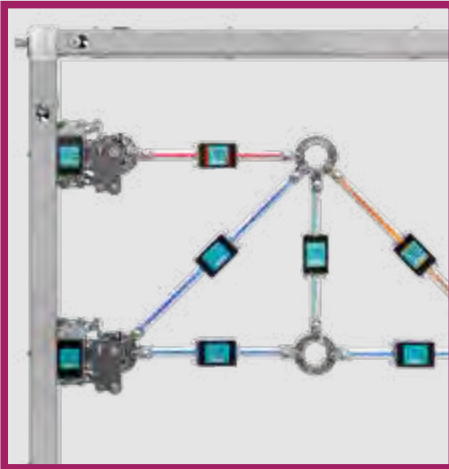




Equipment for engineering education

Entire programme

Innovative sustainable efficient

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



PDF version of the catalogue



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

Visit our website: www.gunt.de

Imprint

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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 multi-media 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

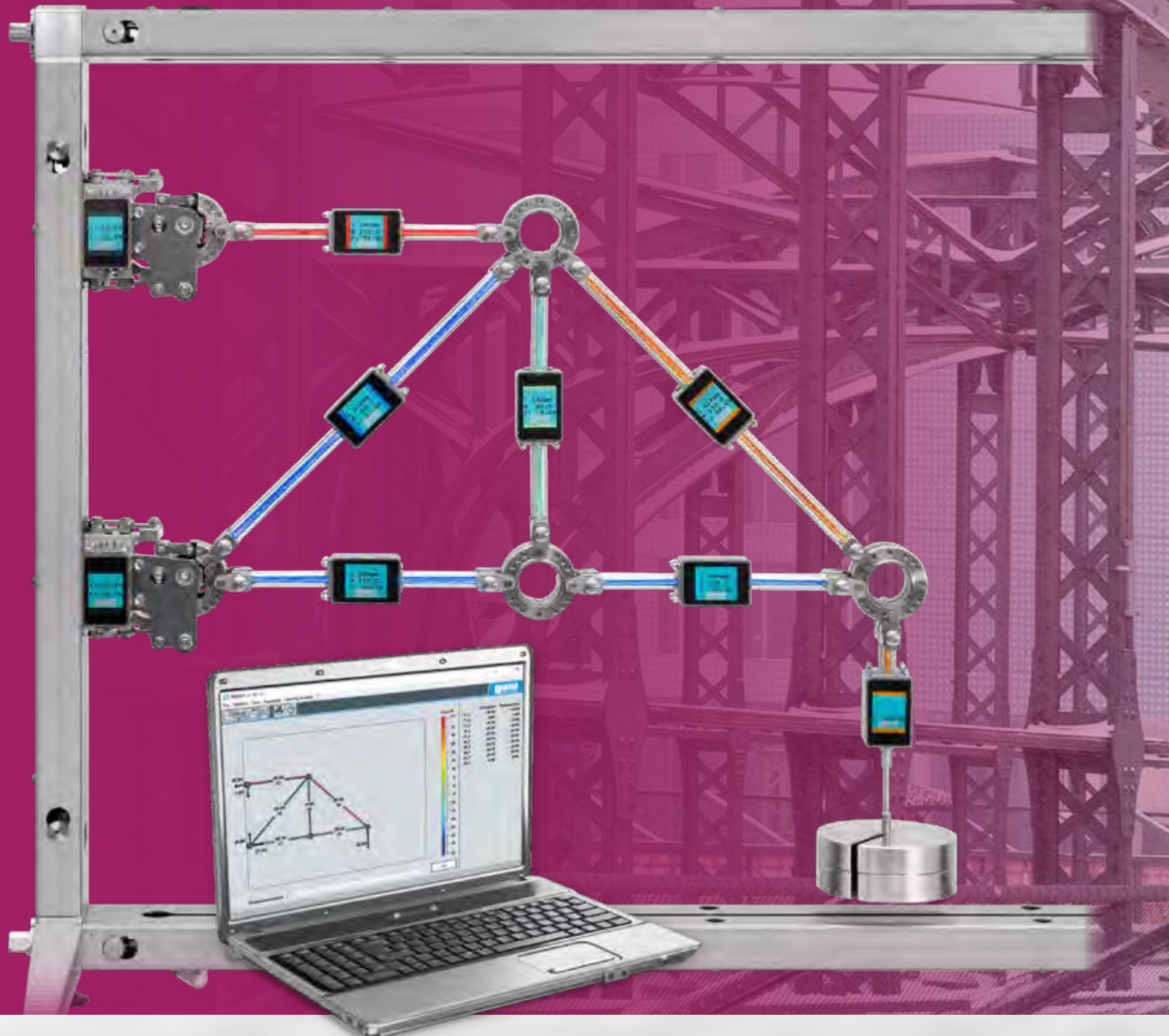


Screen mirroring, mirroring of the user interface on additional terminals

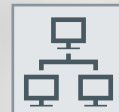


GUNT software, digital data acquisition, experiment evaluation

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



About the product:



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Impact bending test	034
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Engineering mechanics
and engineering design



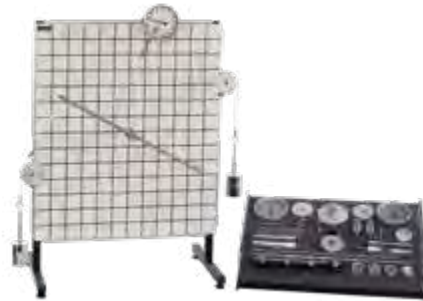


Engineering mechanics – statics

Forces and moments

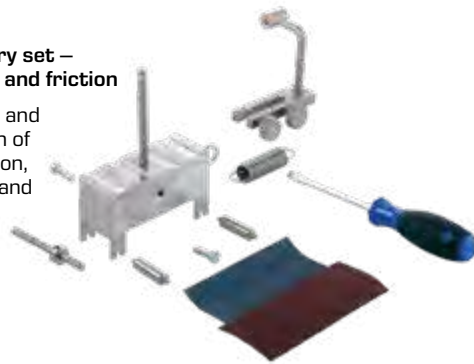
TM 110 Fundamentals of statics

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



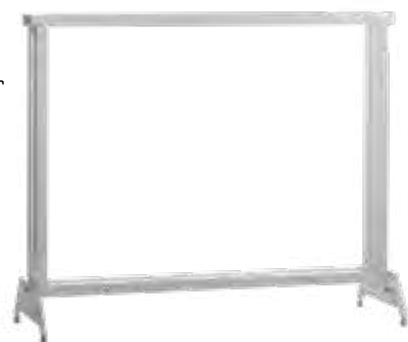
TM 115 Forces in a crane jib

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



SE 112 Mounting frame

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



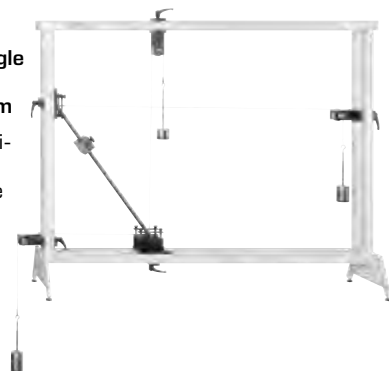
EM 049 Equilibrium of moments on a two-arm lever

Investigation of applied forces, generated moments and equilibrium



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

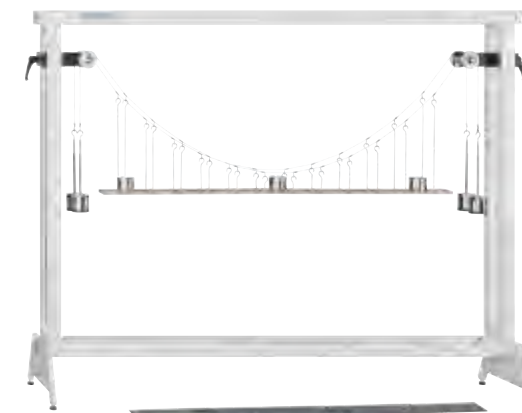


Engineering mechanics – statics

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

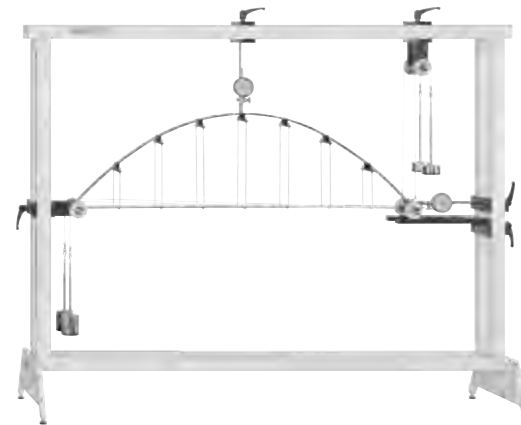
SE 112 Mounting frame required



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



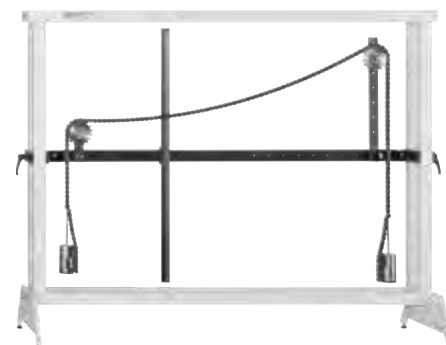
WP 962 Beam on two supports: bending moment diagram

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



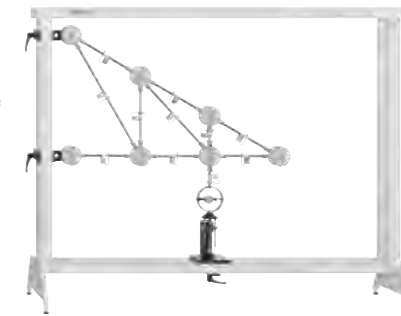
Engineering mechanics – statics

Forces in a truss

SE 110.21 Forces in various single plane trusses

Using strain gauge technology to measure bar forces

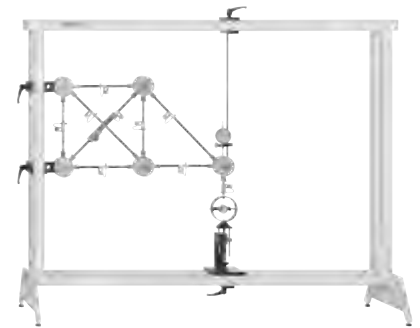
SE 112 Mounting frame required



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



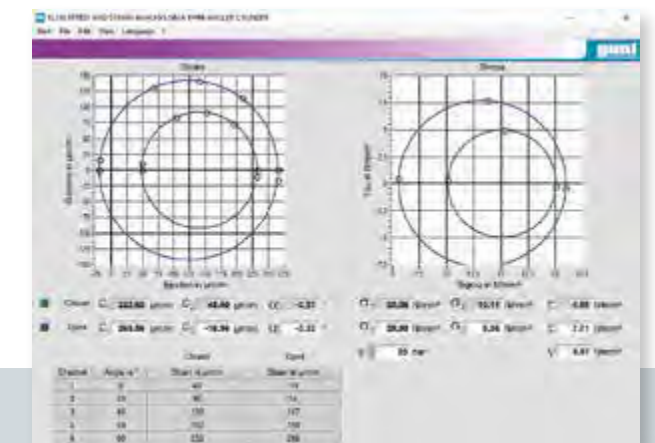
SE 130.01 Truss beam: Warren girder

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

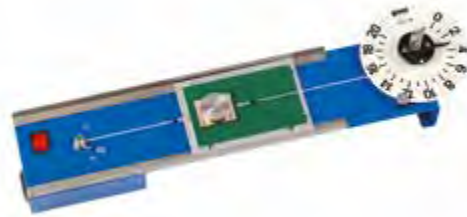
Engineering mechanics – statics

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

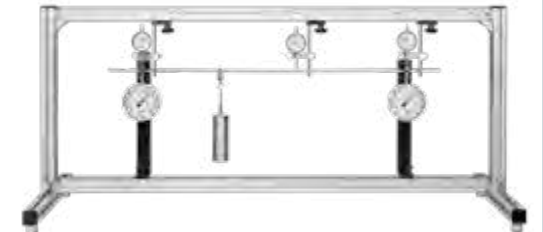
SE 112 Mounting frame required



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

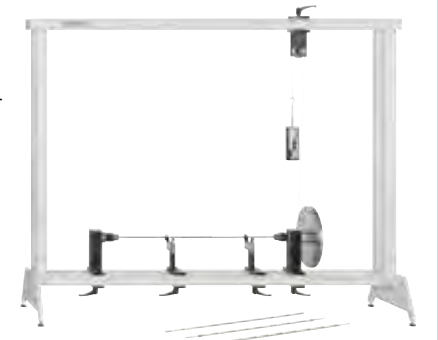


SE 110.29

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

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



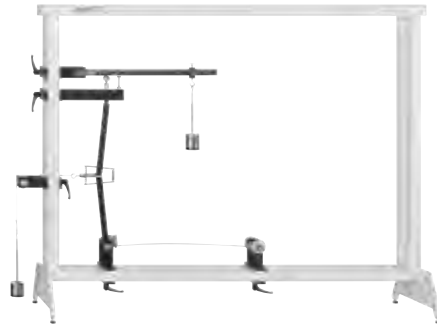
Engineering mechanics – strength of materials

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

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



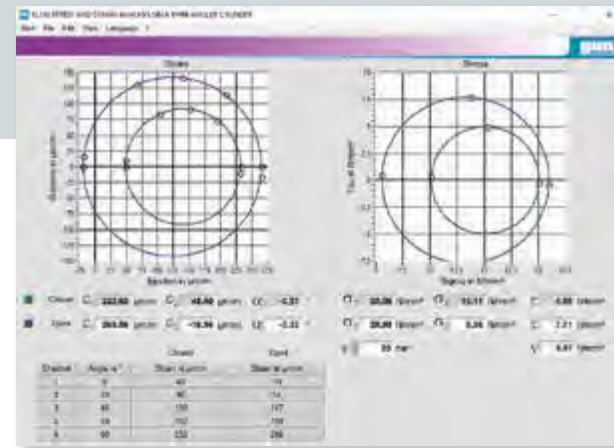
FL 140 Stress and strain analysis on a thick-walled cylinder

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 reciprocating 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; four different transmissions adjustable



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



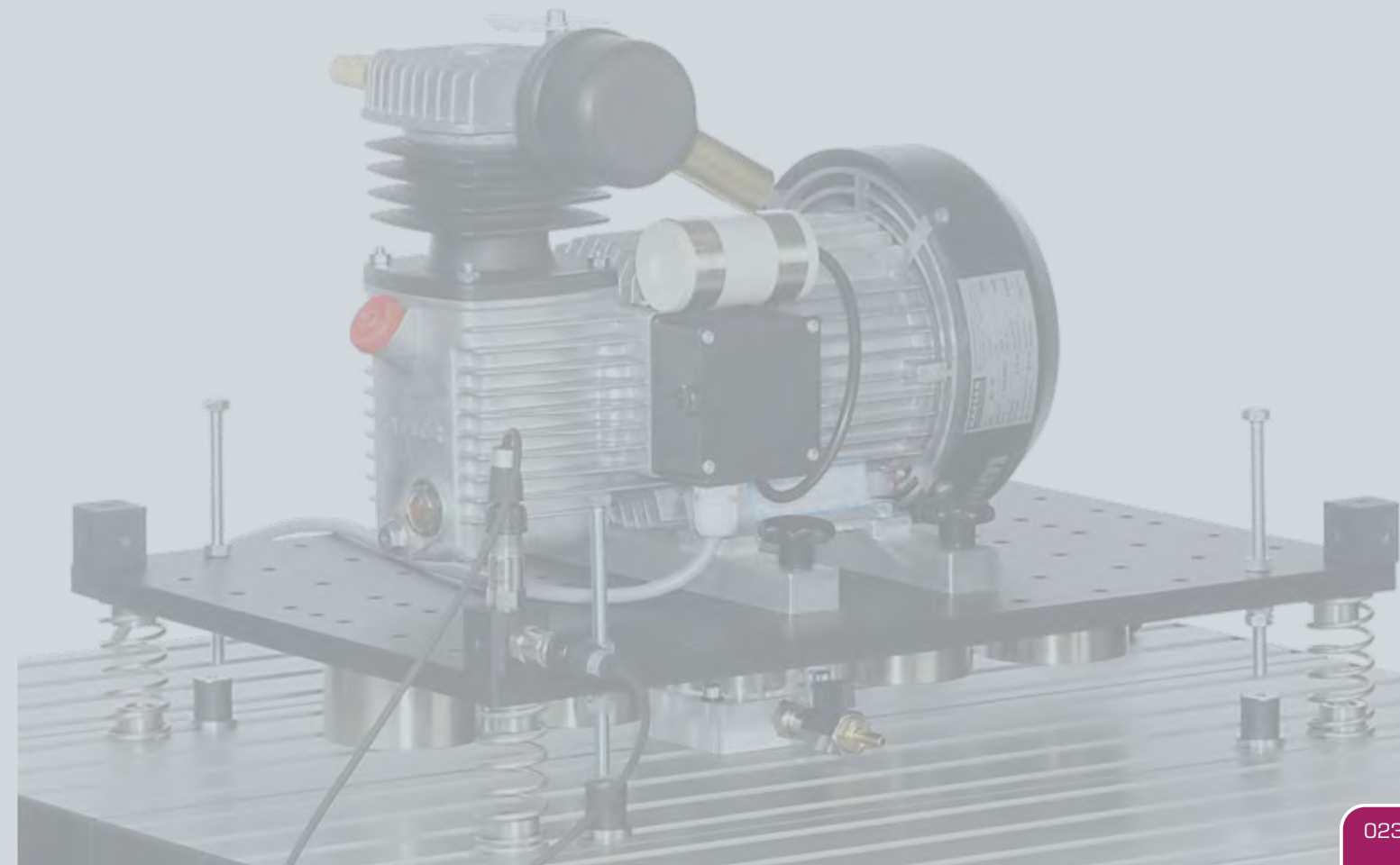
Machine dynamics Vibration isolation



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 diag- nostic 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 500.17 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 500.11 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 500.19 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 500.13 Couplings kit

Vibration analysis of couplings



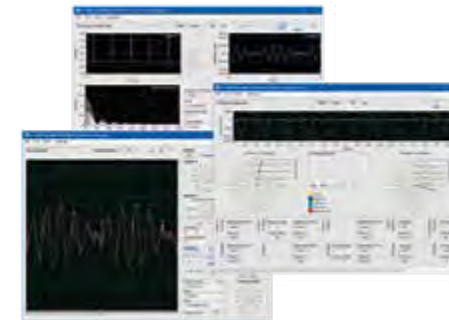
PT 500.14 Belt drive kit

Vibrations in belt drives



PT 500.04 Computerised vibration analyser

Supports all machinery diagnostic experiments of the PT 500 series



PT 500.15 Damage to gears kit

Vibration analysis of gearing damage



PT 500.16 Crank mechanism kit

Vibrations on crank drives



PT 501 Roller bearing faults

Investigation of the vibrations of roller bearings



Engineering design Engineering drawing

TZ 100 Spatial imagination with three-view display

Introduction to three-view display as the basis of engineering drawing

Multimedia instructional materials via Internet



GUNT offers five sets with Geometric models. To start with, TZ 100 establishes and trains the spatial imagination. TZ 110 to TZ 140 contain models with different shapes, used to practise the representation in three views.

TZ 200.01 Assembly exercise: bending press

Functional bending press made of steel: introduction to engineering drawing, measuring exercises, simple assembly sequences

Multimedia instructional materials via Internet



TZ 200.07 Assembly exercise: lever shear

Functional lever shear made of steel: introduction to engineering drawing, measuring exercises, simple assembly sequences

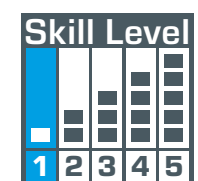


Multimedia instructional materials via Internet

TZ 300 Assembly exercise: lever press

Functional lever press made of steel: introduction to technical drawing, measuring exercises, simple assembly sequences

Multimedia instructional materials via Internet



TZ 100 – TZ 300 are part of the **GUNT DigiSkills 1 learning project.**

In addition to versatile learning objectives of engineering drawing, comprehensive digital skills are developed with GUNT DigiSkills 1.

How to achieve the digital transformation to Industry 4.0



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



Engineering design Machine elements: fasteners

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 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: bearings

MG 911
Roller bearings kit

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

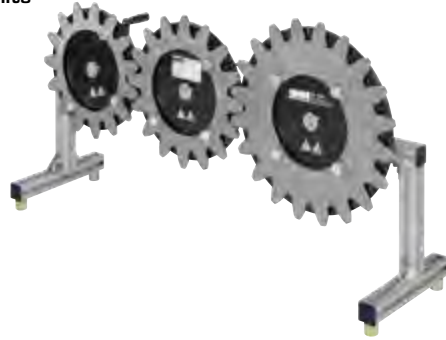


Engineering design

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)



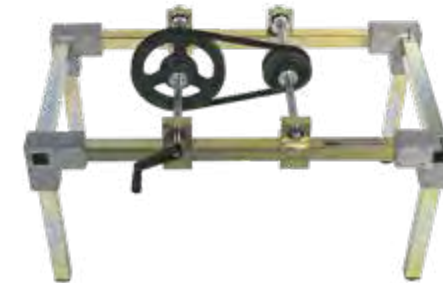
AT 200 Determination of gear efficiency

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



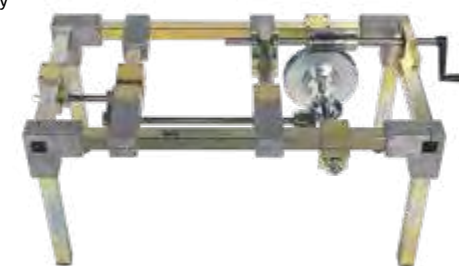
GL 410 Assembly simple gears

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



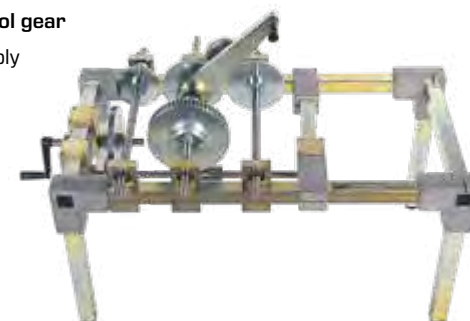
GL 420 Assembly combined gears

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 hydro-dynamic 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



GUNT DigiSkills



How to achieve the digital transformation to Industry 4.0



MT 120



MT 121



MT 122



MT 123



MT 174 Sorting plant

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



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

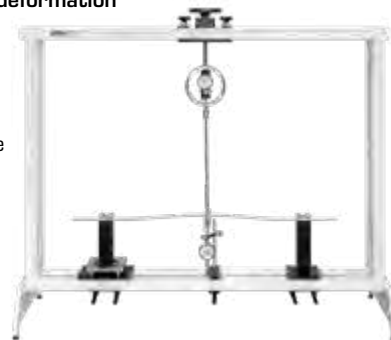
Load tests on components from steelwork and civil engineering; size allows measurements on real components

**SE 110.48**

Bending test, plastic deformation

Observation and determination of the transition from elastic to plastic deformation

SE 112 Mounting frame required



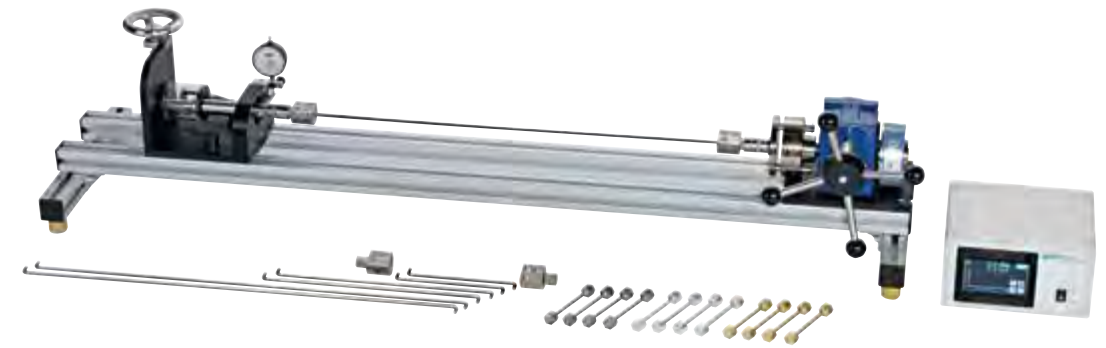
Materials testing

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

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

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



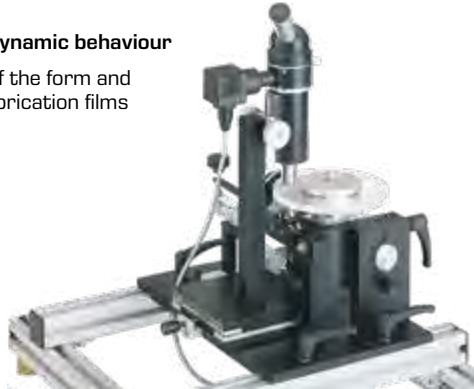
TM 260.01 Rolling friction in friction wheels

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 260.05 Dynamic friction in cylindrical pin – roller

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



TM 260.06 Pressure distribution in journal bearings

Demonstration of pressure distribution in a plain bearing with hydrodynamic lubrication



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 experimentation



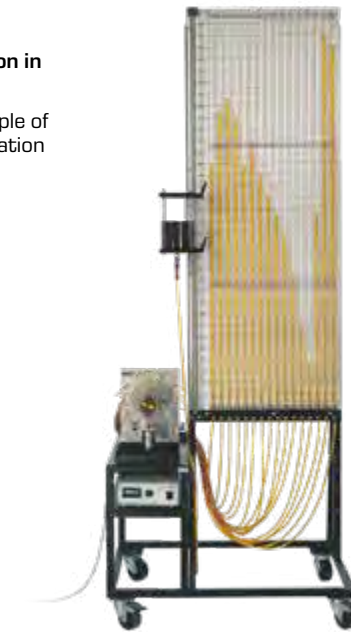
TM 290 Journal bearing with hydrodynamic lubrication

Investigation of friction in a hydrodynamically lubricated journal bearing



TM 280 Pressure distribution in journal bearings

Illustrates the principle of hydrodynamic lubrication



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



Engineering design

Engineering drawing	040
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Maintenance

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Automation and process control engineering

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Mechatronics



About the product:



Engineering design
Engineering drawing
TZ 100
Spatial imagination with three-view display

Introduction to three-view display as the basis of engineering drawing

Multimedia instructional materials via Internet



GUNT offers five sets with Geometric models. To start with, TZ 100 establishes and trains the spatial imagination. TZ 110 to TZ 140 contain models with different shapes, used to practise the representation in three views.

TZ 110
Cylindrical models with cuts parallel to axis

Comprehensive collection of models with varying levels of difficulty


TZ 120
Cylindrical models with slanted cuts

Comprehensive collection of models with varying levels of difficulty


TZ 140
Prismatic models with slanted cuts

Comprehensive collection of models with varying levels of difficulty


TZ 130
Prismatic models with cuts parallel to edges

Comprehensive collection of models with varying levels of difficulty


TZ 200.01
Assembly exercise: bending press

Functional bending press made of steel: introduction to engineering drawing, measuring exercises, simple assembly sequences

Multimedia instructional materials via Internet

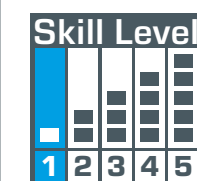

TZ 300
Assembly exercise: lever press

Functional lever press made of steel: introduction to technical drawing, measuring exercises, simple assembly sequences

Multimedia instructional materials via Internet


TZ 200.07
Assembly exercise: lever shear

Functional lever shear made of steel: introduction to engineering drawing, measuring exercises, simple assembly sequences



TZ 100 – TZ 300 are part of the **GUNT DigiSkills 1 learning project.**

In addition to versatile learning objectives of engineering drawing, comprehensive digital skills are developed with GUNT DigiSkills 1.

How to achieve the digital transformation to Industry 4.0



Engineering design
Cutaway models: gear and drive elements

GL 300.01
Cutaway model:
worm gear



GL 300.02
Cutaway model:
mitre gear



GL 300.06
Cutaway model:
variable speed belt drive



GL 300.07
Cutaway model:
control gear



GL 300.03
Cutaway model: spur gear



GL 300.04
Cutaway model: two-stage spur gear



GL 300.08
Cutaway model: multiple-disc clutch



GL 300.12
Cutaway model: pedestal bearing



GL 300.05
Cutaway
model:
planetary gear



GL 300.10
Cutaway model:
electromagnetic
single disk brake



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



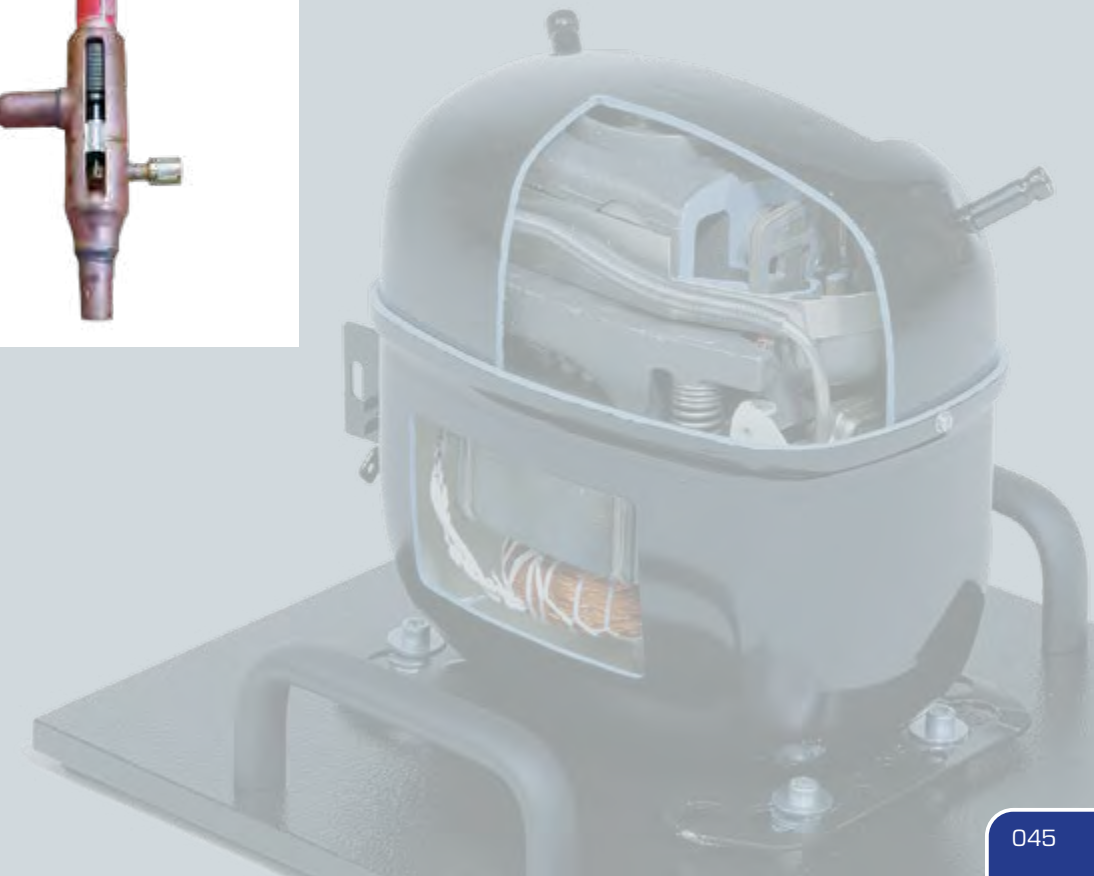
ET 499.14
Cutaway model:
liquid separator



ET 499.16
Cutaway model:
ball valve



ET 499.26
Cutaway model:
condensation pressure
control 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 700.09
Cutaway model:
strainer



HM 700.10
Cutaway model:
gate valve



HM 700.03
Cutaway model:
standard Venturi meter



HM 700.04
Cutaway model:
straight-way valve



HM 700.11
Cutaway model:
straight-way plug valve



HM 700.12
Cutaway model:
three-way plug valve



HM 700.05
Cutaway model:
corner valve



HM 700.06
Cutaway model:
angle seat valve



HM 700.13
Cutaway model:
ball valve



HM 700.14
Cutaway model:
safety valve



HM 700.07
Cutaway model:
non-return valve



HM 700.08
Cutaway model:
pressure reducing 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 106
 Cutaway model:
 backflow preventer



VS 107
 Cutaway model:
 non-return butterfly valve



VS 108
 Cutaway model:
 water meter



VS 109
 Cutaway model:
 strainer



VS 102
 Cutaway model:
 resilient seated gate valve



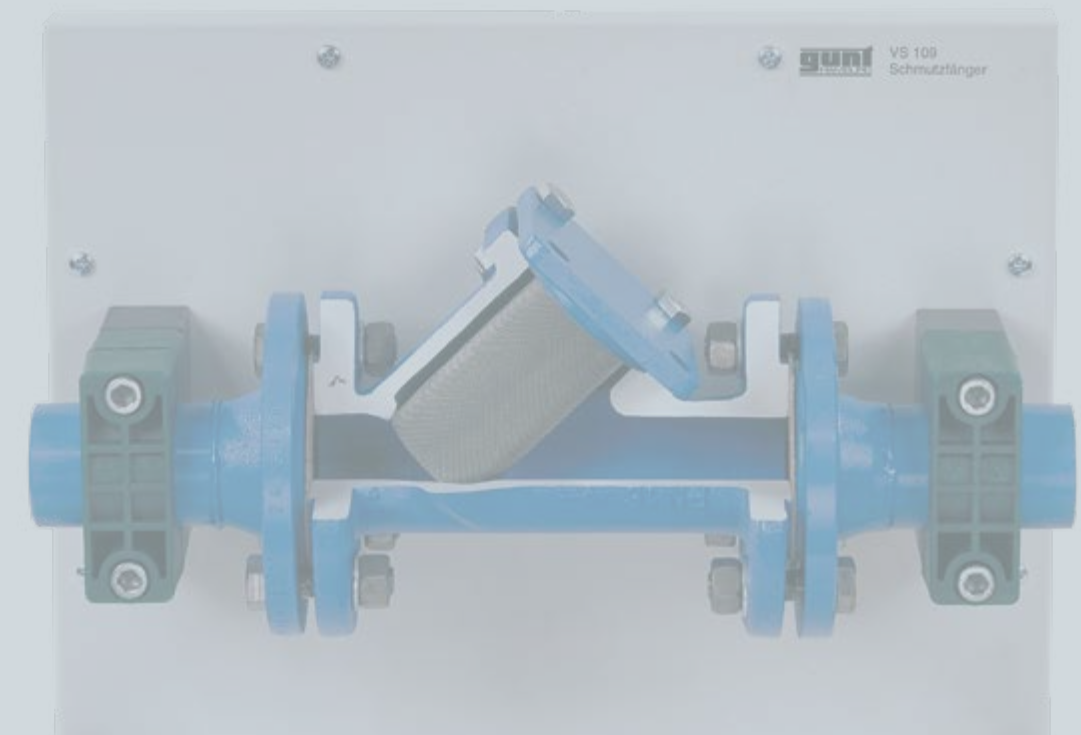
VS 103
 Cutaway model:
 screw down valve



VS 104
 Cutaway model:
 changeover valve



VS 105
 Cutaway model:
 gas meter



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 903

Screw-locking devices kit

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



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



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

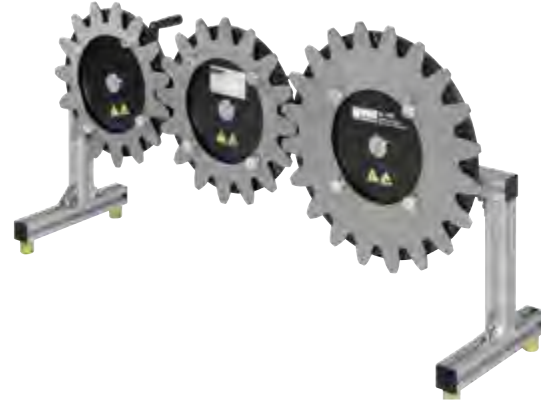


Engineering design

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

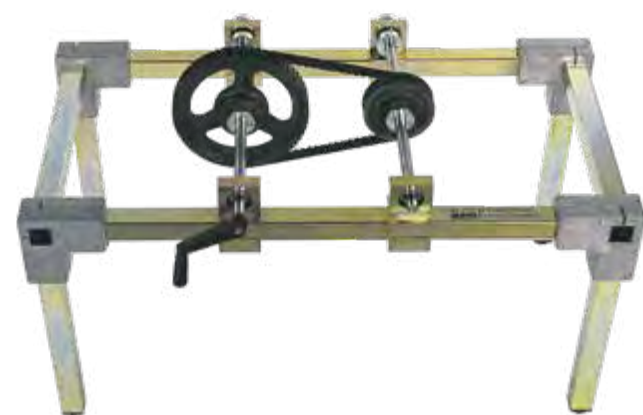
Mechanical and electrical engineering assembly kit: fully functional data acquisition for the materials tester MT 190



Assembly technology Drive elements and gears

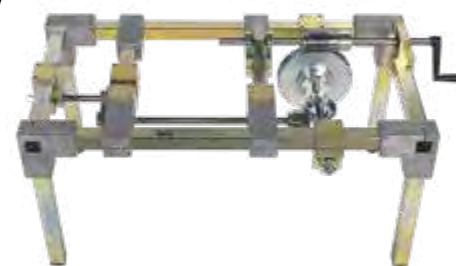
GL 410 Assembly simple gears

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



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 120



MT 121



MT 122



MT 123



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 157 Assembly exercise: butterfly valve and non-return valve

Assembly, disassembly
and maintenance of
industrial fittings



MT 156 Assembly exercise: wedge gate valve and angle seat 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



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 130

Assembly exercise: centrifugal pump

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



Multimedia instructional materials via Internet

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 134

Montage d'une pompe à piston

Fonction et montage d'une pompe à piston; planifier, monter, démonter



Multimedia instructional materials via Internet

MT 185

Assembly & maintenance exercise: in-line centrifugal 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



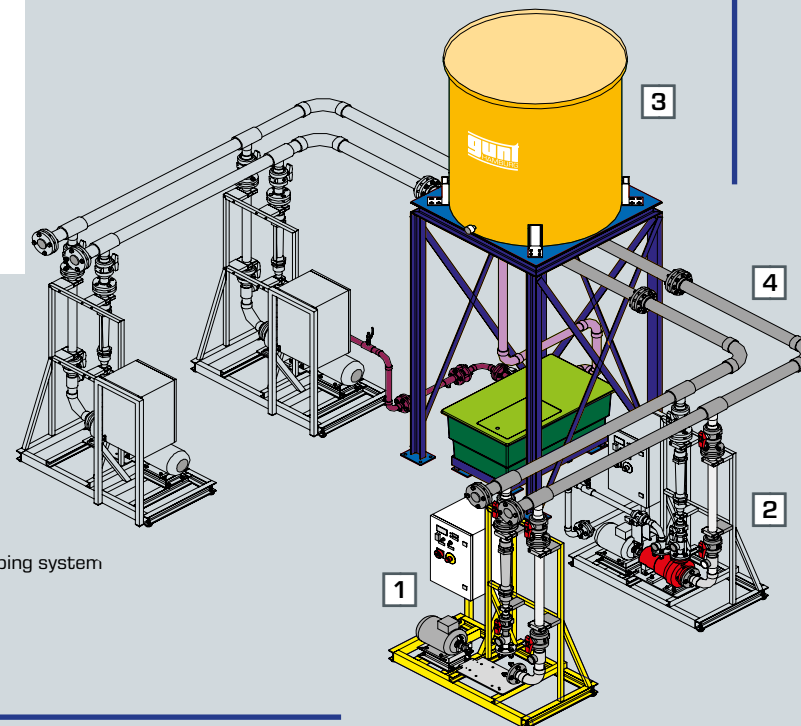
HL 962.03 Side channel pump

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



Maintenance Machinery diagnosis

PT 500 Machinery diag- nostic 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 500.17 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 500.11 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 500.19 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 500.13 Couplings kit

Vibration analysis of couplings



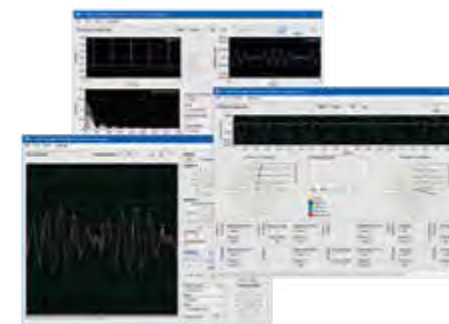
PT 500.14 Belt drive kit

Vibrations in belt drives



PT 500.04 Computerised vibration analyser

Supports all machinery diagnostic experiments of the PT 500 series



PT 500.15 Damage to gears kit

Vibration analysis of gearing damage



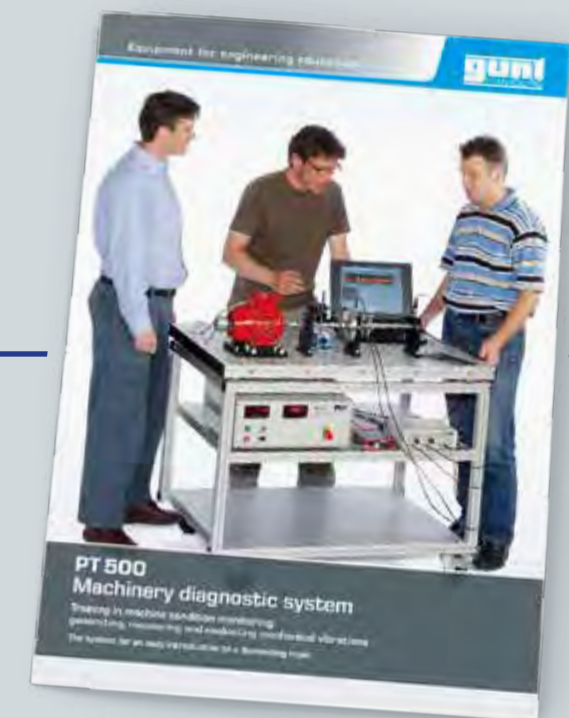
PT 500.16 Crank mechanism kit

Vibrations on crank drives



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



Multimedia instructional materials via Internet

PT 104 Dimensional metrology, angle piece

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



Multimedia instructional materials via Internet

PT 105 Dimensional metrology, shaft

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



Multimedia instructional materials via Internet

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



Multimedia instructional materials via Internet

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



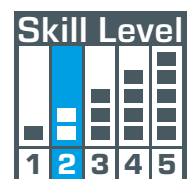
Multimedia instructional materials via Internet

PT 109 Dimensional metrology, hub

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



Multimedia instructional materials via Internet



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 counter-sinking 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



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 Components: sensors / instrumentation

IA 110
Calibrating a pressure sensor
Test-pressure generated with dead-weight piston manometer



IA 120
Principles of industrial sensors
Familiarisation with key sensors: mode of operation and application



RT 306
Adjustment of level sensors

Familiarisation with different industry standard components with a 4-20mA 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



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.

Automation and process control engineering

Components: actuators

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



RT 396

Pump and valves and fittings test stand

Recording characteristic curves of industrial fittings and a centrifugal pump



RT 390

Test stand for control valves

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



RT 395

Maintenance of valves and fittings and actuators

Maintenance and operational check: four different fittings and actuators



Automation and process control engineering

Components: 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



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](#)



Automation and process control engineering

Components: fundamentals of pneumatics and hydraulics

RT 700

Training system: fundamentals of hydraulics

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



RT 701

Components set electrohydraulics

Set of electrohydraulics components for hydraulics trainer RT 700



RT 710

Hydraulic servo system

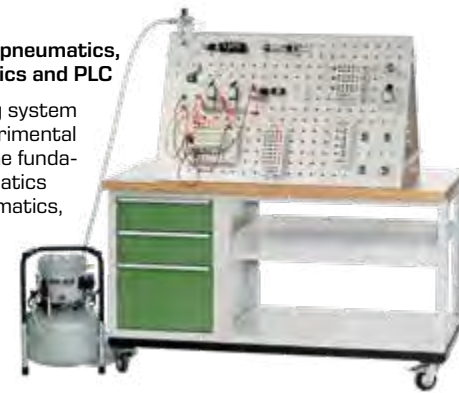
Hydraulic position control circuit with adjustable load conditions



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



Automation and process control engineering

Modular calibration systems

RT 310

Calibration station

Calibration of control loop components using precision measuring technique



RT 304

Calibration trainer

Investigation of the transmission behaviour of actuators and transducers



Automation and process control engineering

Simple process engineering control systems

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 lag 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



Automation and process control engineering

Simple process engineering control systems

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 614 Level control demonstration unit

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



RT 634 Pressure control demonstration unit

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



RT 624 Flow control demonstration unit

Experimental introduction to control engineering using an example of flow 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

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

PLC and PLC applications

RT 800 PLC application: mixing process

Experiments using PLC to control discontinuous mixing processes



IA 130 PLC module

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



IA 210 PLC application: materials handling process

Basic system of automation: transporting and sorting workpieces



Automation and process control engineering

Multivariable systems

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



Automation and process control engineering

Control systems with several 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

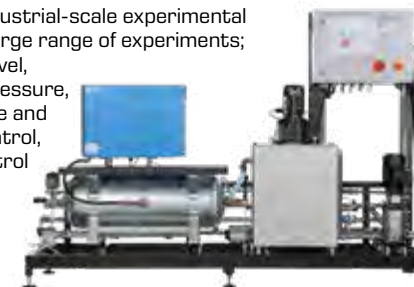
Control of level, flow rate, temperature and cascade control; plant control and configuration via touch screen and PLC



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



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



About the product:



3 | Thermal engineering



Fundamentals of thermodynamics

Thermodynamic state variables	080
Phase transition	081
Principles of heat transfer	082



Heat exchangers

Heat transfer	084
Recuperators	085
Direct-contact heat exchangers	087
Fluidisation and heat transfer	087



Thermal fluid energy machines

Steam power plants	088
Gas turbines	090
Piston compressors	091
Internal combustion engines	092



Fundamentals of refrigeration

Principles of cold production	095
Compression refrigeration system	096
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Thermodynamic applications in supply engineering: HVAC

Hot water generation	097
Air conditioning technology and ventilation	099
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Heating

Fundamental experiments on heating – training panels	101
Heating systems in buildings	102



Sanitary systems

105



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



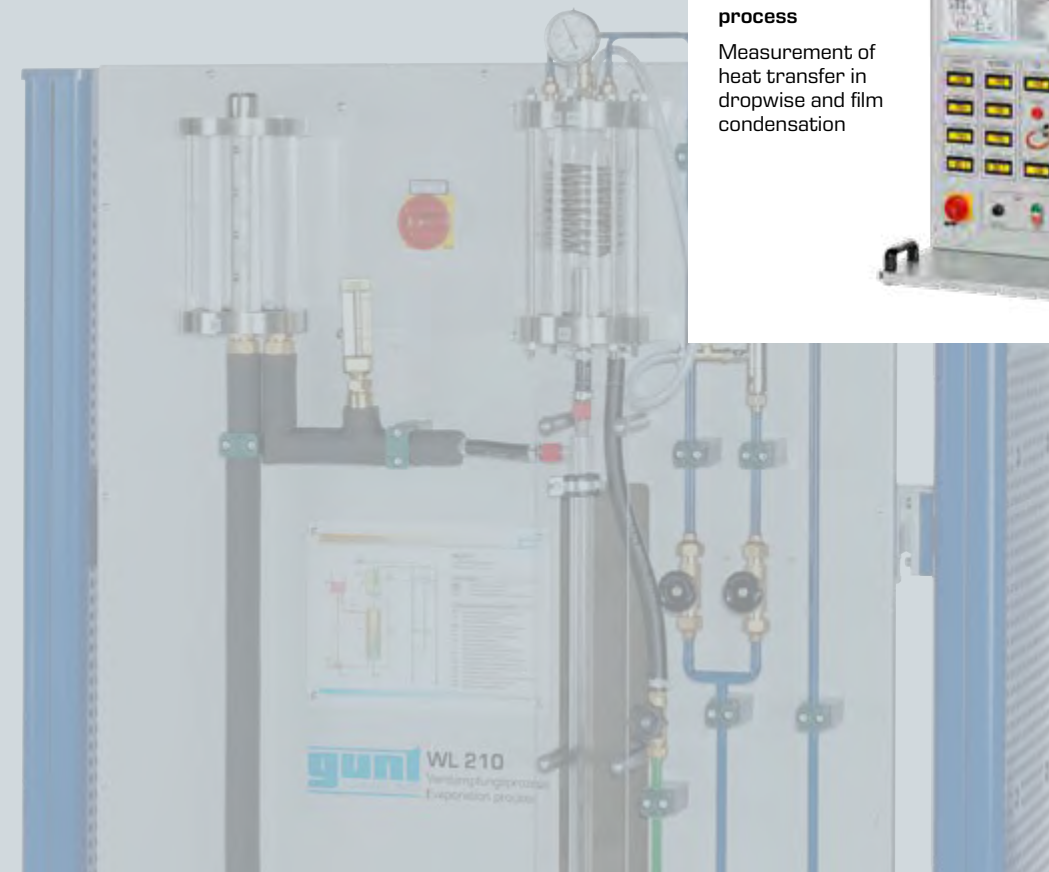
WL 220 Boiling process

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 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 430****Heat conduction and convection**

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

**WL 372****Radial and linear heat conduction**

Study of heat conduction in solids

**WL 420****Heat conduction in metals**

Investigation of the thermal conductivity of different metals

**WL 422****Heat conduction in fluids**

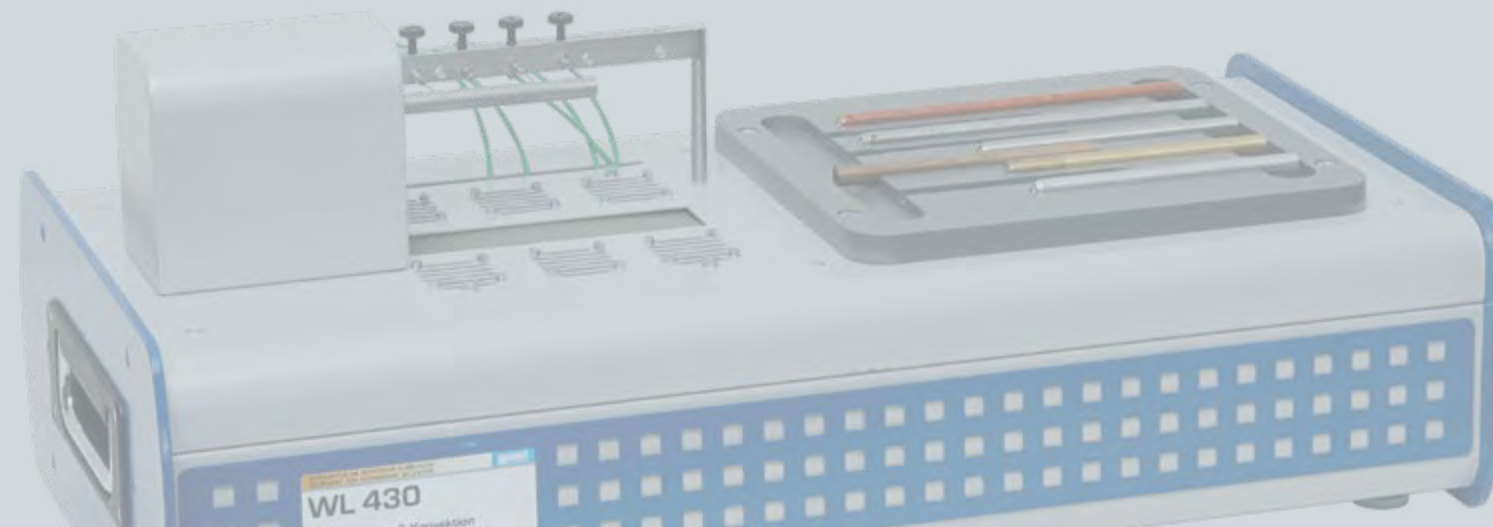
Determination of the coefficient of thermal conductivity for gaseous and liquid fluids

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

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

**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, type 2 - type 5

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



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



HM 365 Universal drive and brake unit

Core component for experiments on various driving and driven machines



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 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



Wet cooling towers for steam power plants ET 830 / ET 833 for re-cooling the cooling water

ET 830.01 (115kW) or
ET 830.02 (140kW)

ET 833.01 (115kW) or
ET 833.02 (140kW)



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



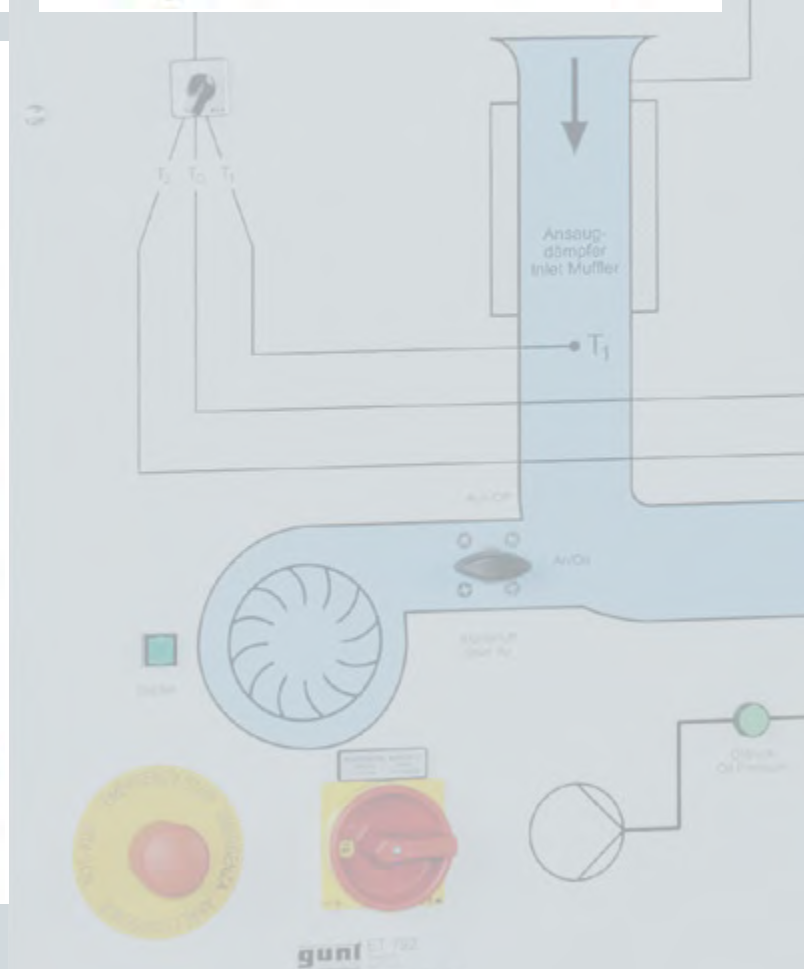
ET 794 Gas turbine with power turbine

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 150
Four-stroke petrol engine for CT 159
Air-cooled overhead valve four-stroke petrol engine



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 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 100.22
Four-stroke diesel engine for CT 110

Air-cooled four-stroke diesel engine with direct injection



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 100.23
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

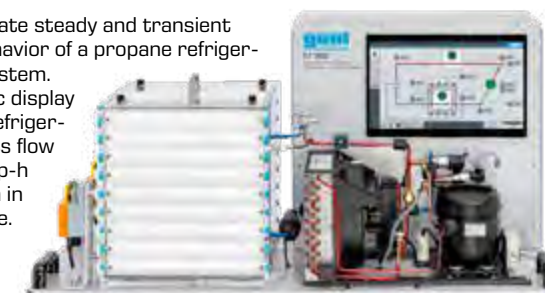


ET 122
Vortex cooling
device
Cooling and
heating using
compressed air



ET 360
Refrigeration circuit with propane

Investigate steady and transient load behavior of a propane refrigeration system. Dynamic display of the refrigerant mass flow and log p-h diagram in real time.



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



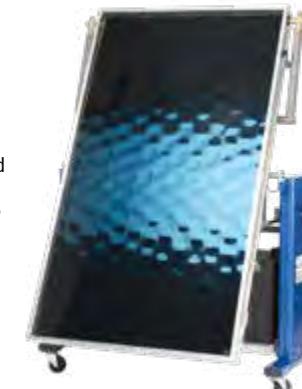
ET 202.01 Parabolic trough collector

Function and operating behaviour of a parabolic trough collector; accessories for ET 202



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 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 RHLne 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 func-
tion and operating
behaviour: two handle
mixers, flushing valve



ST 330 Protection of drinking water training panel

Safety and hygiene of
drinking water pipes



ST 320 Pipe cleaning training panel

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



ST 310 Drinking water instal- lation 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:



3a | Refrigeration and air conditioning technology



Refrigeration

Principles of refrigeration:	
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▶ training systems	110
Thermodynamics of the refrigeration cycle	112
Components of refrigeration:	
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Air conditioning technology

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Electrical engineering in refrigeration and air conditioning technology

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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 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



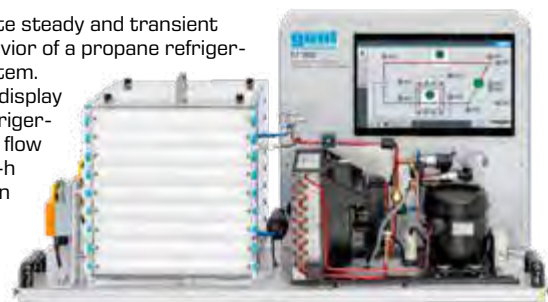
ET 352 Vapour jet compressor in refrigeration

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



ET 360 Refrigeration circuit with propane

Investigate steady and transient load behavior of a propane refrigeration system. Dynamic display of the refrigerant mass flow and log p-h diagram in real time.



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

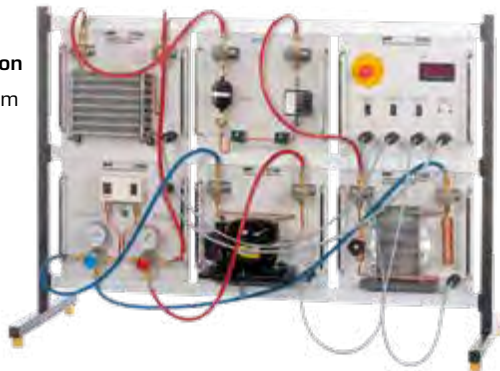
Energetic analyses of the refrigeration cycle; transparent components offer insights into the changes of state



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 refrig-
eration 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 915.02
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

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 380
Processes in the refrigeration cycle

Visible phase transitions in evaporator and condenser, log p-h diagram in real time



ET 412C
Refrigeration system with refrigeration and freezing chamber

Simulation of 18 electrical and hydraulic 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



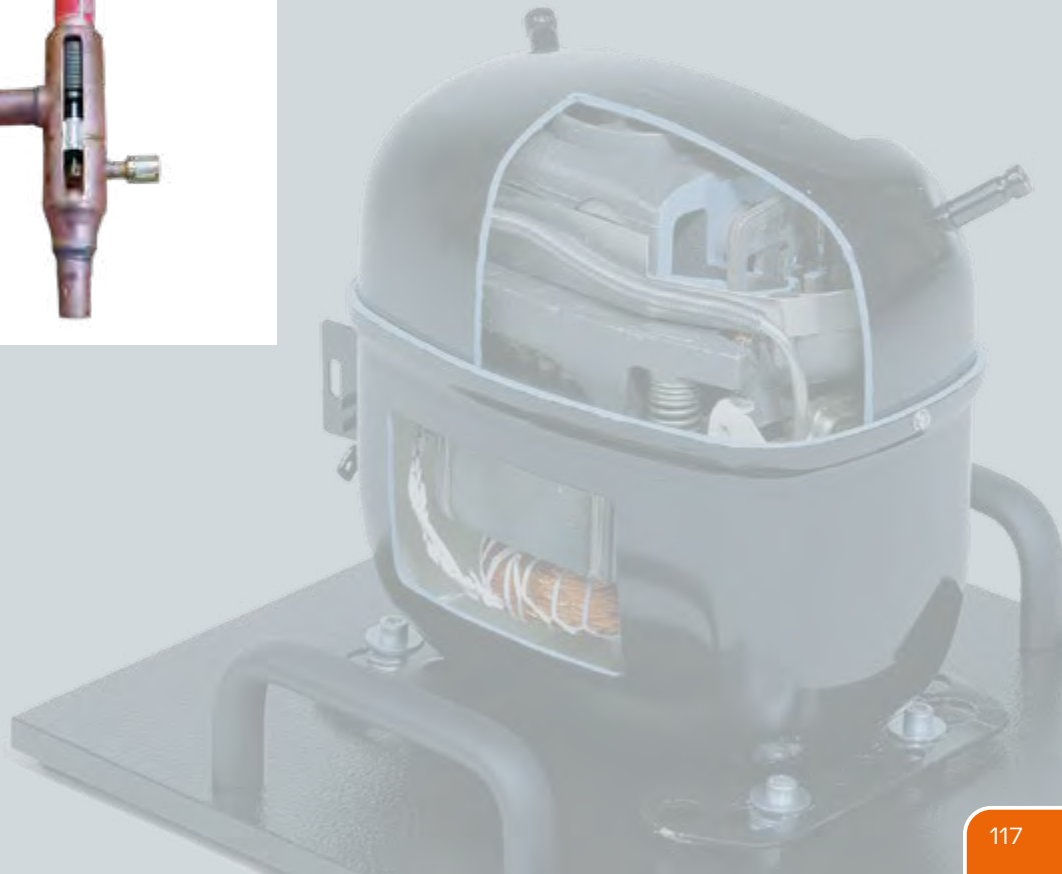
ET 499.26
Cutaway model:
condensation pressure
control valve



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 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, type 2 - type 5

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

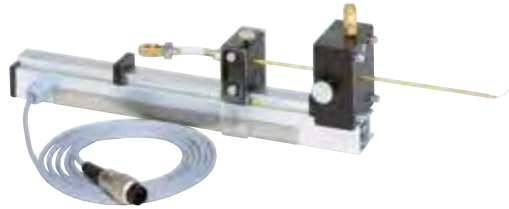


Air conditioning technology
Ventilation

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 straight 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

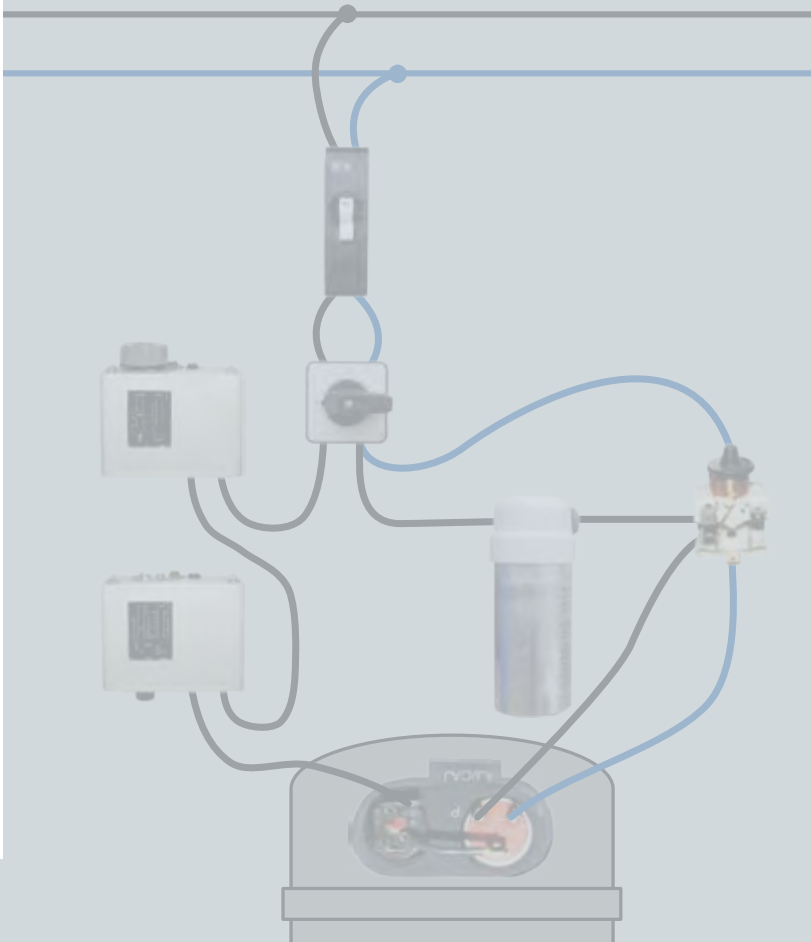


ET 171
Electrical connection of refrigerant compressors
Use of a real refrigerant compressor



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



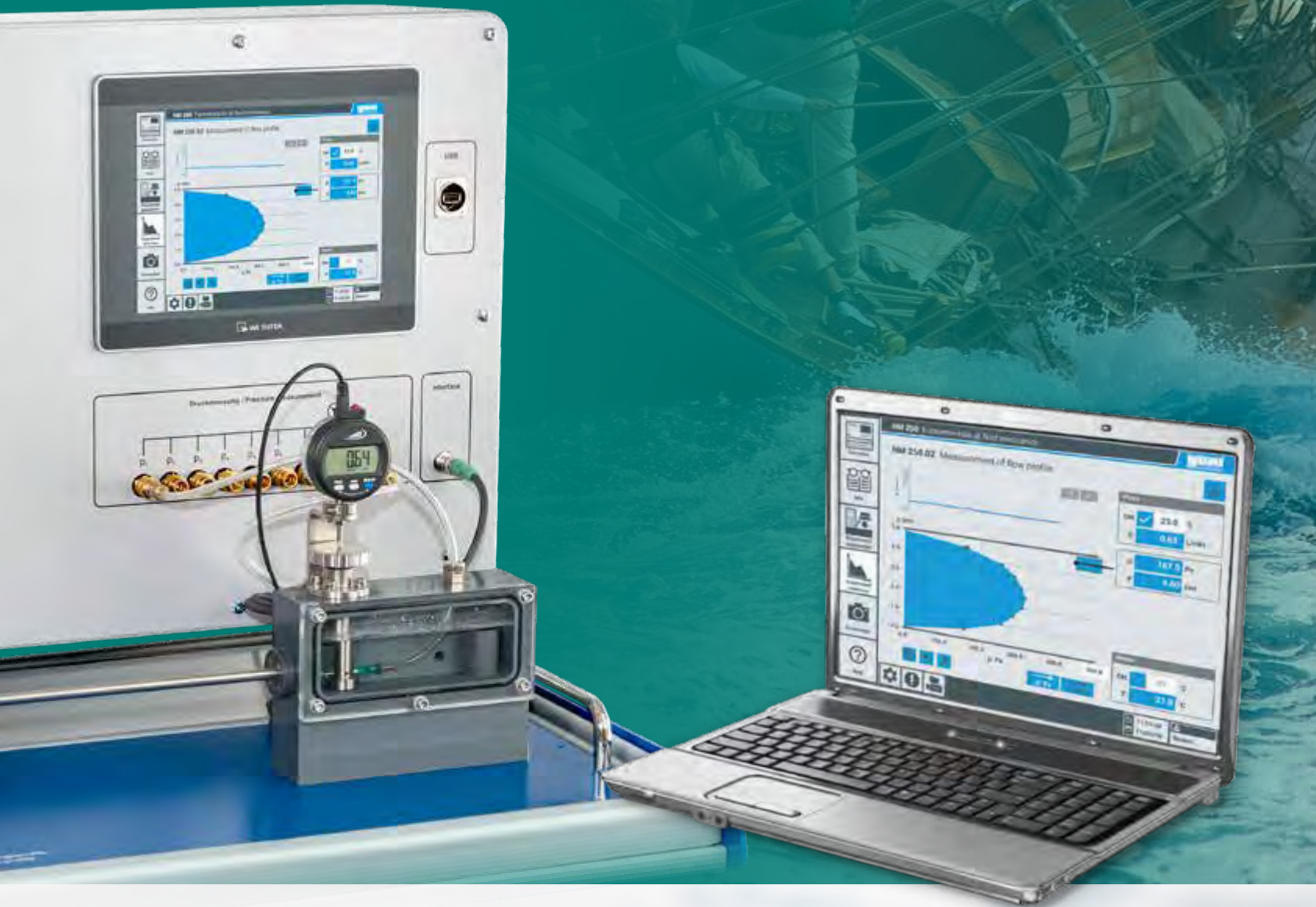
ET 170
Electrical faults in simple air conditioning systems
Simulation of a simple air conditioning system with compressor, fan and thermostat



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:



4 | Fluid mechanics



Fundamentals of fluid mechanics

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Steady flow

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Examples of transient flow

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Flow around bodies

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Fluidic experimental plants

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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 103

Expansion of ideal gases

Determination of the adiabatic exponent according to Clément-Desormes



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

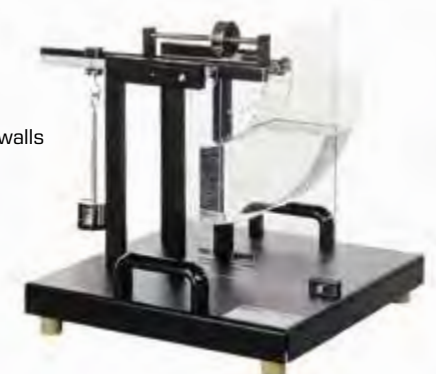
Experiments on buoyancy, density, capillarity etc.; various methods of pressure measurement



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:
HM150 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:
HM150 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:
HM150 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:
HM150 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:
HM150 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:
HM150 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:
HM150 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:
HM150 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: HM150 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:
HM150 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: HM150 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: HM150 Base module for experiments in fluid mechanics



HM 150.04

Centrifugal pump

Determining the characteristics of a typical centrifugal pump

HM150 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: HM150 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

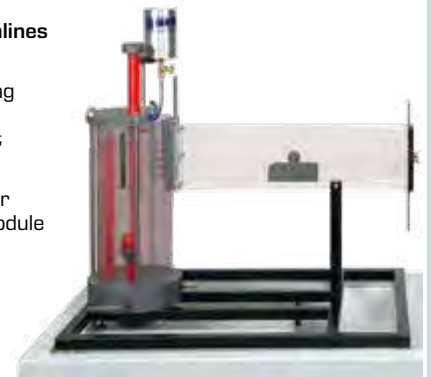


HM 150.21

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: HM150 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 86x300 mm

Experimental section lengths of 2,5m or 5m 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

**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

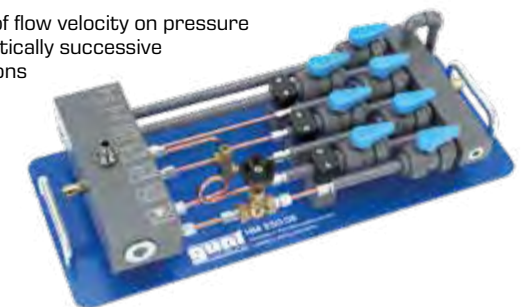
Recording the trajectory of the water jet and discharge
coefficients at different outlet velocities

**HM 250.07**
Bernoulli's principle

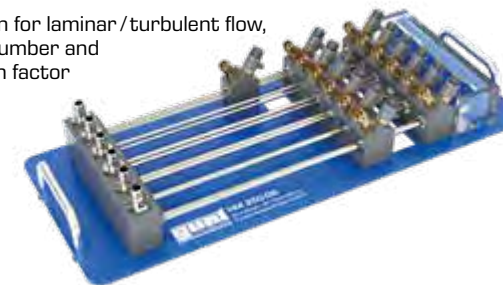
Static pressure and total pressure
distribution along the
Venturi nozzle

**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

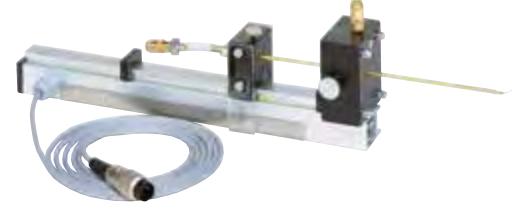


Steady flow Fundamentals of steady flow

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 240.05
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 240.06
Heat transfer at a cylinder in transverse flow
Investigation of heat transfer from a heated rod to an air flow



HM 241
Fundamentals of water flow
Experiments on water flow in open flumes and in pipes. Transparent design allows observation of the flow processes.



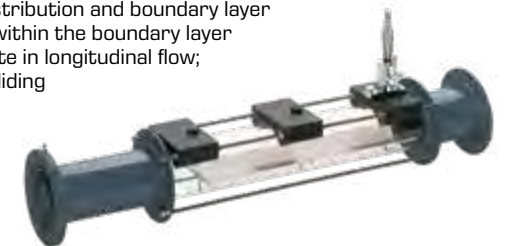
HM 220
Air flow experimental plant
Determining pressure loss and velocity profiles; different measuring objects



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

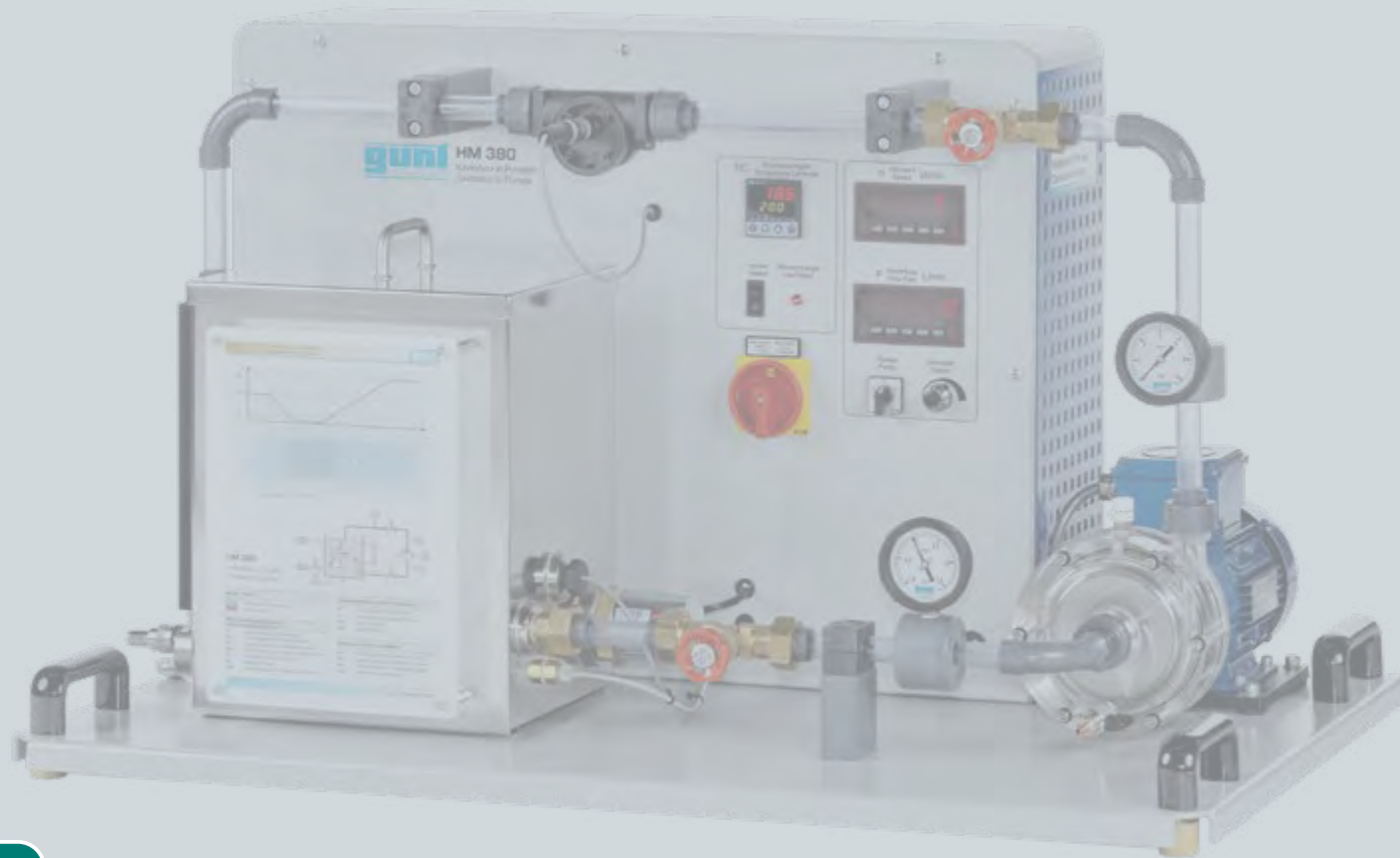
HM 380 Cavitation in pumps

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 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 155

Water hammer in pipes

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



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 150.15

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



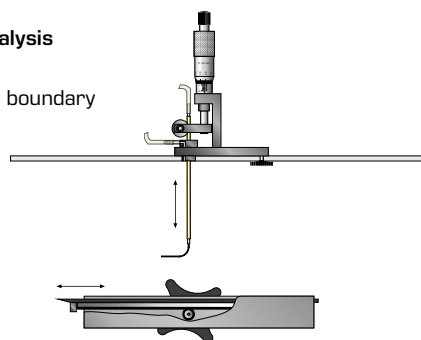
Drag bodies
HM 170.01 – HM 170.11

HM 170.22
Pressure distribution on an aerofoil NACA 0015

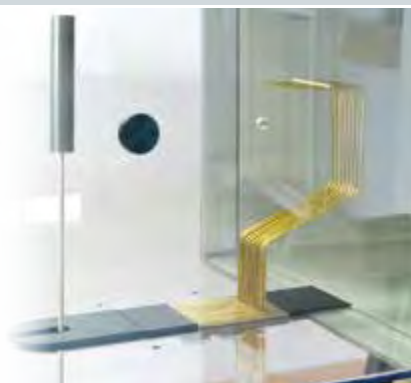
Experiments with different aerofoil angles of attack


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 225.06
Coanda effect

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


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 225.08
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 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



Flow around bodies

HM 226
Wind tunnel for visualisation of streamlines

Illuminated test section, various models, fog generator included

**HM 153**
Visualisation of different flows

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

**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 700.09
Cutaway model:
strainer



HM 700.10
Cutaway model:
gate valve



HM 700.03
Cutaway model:
standard Venturi meter



HM 700.04
Cutaway model:
straight-way valve



HM 700.11
Cutaway model:
straight-way plug valve



HM 700.12
Cutaway model:
three-way plug valve



HM 700.05
Cutaway model:
corner valve



HM 700.06
Cutaway model:
angle seat valve



HM 700.13
Cutaway model:
ball valve



HM 700.14
Cutaway model:
safety valve



HM 700.07
Cutaway model:
non-return valve



HM 700.08
Cutaway model:
pressure reducing 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 106
Cutaway model:
backflow preventer



VS 107
Cutaway model:
non-return butterfly
valve



VS 108
Cutaway model:
water meter



VS 109
Cutaway model:
strainer



VS 102
Cutaway model:
resilient seated
gate valve



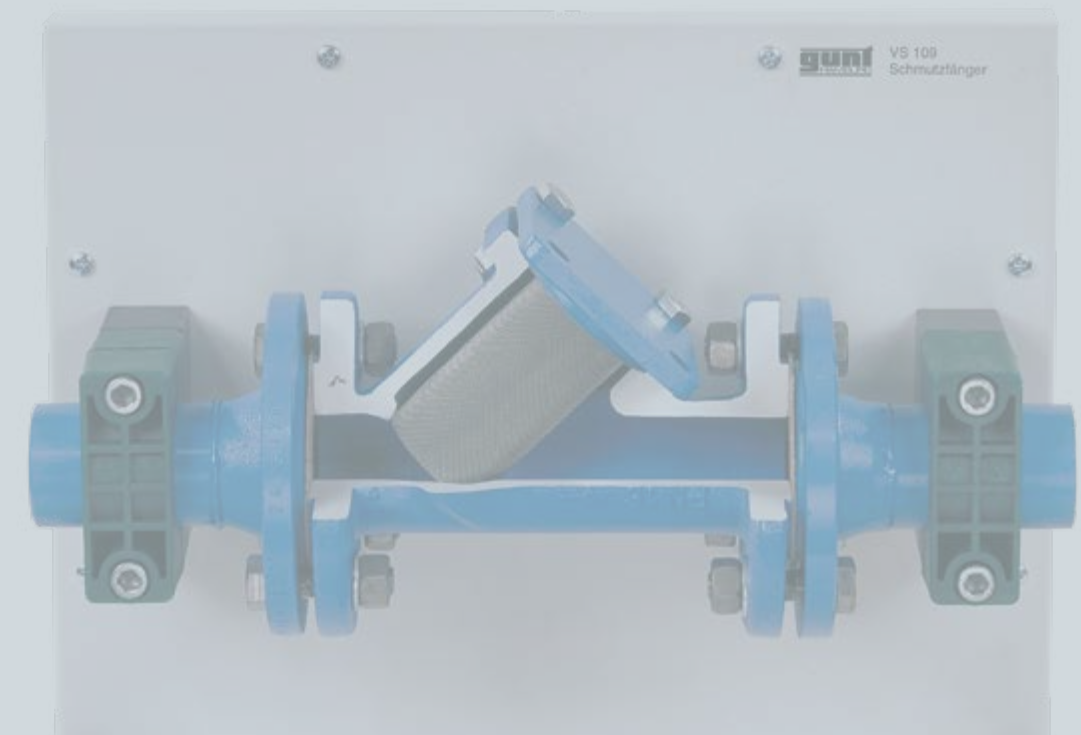
VS 103
Cutaway model:
screw down valve



VS 104
Cutaway model:
changeover valve



VS 105
Cutaway model:
gas meter



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 130

Assembly exercise: centrifugal pump

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



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 134

Montage d'une pompe à piston

Fonction et montage d'une pompe à piston; planifier, monter, démonter



MT 185

Assembly & maintenance exercise: in-line centrifugal 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



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 961

Compact assembly station pipes, valves and fittings

Assembly of real piping and plant installations, space-saving setup



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



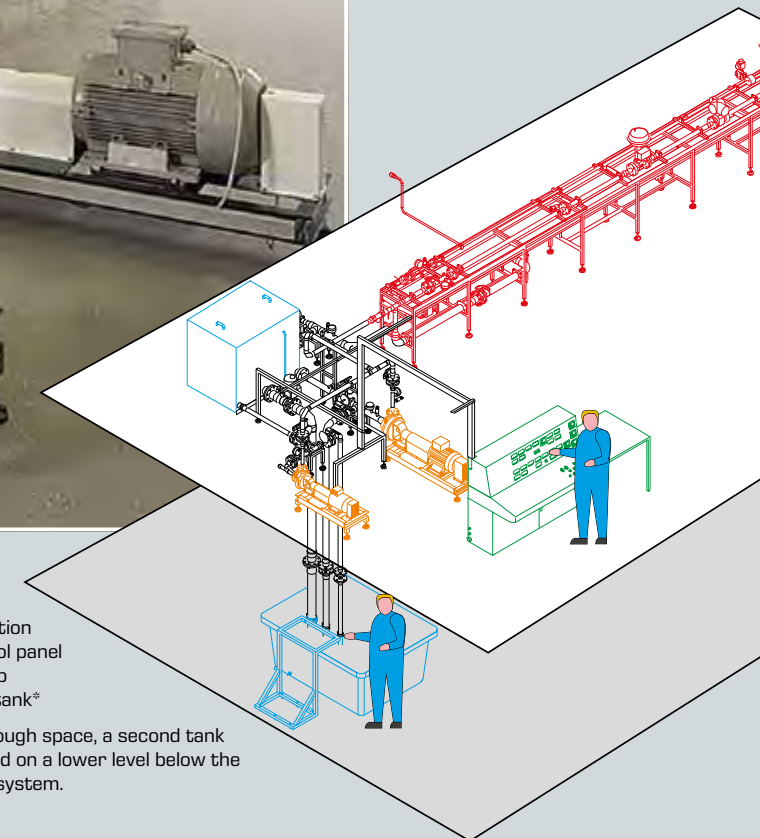
HM 124

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



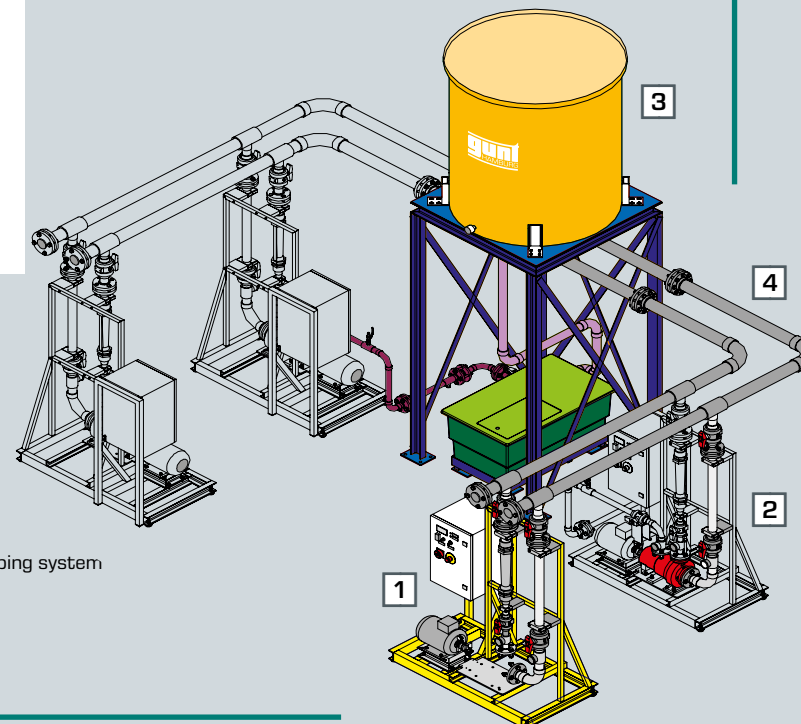
HL 962.03 Side channel pump

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



Fundamentals

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Driving machines

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Driven machines

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Power plants and applied cyclic processes

184



Equipment series

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GUNT FEMLine: turbines	193
GUNT FEMLine: engines	194
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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 122
Pressure losses in pipes

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



HM 150.09
Horizontal flow from a tank

Recording the trajectory of the water jet at different outlet velocities

Recommended for water supply:
HM150 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



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 230
Flow of compressible fluids

Subsonic and sonic flow through different measuring objects



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 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 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, type 2 - type 5

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 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



ET 270 Wave energy converter

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



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 deter-
mination of the efficiency

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



HM 287 Experiments with an axial turbine

Record character-
istics of an axial
reaction turbine



HM 405 Axial-flow turbomachines

Function of a
turbomachine;
configuration as
pump or turbine
with interchange-
able 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 283
Experiments with a centrifugal pump

Determination of characteristic pump variables



HM 450C
Characteristic variables of hydraulic turbomachines

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



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



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



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

HM 365.14
Centrifugal pumps, series and parallel connected

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



HM 365.10
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



CE 271
Multi-head diaphragm pump

Metering
pump
with three
pump heads



CE 272
Rotary vane vacuum pump

Generation
of negative
pressure
over time



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



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



ET 830
Steam power plant, 1,5kW

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



Wet cooling towers
ET 830.01 (115kW) or ET 830.02 (140kW)
for steam power plant ET 830 for re-cooling the cooling water



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 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 characteris-
tics 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 365.18
Gear pump

A gear pump is characterised by a steady flow rate



HM 365.10
Supply unit
for water pumps

Water supply for HM 365.11 to HM 365.19



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 365.19
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
Vane pump

Vane pumps can be used both for liquid and gaseous media



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



Fundamentals of fluid mechanics

Hydrostatics	200
Discharge	201
Hydrodynamics	202
Pipe flow	204
Transient flow	205
Turbomachines	206



Hydraulic engineering

Open-channel flow	208
Sediment transport	210
Seepage flow	211

About the product:



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



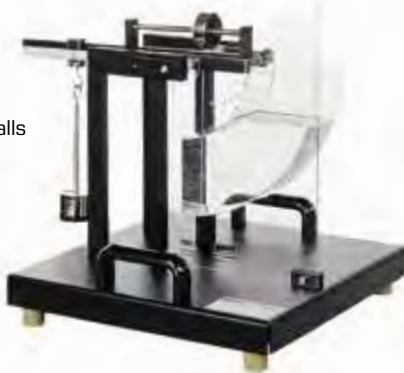
HM 150.02
Calibration of pressure gauges

Operation of a Bourdon tube pressure gauge and a piston manometer



HM 150.05
Hydrostatic pressure in liquids

Investigation of fluid pressure on vessel walls



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:
HM150 Base Module for
experiments in fluid mechanics



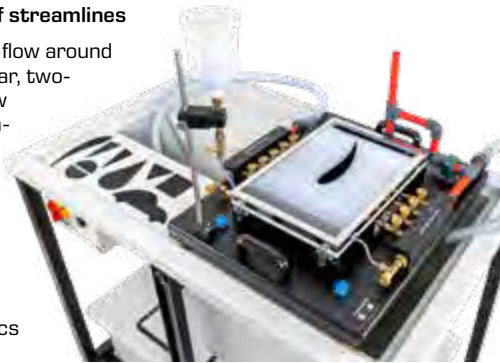
HM 150.08
Measurement of jet forces

Demonstration of the principle of linear momentum and impact forces on interchangeable deflectors with different deflection angles
Recommended for water supply:
HM150 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:
HM150 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



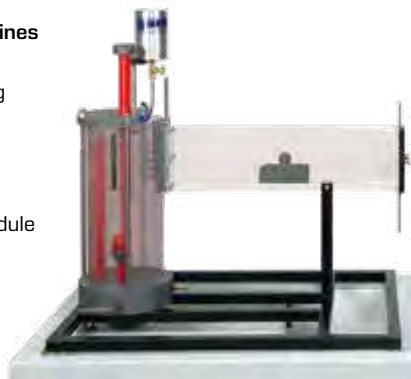
HM 150.07
Bernoulli's principle

Static pressure and total pressure distribution along the Venturi nozzle
Recommended for water supply:
HM150 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:
HM150 Base module for
experiments in fluid mechanics



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 250.07
Bernoulli's principle

Static pressure and total pressure distribution along the Venturi nozzle



HM 250.05
Measurement of jet forces

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



Fundamentals of fluid mechanics
Pipe flow

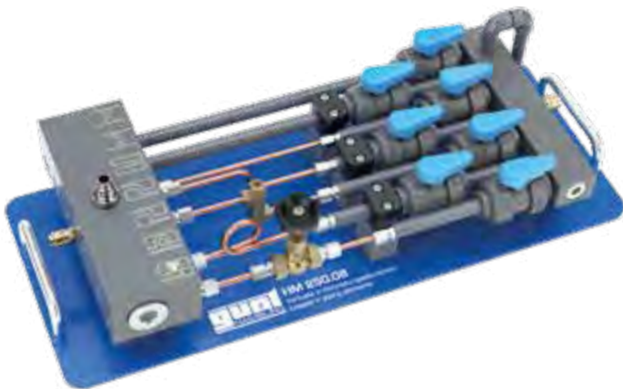
HM 250.01
Visualisation of pipe flow
Visualisation of laminar and turbulent flow



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 deter-
mination 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 commis-
sioned 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 86x300mm
Experimental section lengths of 2,5m or 5m available, closed water circuit and inclination adjustment



HM 162/163
Experimental flume
Experimental section for performing flow experiments in open flumes with lengths of 5m, 7,5m, 10m or 12,5m available, closed water circuit and inclination adjustment
Flow cross-section WxH:
309x450 mm (HM 162) /
409x500 mm (HM 163)



HM 161
Experimental flume 600x800mm
Experimental section for performing flow experiments in open flumes of 16m length, closed water circuit, inclination adjustment



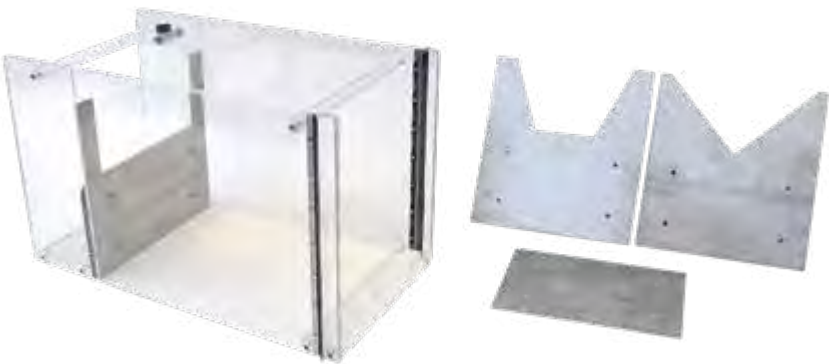
HM 250.11
Open channel
Flow around various drag bodies and incident flow of weirs



HM 250
Fundamentals of fluid mechanics
Base module for experiments in fluid mechanics, system control via PLC



HM 162.30
Set of plate weirs, four types
Flow over different sharp-crested weirs, investigations on an aerated overshoot weir



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 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



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



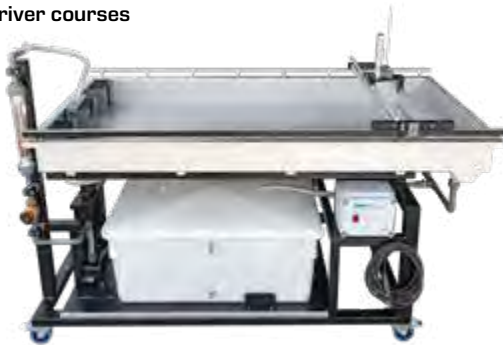
HM 142
Separation in sedimentation tanks

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



About the product:



5 | Process engineering



Mechanical process engineering

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Thermal process engineering

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Process engineering

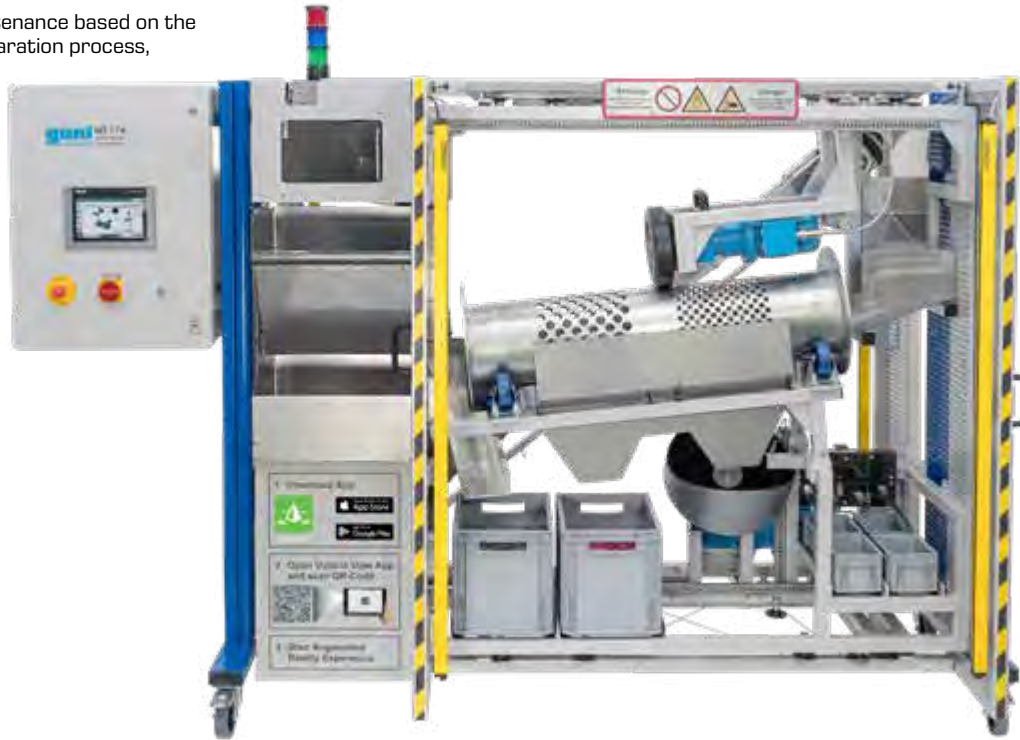




Mechanical process engineering Separation methods: classifying and sorting

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 588 Demonstration of dissolved air flotation

Basic function and visualisation of the process



CE 587 Dissolved air flotation

Removal of solids from raw water using dissolved air flotation



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

**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: 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



Mechanical process engineering

Comminution

CE 245**Ball mill**

Observation of the milling process: comminution of solids

**CE 264****Screening machine**

Professional analyser for CE 245 and CE 275; determination of particle size distributions



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



 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



Thermal process engineering Mass transfer

CE 110

Diffusion in liquids and gases

Use of Fick's law



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



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 704
SBR process
Sequencing batch 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

Biotechnological 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



Laboratory and conceptual design from A–Z

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A new specialist room?

An entire department?

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Pilot plants Maintenance

MMTS Mechanical Maintenance Training Skid

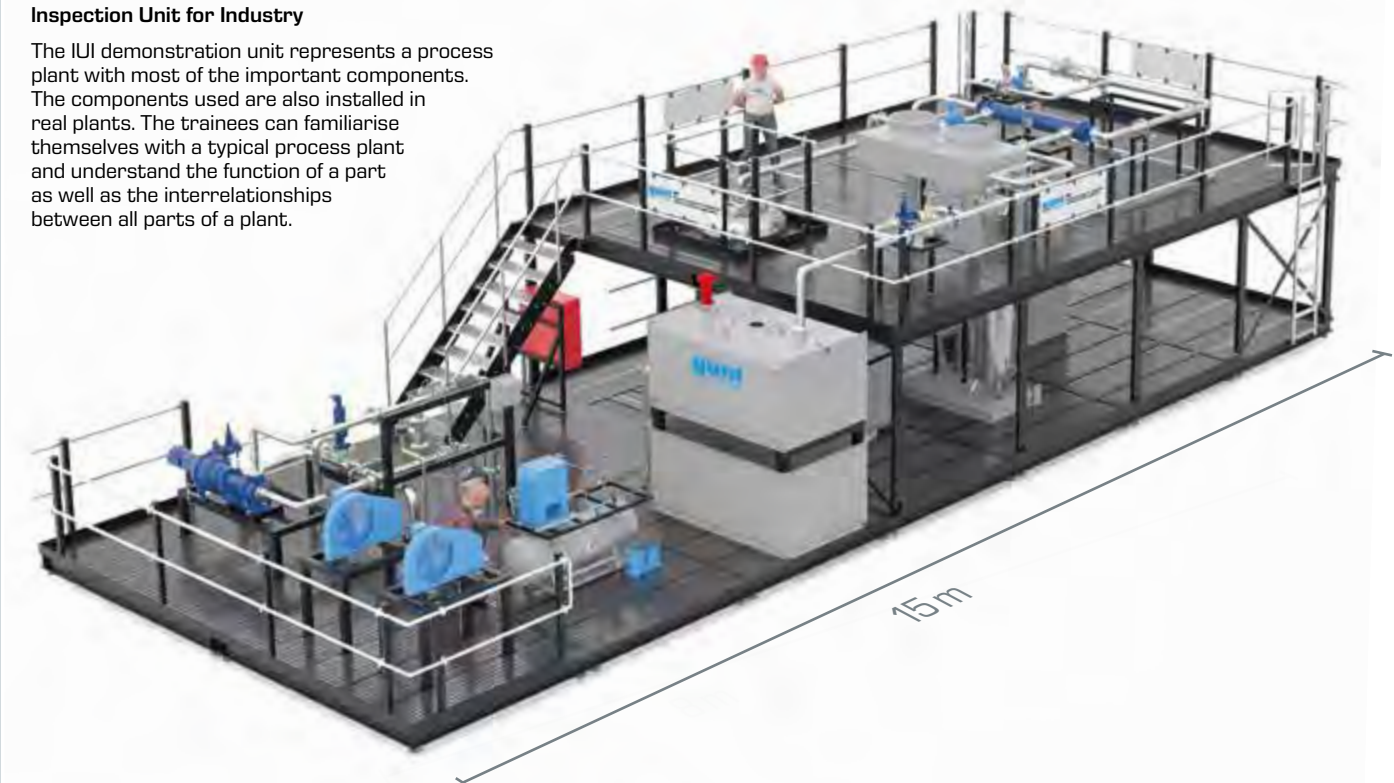
The training system MMTS is used for the maintenance of mechanical components as well as for the measurement and control of various parameters in a piping system with two different working media (oil and water).

In real applications, such systems can be found in power stations or in facilities for oil refining and natural gas processing.



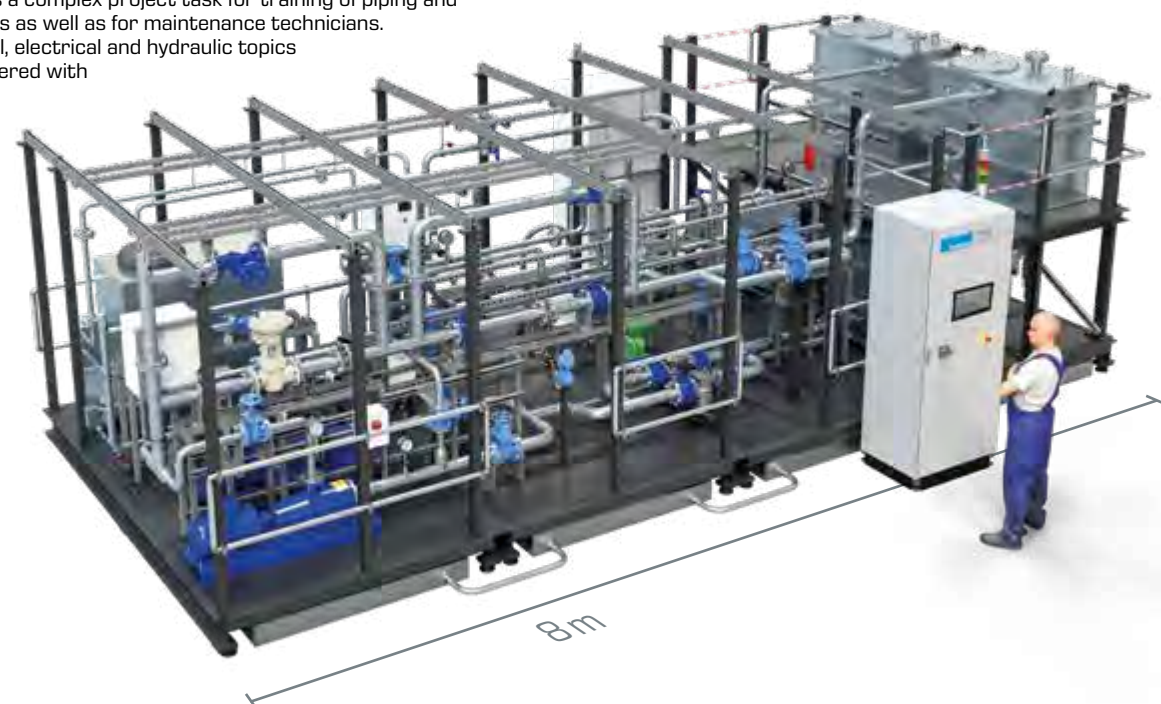
IUI Inspection Unit for Industry

The IUI demonstration unit represents a process plant with most of the important components. The components used are also installed in real plants. The trainees can familiarise themselves with a typical process plant and understand the function of a part as well as the interrelationships between all parts of a plant.



MPTR Main Process Training Rig

The training rig is based entirely on industrial technologies. It presents a complex project task for training of piping and plant fitters as well as for maintenance technicians. Mechanical, electrical and hydraulic topics can be covered with this rig.



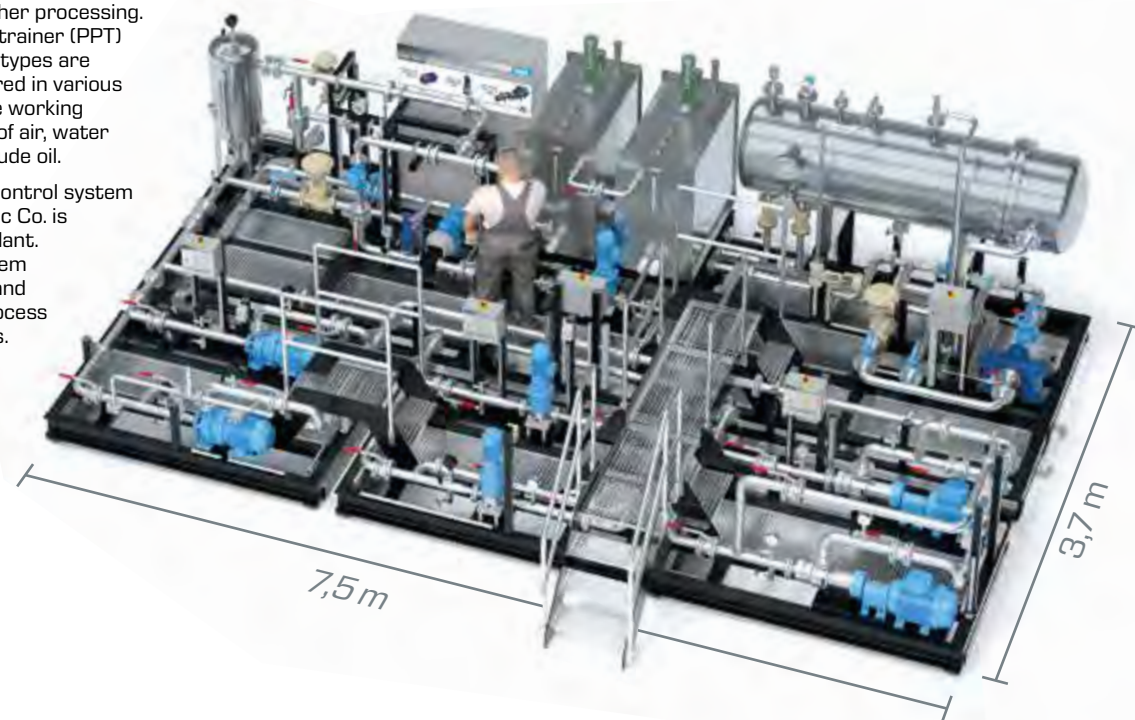
Pilot plants Oil & gas industry

PPT Process Pump Trainer

In oil industry, crude oil is extracted from a well and then pumped for further processing. In the process pump trainer (PPT) three different pump types are operated and compared in various operation modes. The working medium is a mixture of air, water and oil to simulate crude oil.

The DeltaV process control system from Emerson Electric Co. is used to control the plant. This automation system is very user-friendly and widely used in the process and energy industries.

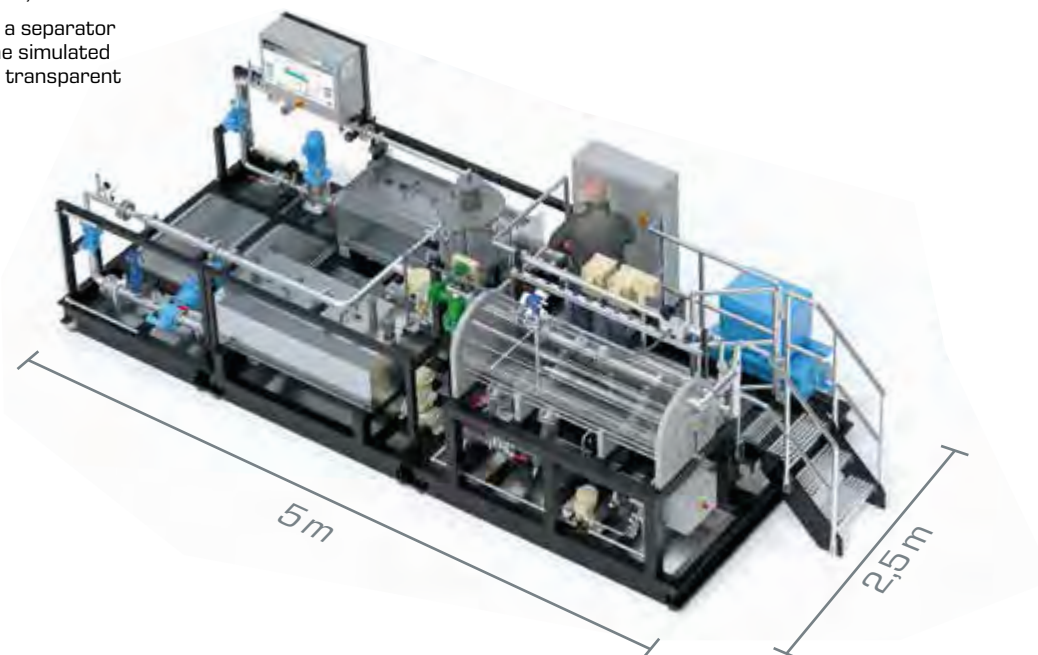
DeltaV has modern control functions and allows the operator optimum control of the plant at all times.



PST Phase Separation Trainer

The phase separation trainer demonstrates the separation of simulated crude oil into air, water and oil.

Main part of the trainer is a separator using gravity to split up the simulated crude oil. The separator is transparent to enable observing the separation process.



WaXTMT Wellhead and Xmas-Tree Maintenance Trainer

In the oil industry, crude oil is extracted from a well and then pumped for further processing.

A wellhead is installed at the top of the oil well as an interface between the drilling equipment and production equipment. Connected to the wellhead is an eruption cross (Xmas-Tree) with valves, coils and fittings for oil processing.

The trainer is used to assemble and disassemble the wellhead and the eruption cross. No fluids are pumped through pumped through the trainer. The tools required for the work are included.

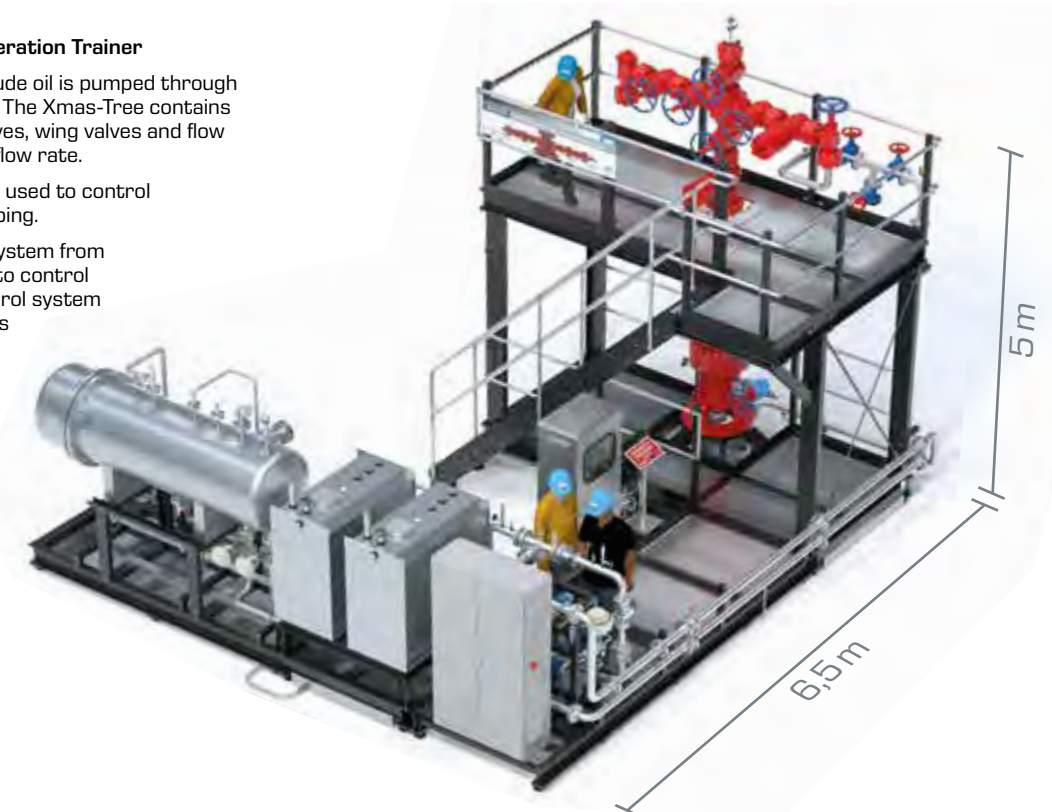


WaXTOT Wellhead and Xmas-Tree Operation Trainer

In this trainer, a simulated crude oil is pumped through a wellhead and an Xmas-Tree. The Xmas-Tree contains the lower and upper main valves, wing valves and flow control valves to control the flow rate.

A commercial control panel is used to control the safety functions and pumping.

The DeltaV process control system from Emerson Electric Co. is used to control the trainer. This process control system is very common in the process and energy industry.

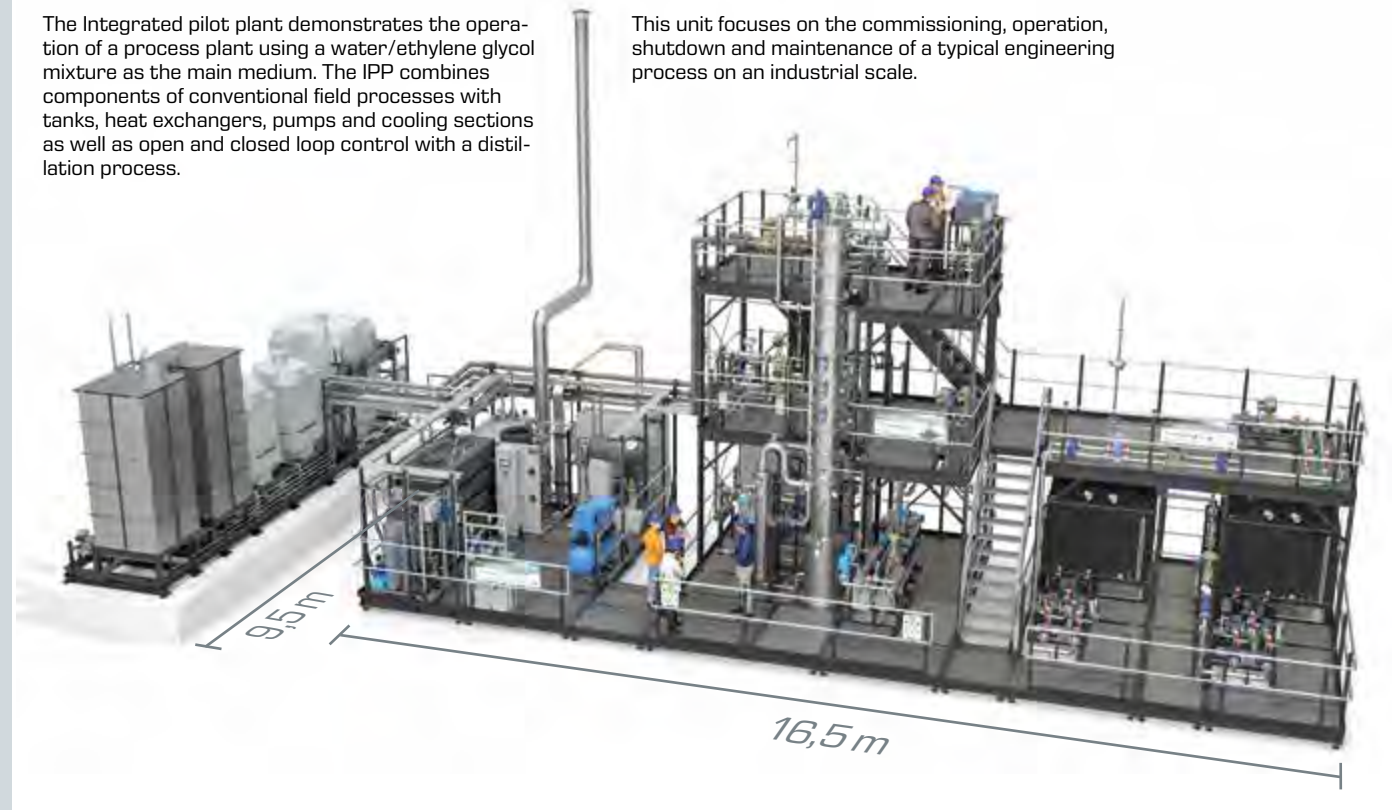


Pilot plants Chemical industry

IPP Integrated Pilot Plant

The Integrated pilot plant demonstrates the operation of a process plant using a water/ethylene glycol mixture as the main medium. The IPP combines components of conventional field processes with tanks, heat exchangers, pumps and cooling sections as well as open and closed loop control with a distillation process.

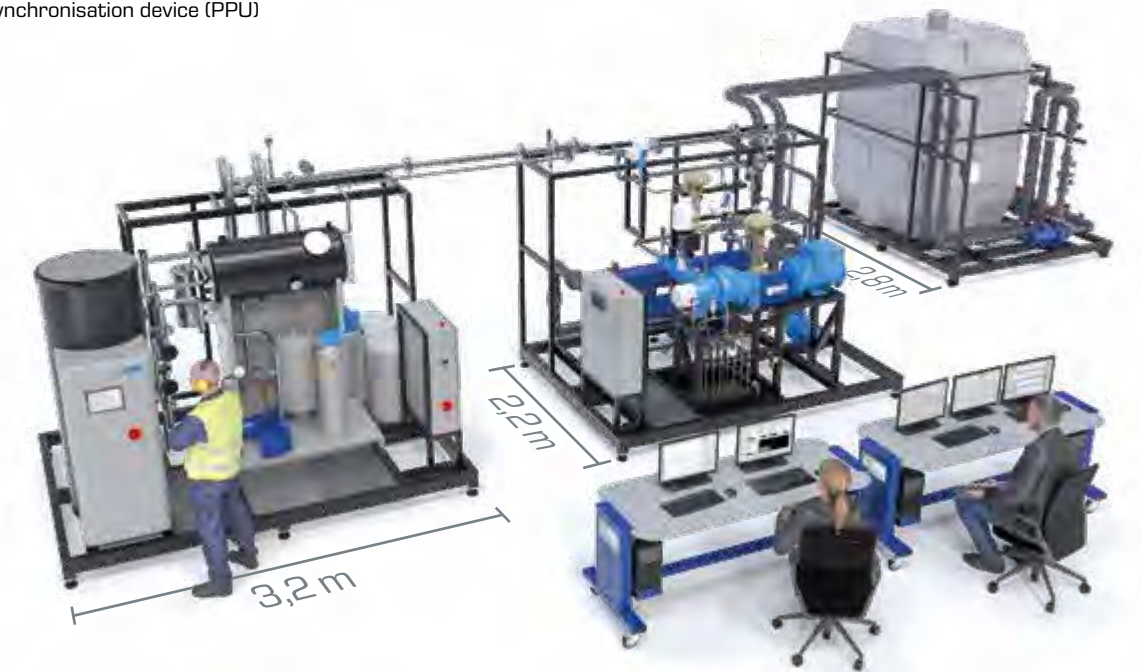
This unit focuses on the commissioning, operation, shutdown and maintenance of a typical engineering process on an industrial scale.



Pilot plants Power plant industry

ET 805 Steam power plant 20kW with process control system

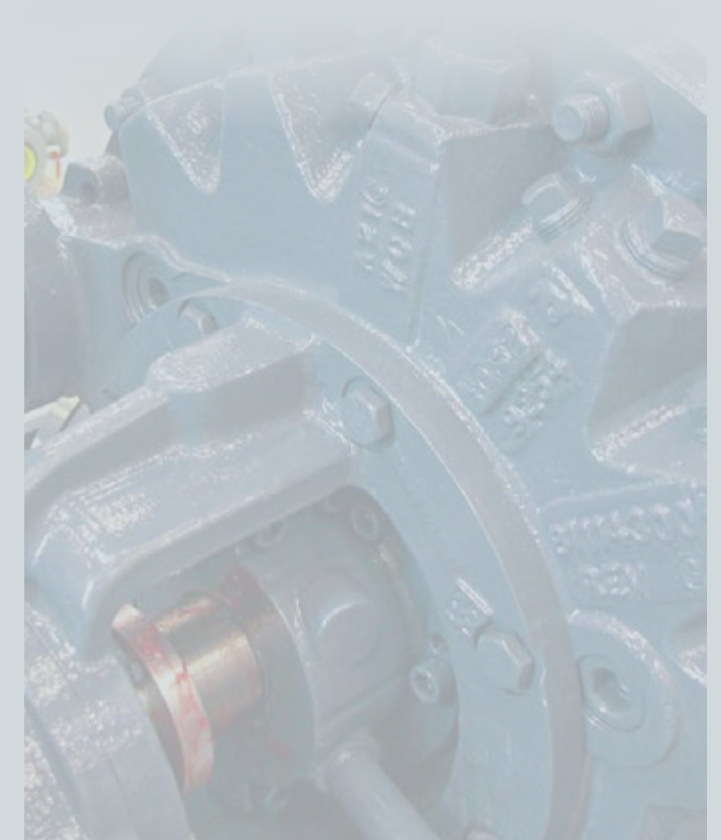
Steam turbine with synchronous generator for grid-connected or stand-alone operation. Fully equipped with oil-fired or gas-fired boiler, condenser, cooling tower, feed water treatment and modern synchronisation device (PPU)



The ET 805 steam power plant is specially designed for education and training in the field of power plant technology with process control system.

Due to the size and complexity of the plant, the operating behaviour corresponds to many aspects of real large-scale plants and thus enables practical training. With this plant, all relevant characteristics of a steam turbine power plant can be investigated.

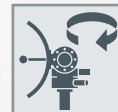
The integrated process control system enables students to practise the operation of an automated power plant. All important variables for the process are clearly displayed in process diagrams and converted into characteristic values.



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



About the product:



6 | 2E Energy & Environment

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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 250 Solar module measurements

Determining the characteristic parameters of a photovoltaic system



ET 250.01 Photovoltaic in grid-connected operation

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



ET 250.02 Stand-alone operation of photovoltaic modules

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



Energy Solar energy: solar thermal energy

ET 202 Principles of solar thermal energy

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



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



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

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 202.01 Parabolic trough collector

Function and operating behaviour of a parabolic trough collector; accessories for ET 202



HL 320.03 Flat collector

Pivotal 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 220.10 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 210 Fundamentals of wind power plants

Wind power plant with rotor blade adjustment and yaw angle
adjustment



HM 226 Wind tunnel for visualisation of streamlines

Illuminated test section, various models, fog generator included



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 airfoil NACA 0015



HM 170.22 Pressure distribution on an airfoil NACA 0015

Experiments with
different airfoil
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; four different transmissions adjustable



ET 224 Operating behaviour of wind turbines

Characteristic and control on a wind power drive train



ET 222 Wind power drive train

Experiments on conversion of rotational energy into electrical energy



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 diag- nostic 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





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**Biotechnological 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 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 biva-
lent storage for
heating systems
with renewable
energies, oper-
ating 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



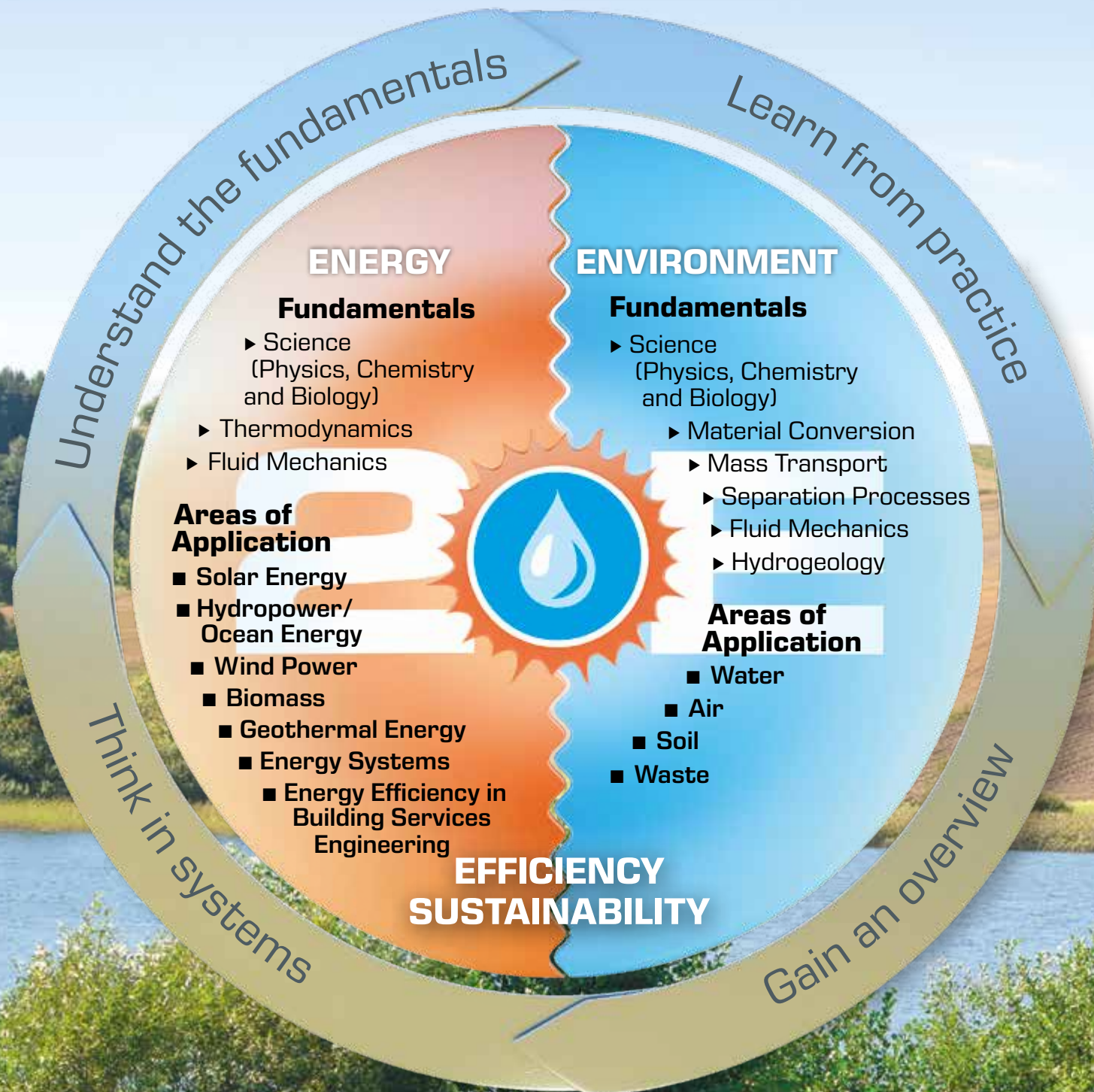
HL 320.08

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 ground-water 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 ground-water; 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

Sorting with a drum-type magnetic separator



Environment Waste: comminution

CE 245 Ball mill

Observation of the milling process: comminution of solids



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