

MAINTENANCE

SYSTEM COMPONENTS: VALVES, PUMPS, PIPES

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The principle of complete systems from GUNT

It is our principle to provide you with complete teaching and training systems that are ready for immediate use. This means that GUNT always supplies comprehensive instructional material to accompany the actual product.

For our **maintenance** training systems we additionally include the necessary jigs, fixtures and assembly tool kits in almost every case. In many cases additional small and wearing parts are also included, ensuring long-term usability of the training system.

LEARNING CONCEPTS RELATING TO INDUSTRIAL MAINTENANCE

The maintenance

of industrial plant and machinery is a key field of activity for technicians and skilled tradesmen working in mechanical and electrical engineering.

Key area in technical training

The level of attention devoted to the subject of maintenance by the curricula is therefore high.

TEACHING AND LEARNING SYSTEMS RELATING TO MAINTENANCE

GUNT-Gerätebau GmbH offers you a wide range of wholly practice-oriented teaching and training systems relating to technical maintenance with which you can cover essential learning content:

Use of specific manufacturer's documentation for maintenance, inspection and repair	Planning and assessing maintenance sequences and steps
Reading and understanding engineering drawings	Practical execution and documentation of maintenance operations
Familiarisation with machine and system components	Testing and commissioning of repaired systems
Understanding maintenance as the interaction between inspection, maintenance and repair	Assessment of malfunctions, detection of faults

The GUNT training systems are ideally suitable for students' group working, and of course for project-oriented working methods.



Things don't have to get this bad



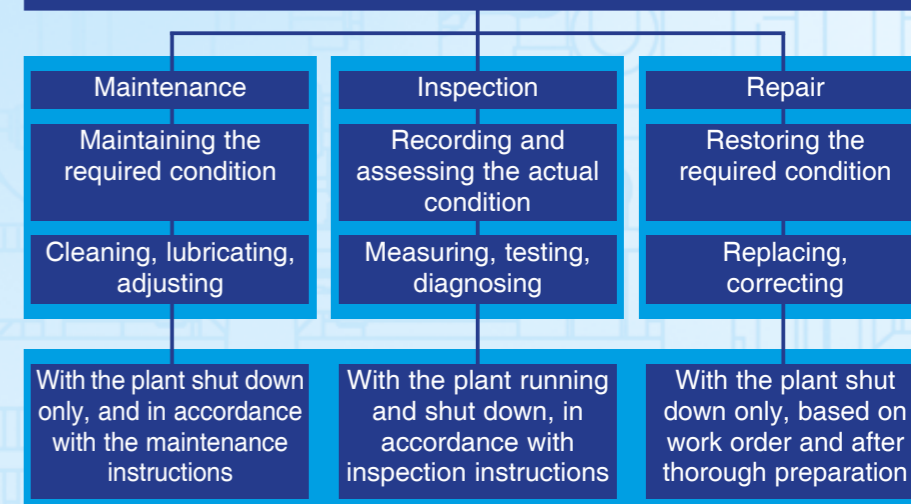
It's possible to do something in time

What is maintenance?

'Maintenance' as defined by German industry standard DIN 31051 is a complex field, so the range of teaching and training systems we offer in this area is very diverse.

This Maintenance chapter of the GUNT catalogue should be read in close conjunction with the other sections.

MAINTENANCE TO DIN 31051



LEARNING THROUGH PRACTICE...

This chapter deals with the process of familiarisation with component and their functions, reading and understanding engineering drawings or operating instructions, and familiarisation with technical terminology and language. The assembly exercises can be conducted in relatively short periods of time (within lesson units) and do not as yet require any particular technical experience. Fault diagnosis and maintenance measures are not yet central to the training systems set out in this chapter.

CHAPTER ASSEMBLY PROJECTS

CHAPTER MAINTENANCE

The real, industrial nature of the exercises is higher than in the Assembly Projects. Typical maintenance methods and testing procedures are offered as learning content. Some of the exercises take a lot of time to complete and amount to substantial project work. Demands are made on technical skills.

CHAPTER MACHINERY DIAGNOSTICS

The teaching systems familiarise trainees with the specific methods of monitoring plant/machinery condition, such as the early detection of bearing or gear damage. We work primarily with vibration analysis methods which constitute diagnostic steps for preventive maintenance or targeted repair.

...SO THE THEORY IS EASY!

MT 180 Assembly & Maintenance Exercise: Centrifugal Pump



The illustration shows the tool box with kit and tool inlay, and in the foreground the fully assembled pump.

- * **Practical exercise on the assembly and maintenance of a standard centrifugal pump**
- * **Comprehensive and well-structured instructional material**

Technical Description

Centrifugal pumps are rotodynamic pumps and operate normally primed. They are in widespread use, and are deployed primarily in the pumping of water. Their applications include use in shipbuilding, the process industries and in water supply systems. They are compact and relatively simple in design. The water is conveyed by centrifugal force generated by the rotation of the pump impeller. Standard pumps are - as the term suggests - standard items. As a result they are relatively inexpensive to purchase and maintain. In the lifecycle of a pump, maintenance and repair work is usually required as in many cases pumps are not considered as pure replacement items.

The MT 180 kit forms part of the GUNT assembly, maintenance and repair practice line designed for training at technical colleges and in company training centres. A close link between theory and practice is key to the learning content. The kit is ideally suited to project based learning with a particular emphasis on 'hands-on' work. Independent working by the students is assisted and encouraged. Learning in a small team offers a useful learning format.

MT 180 enables a typical standard centrifugal pump to be assembled and maintained. Students become familiar with all the pump components and their modes of operation. The parts are clearly laid out in a tool box. Systematic assembly and disassembly of a pump is practiced.

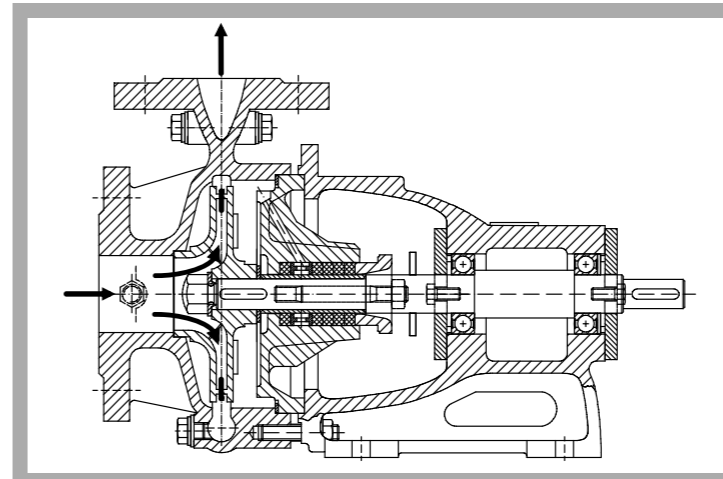
The instructional material details the individual steps involved in the exercise, and provides additional information on the areas of application, mode of operation and design of the pump.

Learning Objectives / Experiments

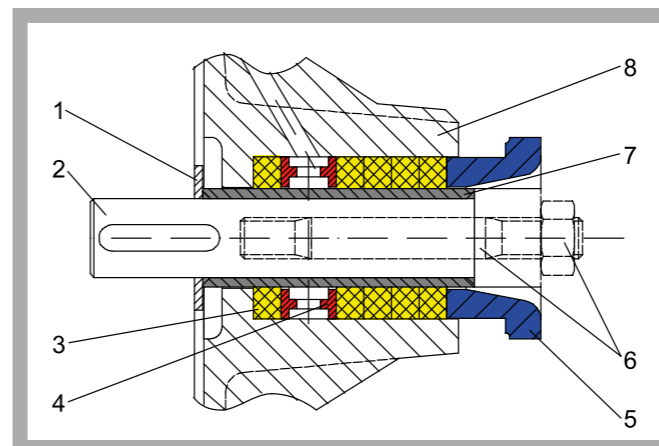
- design and function of a centrifugal pump and its components
- assembly and disassembly for maintenance and repair purposes
- replacing components (e.g. seals or bearings)
- troubleshooting, fault assessment
- planning and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

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MT 180 Assembly & Maintenance Exercise: Centrifugal Pump



Sectional drawing of the centrifugal pump



Packing gland: 1 disk, 2 shaft, 3 gland packing, 4 locking ring, 5 packing gland frame, 6 stud bolt with hexagon nut, 7 shaft sheath, 8 housing cover



Assembly of the centrifugal pump: fixing of the bearing cover with screws

Specification

- [1] learning concept for maintenance and repair exercises on a single-stage, normally primed centrifugal pump with a spiral housing
- [2] pump according to DIN 24255
- [3] enclosed pump impeller with 5 blades, designed for pure liquids
- [4] pump shaft sealing, based on the gland principle
- [5] 2 assembly aids and a complete tool set
- [6] pump parts and tools housed in a tool box
- [7] the kit forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Single-stage centrifugal pump
- power consumption: max. 1100W
- max. flow rate: 19m³/h
- max. head: 25m
- speed: 3000min⁻¹
- intake connection: DN50
- delivery connection: DN32
- housing and impeller: grey cast iron

Dimensions and Weight

- LxWxH: 690x360x312mm (tool box)
- Weight: approx. 35kg

Scope of Delivery

- 1 complete kit of a standard centrifugal pump
- 1 set of tools, consisting of
 - 2 combination wrenches size 13, 17
 - 1 double-ended box spanner size 24/26 with tommy bar
 - 1 bearing puller, three-arm
 - 1 slotted screwdriver, 5,5
 - 1 soft-faced hammer
- 2 assembly aids for assembly / disassembly of bearings
- 1 set of replacement parts, consisting of
 - 1 flat seal
 - 1 gland packing
- 1 tool box with compartment insert and foam inlay
- 1 set of instructional material, consisting of
 - technical description of system, complete set of drawings with individual parts and parts list, description of maintenance and repair processes, suggested exercises
- 1 operator's manual for the industrial pump

Order Details

051.18000 MT 180 Assembly & Maintenance Exercise: Centrifugal Pump

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MT 181 Assembly & Maintenance Exercise: Multistage Centrifugal Pump



The illustration shows the tool box with kit and tools. The fully assembled pump is shown in the foreground.

- * **Practical exercise on the assembly and maintenance of a multistage centrifugal pump**
- * **Comprehensive and well-structured instructional material**

Technical Description

Centrifugal pumps are rotodynamic pumps and operate normally primed. They are in widespread use, and are deployed primarily in the pumping of water. Their range of applications include use in shipbuilding, the process industries and in water supply systems. Very high delivery pressures can be generated by connecting multiple impellers in series. Centrifugal pumps are compact and relatively simple in design. The water is conveyed by centrifugal force generated by the rotation of the pump impeller. In the lifecycle of a pump, maintenance and repair work is usually required as in many cases pumps are not considered as pure replacement items.

The MT 181 kit forms part of the GUNT assembly, maintenance and repair practice line designed for training at technical colleges and in company training centres. A close link between theory and practice is key to the learning content. The kit is ideally suited to project-based learning with a particular emphasis on 'hands-on' work. Independent working by the students is assisted and encouraged. Learning in a small team offers a useful learning format.

MT 181 enables a typical multistage centrifugal pump to be assembled and maintained. Students become familiar with all the pump components and their modes of operation. The parts are clearly laid out in a tool box. Systematic assembly and disassembly of a pump is practiced.

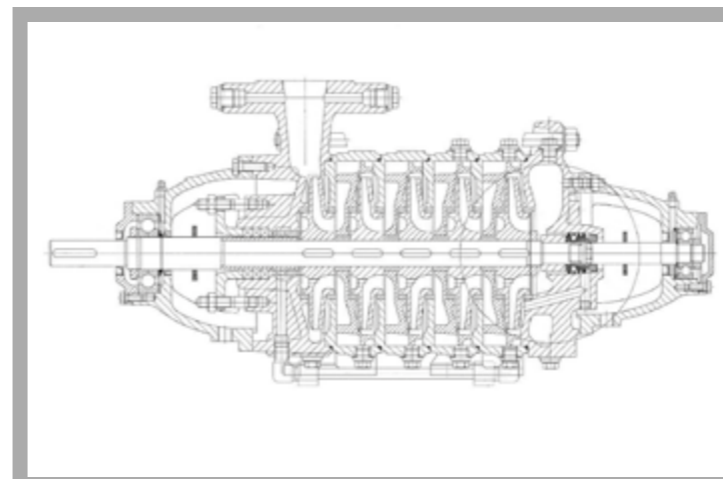
The instructional material details the individual steps involved in the exercise, and provides additional information on the areas of application, mode of operation and design of the pump.

Learning Objectives / Experiments

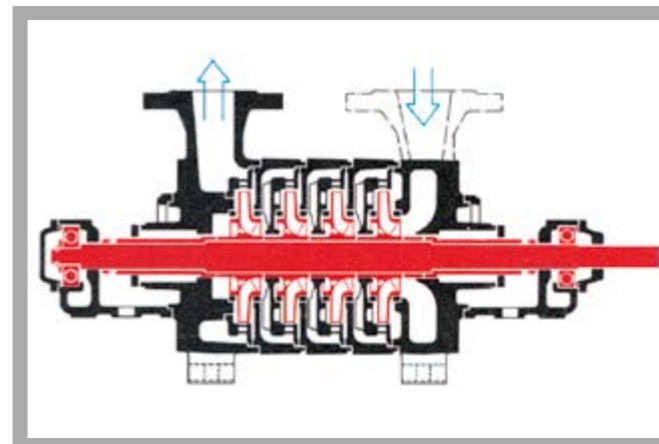
- design and function of a multistage pump and its components
- assembly and disassembly for maintenance and repair purposes
- replacing components (e.g. seals, bearings or impellers)
- troubleshooting, fault assessment
- planning and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

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MT 181 Assembly & Maintenance Exercise: Multistage Centrifugal Pump



Sectional drawing of a similar multistage centrifugal pump (MT 181 has four stages; the intake and delivery connections are on the same side)



Schematic view of a four-stage centrifugal pump



Assembly of the four-stage centrifugal pump: assembling the packing gland rings

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Specification

- [1] learning concept for maintenance and repair exercises on a four-stage, normally primed centrifugal pump
- [2] shaft sealing based on the gland principle (delivery side) and with floating ring seal (intake side)
- [3] driven by motor (not included) and clutch via pump shaft
- [4] 4 assembly aids and complete tool set
- [5] pump parts and tools housed in a tool box
- [6] the kit forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Four-stage centrifugal pump
- power consumption: max. 1400W
- max. flow rate: 18m³/h
- max. head: 28m
- speed: 1450min⁻¹
- intake connection: DN50
- delivery connection: DN40
- housing and impellers: grey cast iron

Dimensions and Weight

- LxWxH: 690x360x312mm (tool box)
- Weight: approx. 58kg

Scope of Delivery

- 1 complete kit of a 4-stage centrifugal pump
- 1 set of tools, consisting of
 - 8 combination wrenches size 10, 13, 17, 24, 27, 36, 2x size 19
 - 1 bearing puller, two-arm
 - 2 screwdrivers
 - 1 set of forcing pliers for shaft circlips
 - 1 punch
 - 1 soft-faced hammer
 - 1 tool for slot nut
 - 1 brace
 - 2 striker sleeves for assembly / disassembly of bearings
- 1 set of replacement parts, consisting of
 - 1 set of packing gland rings
 - 1 seal
 - 1 slot nut
 - 1 tin of corrosion-proofing spray
- 1 box for small parts
- 1 tool box with foam inlay
- 1 set of instructional material, consisting of
 - technical description of system, complete set of drawings with individual parts and parts list, description of maintenance and repair processes, suggested exercises
 - 1 operator's manual for the industrial pump

Order Details

051.18100 MT 181 Assembly & Maintenance Exercise: Multistage Centrifugal Pump

MT 182 Assembly & Maintenance Exercise: Screw Pump



The illustration shows the tool box with kit and tools. The fully assembled pump is shown in the foreground.

- * **Practical exercise on the assembly and maintenance of a screw pump**
- * **Comprehensive and well-structured instructional material**

Technical Description

Screw pumps are positive displacement pumps and operate in a rotary manner, normally primed. The pump presented here can be used for a number of different fluids. These include any non-aggressive fluids with lubricating properties, with viscosities between 2...1500mm²/s, such as lubricating oil, vegetable oil, hydraulic fluid, glycols, polymers and emulsions. Typical applications include: lubricating diesel motors; gears; gas, steam and water turbines; and cooling and filtration circuits in large-scale machines and hydraulic systems.

The MT 182 kit forms part of the GUNT assembly, maintenance and repair practice line designed for training at technical colleges and in company training centres. A close link between theory and practice is key to the learning content. The kit is ideally suited to project-based learning with a particular emphasis on 'hands-on' work. Independent working by the students is assisted and encouraged. Learning in a small team offers a useful learning format.

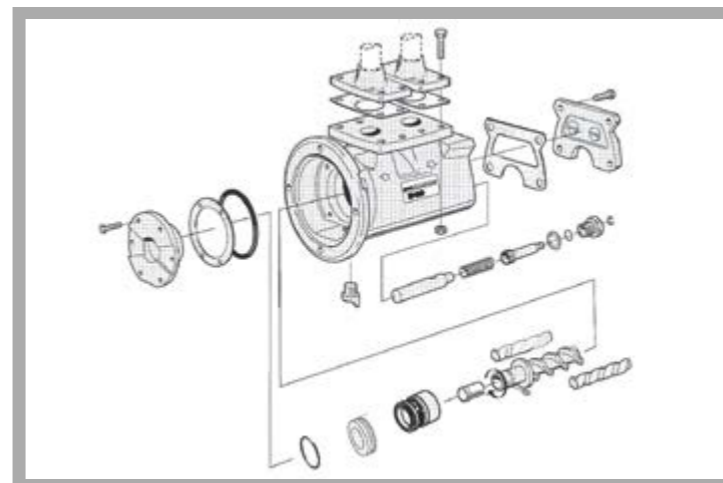
MT 182 enables a typical screw pump to be assembled and maintained. Students become familiar with all the pump components and their modes of operation. The parts are clearly laid out in a toolbox. Systematic assembly and disassembly of a pump is practiced.

The accompanying material details the individual steps involved in the exercise, and provides additional information on the areas of application, mode of operation and design of the pump.

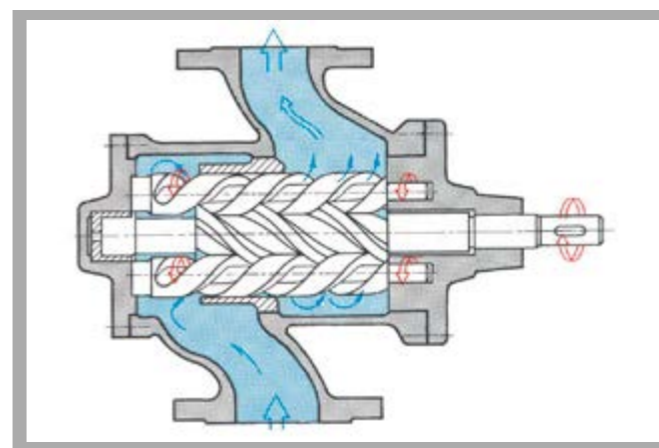
Learning Objectives / Experiments

- design and function of a screw pump and its components
- assembly and disassembly for maintenance and repair purposes
- replacing components (e.g. seals)
- troubleshooting, fault assessment
- planning and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

MT 182 Assembly & Maintenance Exercise: Screw Pump



Exploded-view drawing of the screw pump



Principle of operation of the screw pump



Assembly of the screw pump: assembling the valve piston with the valve spring

Specification

- [1] learning concept for maintenance and repair exercises on a screw pump
- [2] three-spindle screw pump with one driving spindle and two delivery spindles
- [3] integrated pressure limiting valve; at overpressures a portion of the flow is returned to the intake side
- [4] used for media with a kinematic viscosity in the range 2...1500mm²/s
- [5] pump parts and tools housed contained in a tool box
- [6] the kit forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Screw pump
- power consumption: max. 1350W
- max. head: 12bar
- displacement: 13,9cm³/spindle revolution
- max. speed: 3600min⁻¹
- intake connection: DN25
- delivery connection: DN25
- grey cast iron housing

Dimensions and Weight

LxWxH: 690x360x312mm (tool box)
Weight: approx. 50kg

Scope of Delivery

- 1 complete kit of a screw pump
- 1 set of tools, consisting of
 - 2 combination wrenches size 13, 25
 - 2 Allen keys size 2,5, 10
 - 2 screwdrivers
- 1 set of replacement parts, consisting of
 - 1 flange seal
 - 1 O-ring
 - 1 snap ring
- 1 tin of corrosion-proofing spray
- 1 box for small parts
- 1 tool box with foam inlay
- 1 set of instructional material, consisting of
 - technical description of system, complete set of drawings with individual parts and parts list, description of maintenance and repair processes, suggested exercises
 - 1 operator's manual for the industrial pump

Order Details

051.18200 MT 182 Assembly & Maintenance Exercise: Screw Pump

MT 183 Assembly & Maintenance Exercise: Diaphragm Pump



The illustration shows the tool box with kit and tools. The fully assembled pump is shown in the foreground.

- * **Practical exercise on the assembly and maintenance of a diaphragm pump**
- * **Comprehensive and well-structured instructional material**

Technical Description

Diaphragm pumps are positive displacement pumps and operate in an oscillatory manner, normally primed. Since diaphragm pumps operate absolutely leakage-free, they are particularly suitable - provided the appropriate pump materials are used - for handling aggressive fluids such as acids and caustic solutions as well as radioactive, combustible, odorous and toxic liquids. Another advantage is that they can run dry. Diaphragm pumps are often used for volumetric metering (metering pumps).

The materials used in the construction of the diaphragm pump employed here make it particularly suitable for use in chemical engineering. It is equipped with a stroke length adjuster, and is deployed as a metering pump.

The MT 183 kit forms part of the GUNT assembly, maintenance and repair practice line designed for training at technical colleges and in company training centres. A close link between theory and practice is key to the learning content. The kit is ideally suited to project-based learning with a particular emphasis on 'hands-on' work. Independent working by the students is assisted and encouraged. Learning in a small team offers a useful learning format.

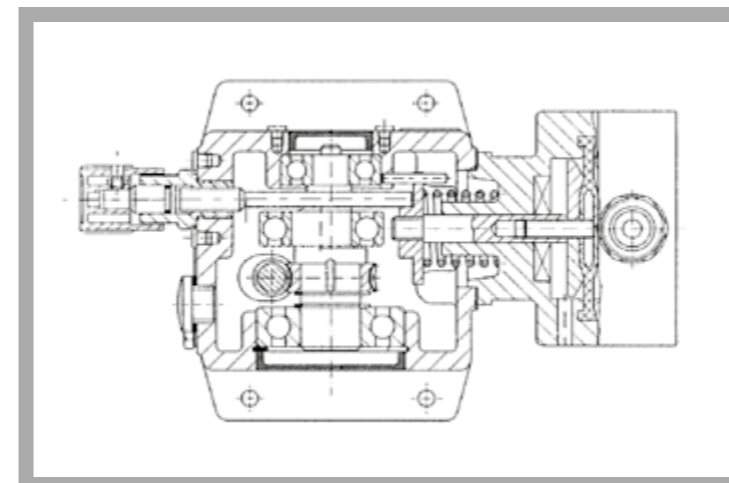
MT 183 enables a typical diaphragm pump to be assembled and maintained. Students become familiar with all the pump components and their modes of operation. The parts are clearly laid out in a toolbox. Systematic assembly and disassembly of a pump is practiced.

The instructional material details the individual steps involved in the exercise, and provides additional information on the areas of application, mode of operation and design of the pump.

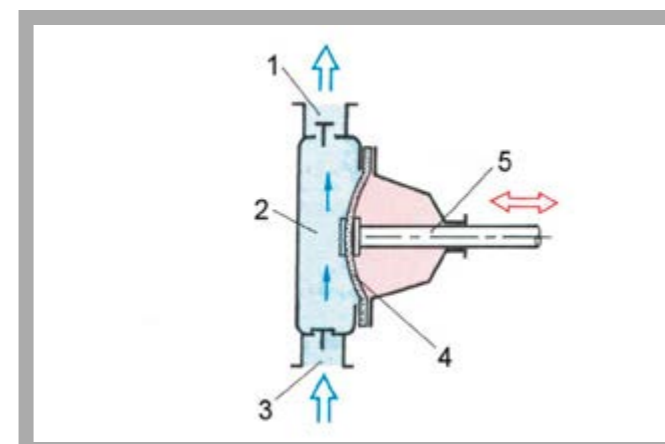
Learning Objectives / Experiments

- design and function of a diaphragm pump and its components
- assembly and disassembly for maintenance and repair purposes
- replacing components (e.g. seals or bearings)
- troubleshooting, fault assessment
- planning and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

MT 183 Assembly & Maintenance Exercise: Diaphragm Pump



Sectional drawing of the diaphragm pump



Operating principle of the single diaphragm pump: 1 outlet, 2 pumping chamber, 3 inlet, 4 diaphragm, 5 push rod



Assembly of the diaphragm pump: driving the eccentric into the housing (using a device)

Specification

- [1] learning concept for maintenance and repair exercises on a single-diaphragm pump
- [2] diaphragm and push rod directly linked
- [3] flow setting by manual stroke length adjustment (including during operation)
- [4] manual drive with crank instead of a drive motor
- [5] pump parts and tools housed in a tool box
- [6] the kit forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Diaphragm pump
- flow rate: 0...2,4L/h
- max. head: 100m
- nominal stroke rate at 50Hz: 156min⁻¹
- power consumption: max. 90W
- intake connection: DN5
- delivery connection: DN5
- pump materials
- pump body: Polypropylene (PP)
- double-ball valves: PP/glass fibre-reinforced plastic
- valve balls: glass
- valve seals: FPM
- drive diaphragm: PTFE-lined

Dimensions and Weight

- LxWxH: 690x360x312mm (tool box)
- Weight: approx. 15kg

Scope of Delivery

- 1 complete kit of a diaphragm pump
- 1 set of tools, consisting of
 - 4 combination wrenches size 22, 27, 2x8
 - 3 Allen keys size 2.5, 3, 4
 - 1 screwdriver; 1 bearing puller, three-arm
 - 1 set of forcing pliers for inner circlips
 - 1 set of forcing pliers for outer circlips
 - 1 soft-faced hammer
 - 2 striker sleeves for assembly/disassembly of bearings
- 1 hand drive
- 1 flange seal
- 1 tin of corrosion-proofing spray
- 1 box for small parts
- 1 tool box with foam inlay
- 1 set of instructional material, consisting of
 - technical description of system, complete set of drawings with individual parts and parts list, description of maintenance and repair processes, suggested exercises
 - 1 operator's manual for the industrial pump

Order Details

051.18300 MT 183 Assembly & Maintenance Exercise: Diaphragm Pump

MT 184 Assembly & Maintenance Exercise: Piston Pump



The illustration shows the tool box with kit and tools. The fully assembled pump is shown in the foreground.

- * **Practical exercise based on the assembly and maintenance of a piston pump**
- * **Comprehensive and well-structured instructional material**

Technical Description

Piston pumps are positive displacement pumps and operate in an oscillatory manner, normally primed. At constant speed, their characteristic is an almost vertical straight line; at different pressures the volumetric flow remains approximately constant.

The pump presented here is a dual-action piston pump. This means that each piston stroke is both an intake and delivery stroke. Typical applications of the pump dealt with here are the pumping of drinking and service water for domestic use, in agriculture, shipping, industry and gardening centres.

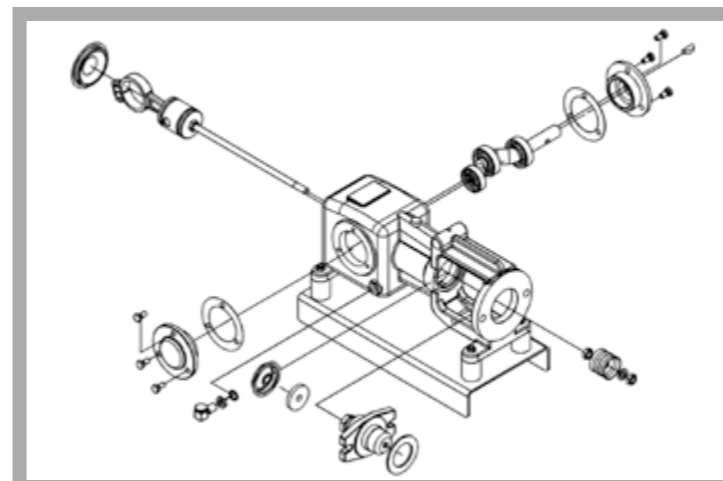
The MT 184 kit forms part of the GUNT assembly, maintenance and repair practice line designed for training at technical colleges and in company training centres. A close link between theory and practice is key to the learning content. The kit is ideally suited to project-based learning with a particular emphasis on 'hands-on' work. Independent working by the students is assisted and encouraged. Performing in a small team offers a useful learning format.

MT 184 enables a typical piston pump to be assembled and maintained. Students become familiar with all the pump components and their modes of operation. The parts are clearly laid out in a tool box. Systematic assembly and disassembly of a pump is practiced. The instructional material details the individual steps involved in the exercise, and provides additional information on the areas of application, mode of operation and design of the pump.

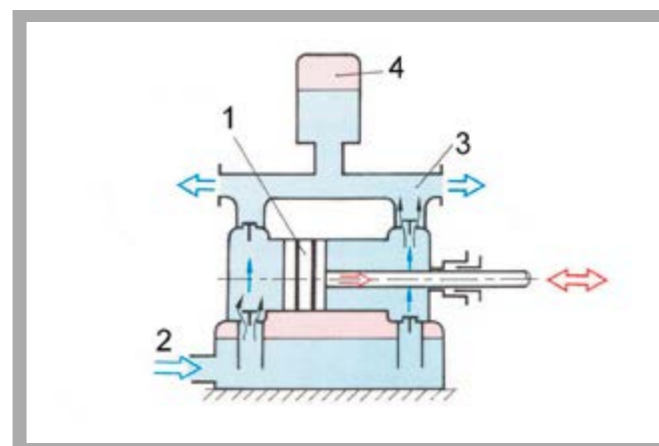
Learning Objectives / Experiments

- design and function of a piston pump and its components
- assembly and disassembly for maintenance and repair purposes
- replacing components (e.g. seals or bearings)
- troubleshooting, fault assessment
- planning and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

MT 184 Assembly & Maintenance Exercise: Piston Pump



Exploded-view drawing of the piston pump



Principle of a double-acting piston pump: 1 piston, 2 inlet, 3 outlet, 4 air vessel



Dissassembly of the piston pump: pulling off the ball bearing of the eccentric shaft (using a bearing puller)

Specification

- [1] learning concept for maintenance and repair exercises on a double-acting piston pump
- [2] air vessel to compensate for pressure surges
- [3] integrated safety valve returns a portion of the flow back to the intake side in event of overpressure
- [4] piston rod seal based on the gland principle
- [5] pump drive via V-belt pulley
- [6] pump parts and tools housed in a tool box
- [7] the kit forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Piston pump
- max. flow rate: 1000L/h
- max. head: 60m
- max. power consumption: 370W
- drive via V-belt, motor speed: 1450min⁻¹
- intake connection: 1"
- delivery connection: 1"

Dimensions and Weight

- LxWxH: 690x360x312mm (tool box)
- Weight: approx. 33kg

Scope of Delivery

- 1 complete kit of a piston pump
- 1 set of tools, consisting of
 - 6 open-end wrenches, size 13, 14, 19, 22, 2x size 10
 - 1 soft-faced hammer
 - 1 bearing puller, three-arm
 - 1 punch
 - 1 screwdriver
 - 1 wrench for pressure relief valve
 - 2 striker sleeves for assembly/disassembly of bearings
 - 1 brace to disassemble connecting rod bearing
- 1 base plate
- 1 sleeve packing for piston
- 1 set of replacement parts, consisting of
 - 1 sleeve packing for piston
 - 4 packing gland rings
 - 2 bearing cover seals
- 1 tin of corrosion-proofing spray
- 1 box for small parts
- 1 tool box with foam inlay
- 1 set of instructional material, consisting of
 - technical description of system, complete set of drawings with individual parts and parts list, description of maintenance and repair operations, suggested exercises
 - 1 operator's manual for the industrial pump

Order Details

051.18400 MT 184 Assembly & Maintenance Exercise: Piston Pump

MT 185 Assembly & Maintenance Exercise: In-Line Centrifugal Pump



The illustration shows the tool box with kit and tools. The fully assembled pump is shown in the foreground.

- * **Practical exercise on the assembly and maintenance of an in-line centrifugal pump**
- * **Comprehensive and well-structured instructional material**

Technical Description

In-line centrifugal pumps are rotodynamic pumps and operate normally primed. In-line pumps are installed in the straight runs of pipelines. The difference between an in-line pump and a standard pump is that the intake and delivery connections of an in-line pump are aligned on a single axis.

The in-line centrifugal pump presented here is used to pump mechanically and chemically non-aggressive liquids. Its range of applications include use in water supply, irrigation and sprinkler systems, and heating engineering systems.

The MT 185 kit forms part of the GUNT assembly, maintenance and repair practice line designed for training at technical colleges and in company training centres. A close link between theory and practice is key to the learning content. The kit is ideally suited to project-based learning with a particular emphasis on 'hands-on' work. Independent working by the students is assisted and encouraged. Performing exercises in a small team offers a useful learning format.

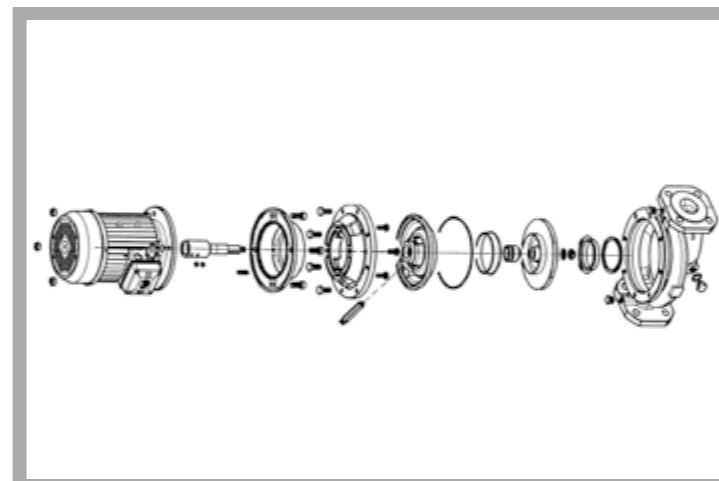
MT 185 enables a typical in-line centrifugal pump to be assembled and maintained. Students become familiar with all the pump components and their modes of operation. The parts are clearly laid out in a tool box. Systematic assembly and disassembly of a pump is practiced.

The instruction material details the individual steps involved in the exercise, and provides additional information on the areas of application, mode of operation and design of the pump.

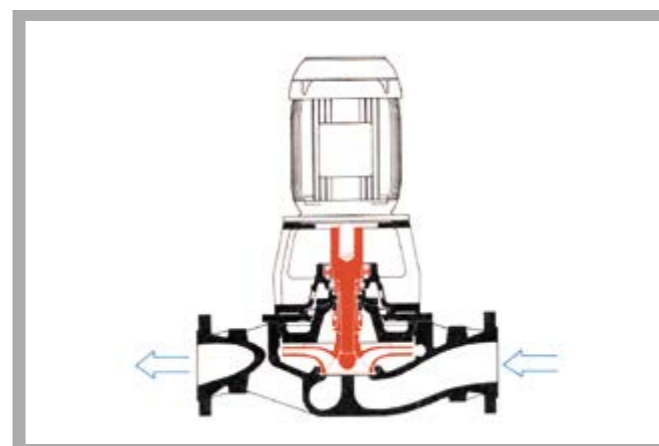
Learning Objectives / Experiments

- design and function of an in-line centrifugal pump and its components
- assembly and disassembly for maintenance and repair purposes
- replacing components (e.g. seals or bearings)
- troubleshooting, fault assessment
- planning and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

MT 185 Assembly & Maintenance Exercise: In-Line Centrifugal Pump



Exploded-view drawing of the in-line centrifugal pump



In-line centrifugal pump: intake and delivery connections on the same axis



Assembly of the in-line centrifugal pump: tightening the impeller nut

Specification

- [1] learning concept for maintenance and repair exercises on an in-line centrifugal pump
- [2] enclosed pump impeller with 5 blades, designed for pure liquids
- [3] pump shaft sealing with floating ring seal
- [4] pump drive by 3-phase AC motor
- [5] pump parts and tools housed in a tool box
- [6] the kit forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- In-line centrifugal pump
- power consumption: max. 750W
- max. flow rate: 19m³/h
- max. head: 16m
- speed: 2900min⁻¹
- intake connection: DN40
- delivery connection: DN40
- housing and impeller: grey cast iron
- Drive motor
- 400V, 50Hz, 3 phases; or 230V, 60Hz, 3 phases

Dimensions and Weight

- LxWxH: 690x360x312mm (tool box)
- Weight: approx. 40kg

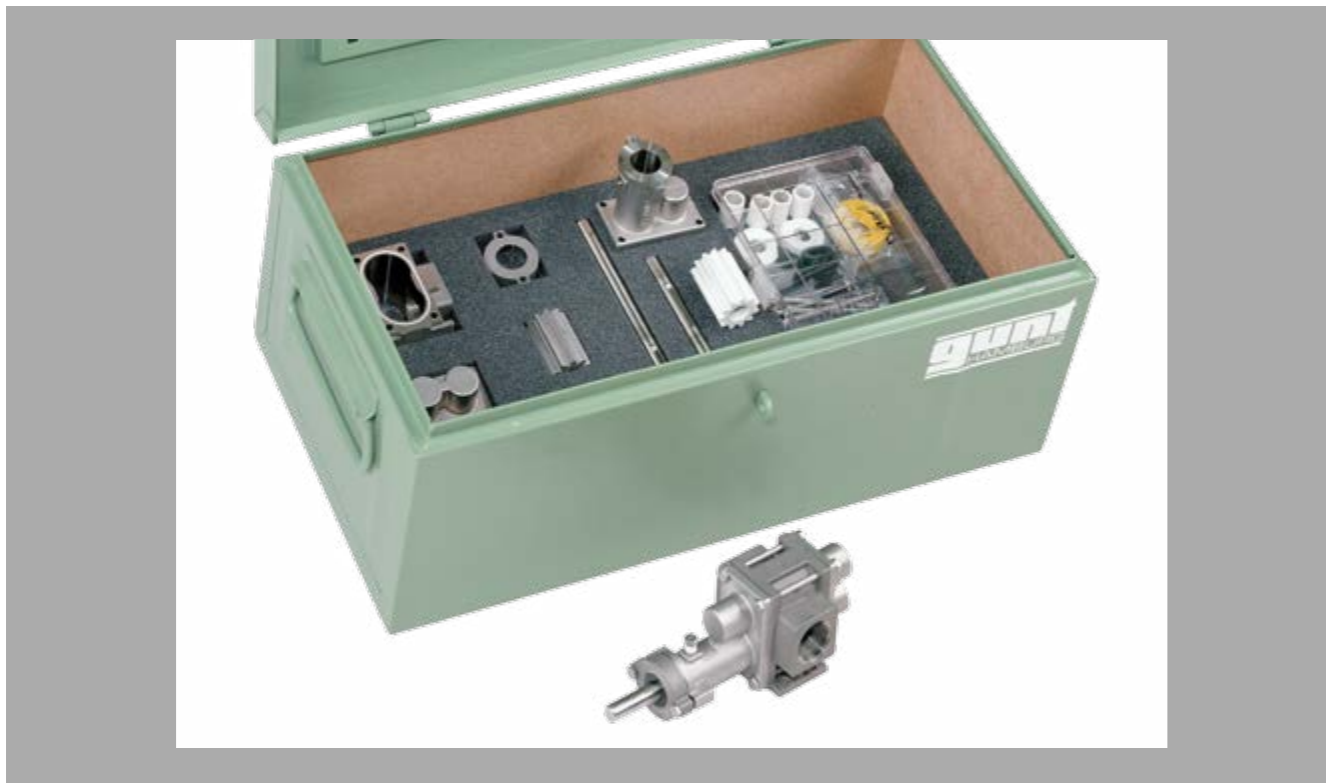
Scope of Delivery

- 1 complete kit of an in-line centrifugal pump
- 1 set of tools, consisting of
 - 5 combination wrenches size 13, 14, 17, 20, 22
 - 2 Allen keys size 3, 8
 - 1 screwdriver
- 1 sealing ring
- 1 box for small parts
- 1 tool box with foam inlay
- 1 set of instructional material, consisting of
 - technical description of system, complete set of drawings with individual parts and parts list,
 - description of maintenance and repair processes,
 - suggested exercises
- 1 operator's manual for the industrial pump

Order Details

051.18500 MT 185 Assembly & Maintenance Exercise: In-Line Centrifugal Pump

MT 186 Assembly & Maintenance Exercise: Gear Pump



The illustration shows the tool box with kit and tools. The fully assembled pump is shown in the foreground.

- * **Practical exercise on the assembly and maintenance of a gear pump**
- * **Comprehensive and well-structured instructional material**

Technical Description

Gear pumps are piston-type rotary pumps which operate on the positive-displacement principle. They are simple in design, and easy to handle. Gear pumps can generate operating pressures of up to 40bar and flow rates of up to 60m³/h. Their pulse-free delivery increases linearly with speed. High-viscosity media (oils, paints, adhesives, etc.) can also be pumped. Gear pumps are sensitive to hard solid-matter particles in the flow.

The materials used in the construction of the pump presented here make it resistant to most corrosive and aggressive chemicals. The plastic / metal gear wheel pairing results in relatively quiet running.

The MT 186 kit forms part of the GUNT assembly, maintenance and repair practice line designed for training at technical colleges and in company training centres. A close link between theory and practice is key to the learning content. The kit is ideally suited to project-based learning with a particular emphasis on 'hands-on' work. Independent working by the students is assisted and encouraged. Performing exercises in a small team offers a useful learning format.

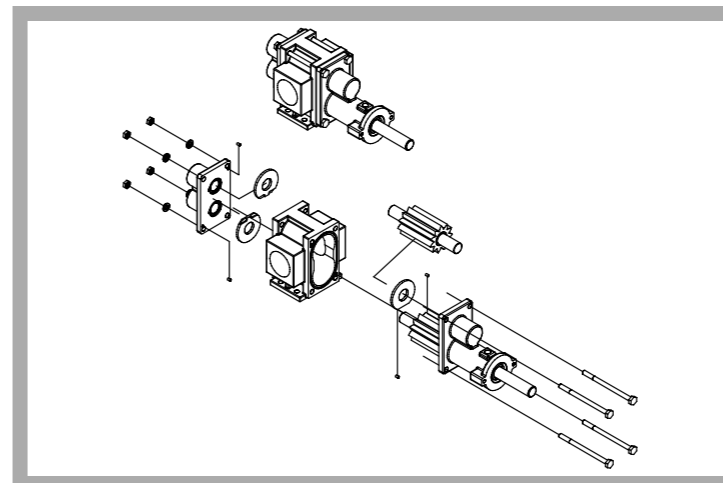
MT 186 enables a typical gear pump to be assembled and maintained. Students become familiar with all the pump components and their modes of operation. The parts are clearly laid out in a tool box. Systematic assembly and disassembly of a pump is practiced. The instructional material details the individual steps involved in the exercise, and provides additional information on the areas of application, mode of operation and design of the pump.

Learning Objectives / Experiments

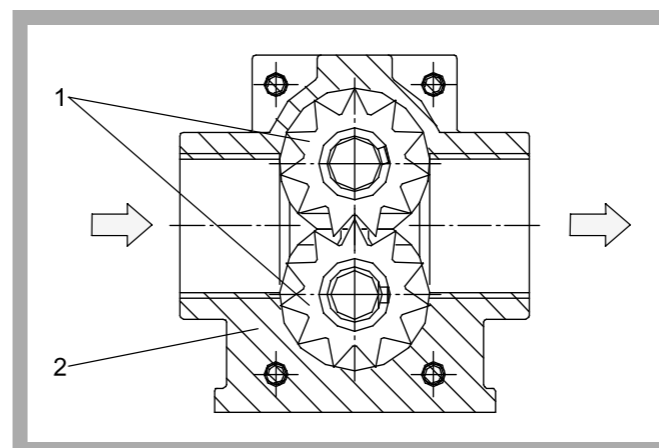
- design and function of a gear pump and its components
- assembly and disassembly for maintenance and repair purposes
- replacing components (e.g. seals)
- troubleshooting, fault assessment
- planning and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

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MT 186 Assembly & Maintenance Exercise: Gear Pump



Exploded-view drawing of the gear pump



Function of a gear pump: 1 gear pair, 2 housing



Assembly of the centrifugal pump: assembling the driving shaft

Specification

- [1] learning concept for maintenance and repair exercises on a gear pump
- [2] relatively quiet running owing to the plastic/metal gear wheel pairing
- [3] pump shaft sealing with floating ringseal
- [4] suitable for solids-free media with dynamic viscosity up to 0...10000mPas
- [5] pump parts and tools housed in a tool box
- [6] the kit forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Gear pump**
- power consumption: max. 2kW
 - max. flow rate: 80L/min
 - max. head: 70m
 - motor speed: 300...1750min⁻¹
 - intake connection thread: R 1 1/4"
 - delivery connection thread: R 1 1/4"
 - pump materials
 - housing: stainless steel 316 (1.4401)
 - gear wheels: stainless steel 316 (1.4401)/PTFE
 - wearing plates: PTFE
 - bearings: PTFE
 - speed-dependent viscosities
 - n=300min⁻¹: 10000mPas,
 - n=1750min⁻¹: 3000mPas

Dimensions and Weight

- LxWxH: 690x360x312mm (tool box)
- Weight: approx. 20kg

Scope of Delivery

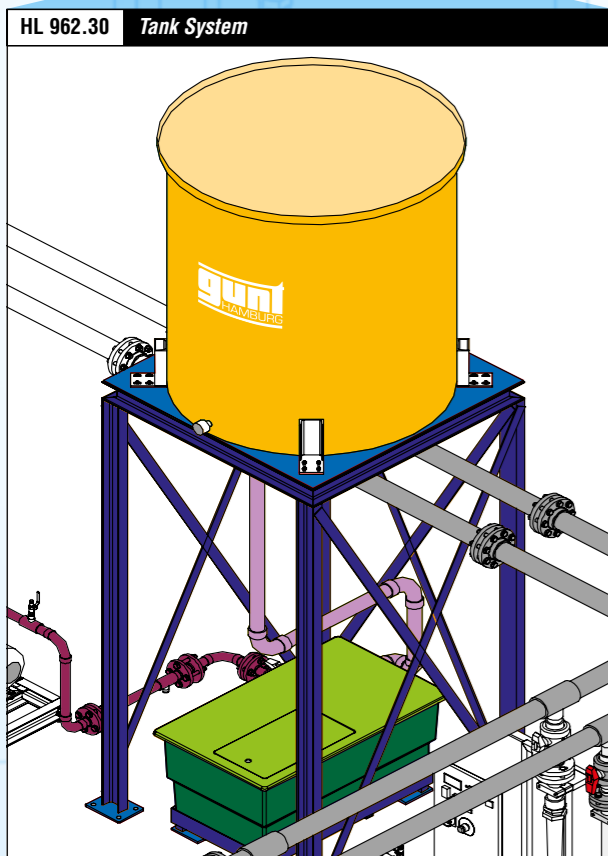
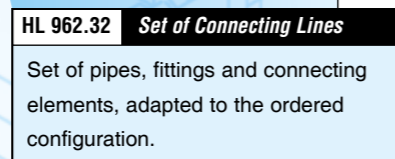
- 1 complete kit of a gear pump
- 1 set of tools, consisting of
 - 2 combination wrenches size 11
 - 1 hexagonal screwdriver, size 3/32"
 - 2 screwdrivers
 - 1 round wire snap ring for shafts
- 1 roll of PTFE sealing tape
- 1 box for small parts
- 1 tool box with foam inlay
- 1 set of instructional material, consisting of
 - technical description of system, complete set of drawings with individual parts and parts list, description of maintenance and repair operations, suggested exercises
 - 1 operator's manual for the industrial pump

Order Details

051.18600 MT 186 Assembly & Maintenance Exercise: Gear Pump

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HL 962 ASSEMBLY AND MAINTENANCE EXERCISES: PIPES, FITTINGS, PUMPS



The practice and training system is based entirely on industrial technologies. It presents a complex project task for the training of piping and plant fitters as well as for maintenance mechanics. The planning and practical procedures may take several days.

The training system is particularly suitable for action-oriented project work in small groups of students. Detailed technical documentation, allied to didactic instruction, forms the basis for a successful learning process.

The HL 962 assembly stand for pumps is the main element of the training system. It can facilitate the installation of different centrifugal pumps (HL 962.01 – HL 962.04) and also provides the drive. Other key subassemblies are the tank installation for water supply (HL 962.30) and the piping system, constructed with the set of pipework and connection elements (HL 962.32). This then creates a complete system with a closed water circuit.

Multiple assemblies with identical or different pumps can be integrated into the network.

LEARNING CONTENT

Planning and construction of a complex piping and pump system to transport water

Different connecting techniques in piping construction, assembly techniques, assembly aids

Configuration and modification of the complete system

Electrical connections of a pump drive and control, display and operating components

Familiarisation with plant components:

- Different pumps and their drive systems
- Components of piping systems
- Fittings, connecting and sealing elements, measuring devices

Aligning the pump and drive motor

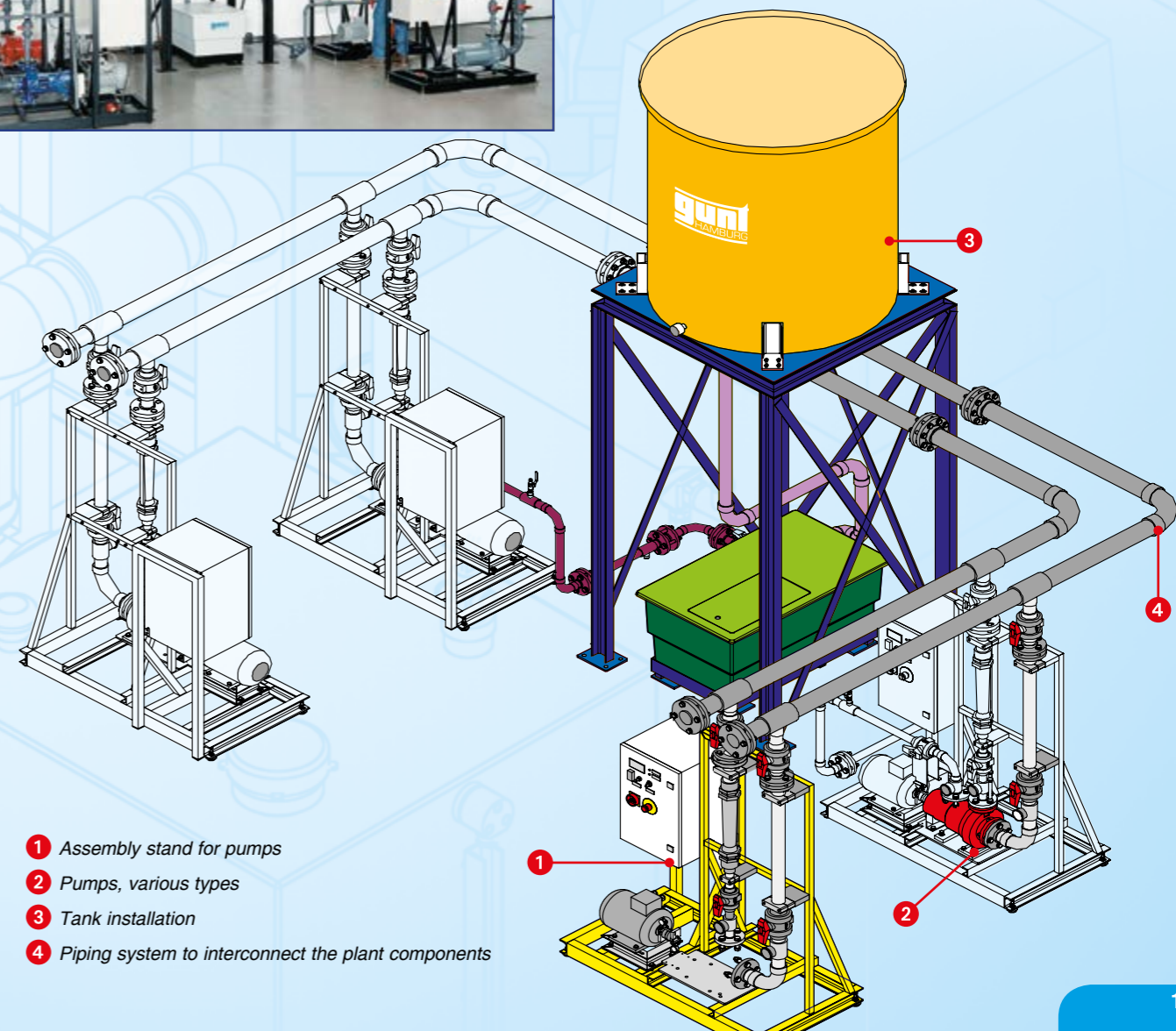
Operational measurements in piping and pump systems

Familiarisation with different materials utilised in the manufacture of plant equipment

Maintenance tasks and operations

Reading and understanding technical documents, such as drawings, schematic diagrams, or original operating instructions

Familiarisation with commissioning procedures



- 1 Assembly stand for pumps
- 2 Pumps, various types
- 3 Tank installation
- 4 Piping system to interconnect the plant components

HL 962 Assembly Stand for Pumps



The illustration shows a similar unit.

- * **Mounting of different pumps (available as accessories)**
- * **Alignment of motor and pump by different methods**
- * **Base unit when constructing a complex piping system**

Technical Description

The individual steps for repairing driven machines such as pumps are: removal and installation of pumps for inspection, repair or replacement; aligning the drive and commissioning and checking the pump, e.g. for leaks.

In conjunction with the HL 962.30 tank system, the HL 962.32 connecting pipes and one of the four HL 962.01 – HL 962.04 pumps, the HL 962 assembly stand forms a complete training system for complex piping and plant systems. The training system forms a closed water circuit.

The assembly stand HL 962 includes a three-phase asynchronous motor with frequency converter as the drive and pipes with valves to adjust the pressure. A pump from the accessory equipment is attached to the base plate of the assembly stand and connected to the drive and the pipes. The pumps that are available as accessories are typical centrifugal pumps used in process engineering.

The position of the asynchronous motor can be adjusted in three directions for alignment purposes. The alignment can either be checked in a conventional manner with a straight edge or with the reverse alignment method using two dial gauges. Non-contact, microprocessor-aided methods can also optionally be used (specific alignment systems are not included in the scope of delivery).

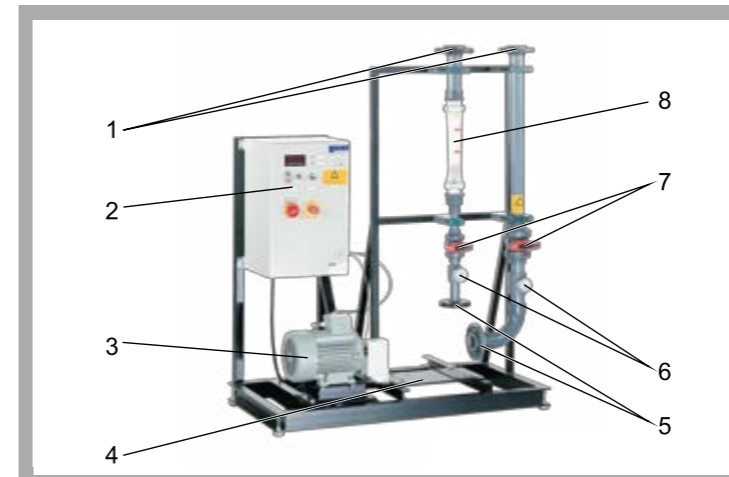
Manometers indicate the pressures upstream and downstream of the pump. The flow rate is measured with a rotameter. Speed and power output of the motor are indicated on digital displays.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

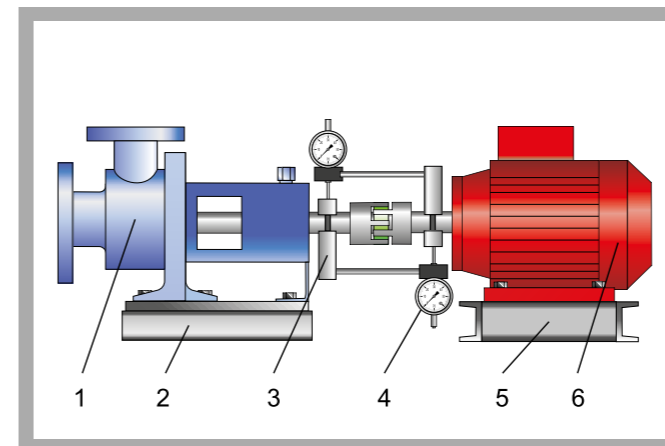
Learning Objectives / Experiments

- in conjunction with an accessory pump (standard chemicals pump HL 962.01, canned motor pump HL 962.02, side channel pump HL 962.03, standard chemicals pump with magnetic clutch HL 962.04) and a suitable water supply, e.g. HL 962.30 with HL 962.32
- mounting of the pump and alignment of the electric motor
- familiarisation with various methods of aligning the motor and pump
- commissioning and leak testing
- recording a pump characteristic
- comparison of various pump types (only if multiple pumps are available)

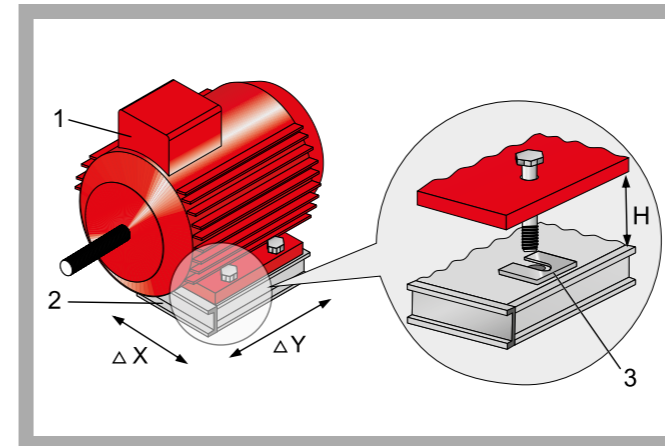
HL 962 Assembly Stand for Pumps



1 flange connections to connect HL 962 to HL 962.30, 2 switch box with displays and controls, 3 electric motor, 4 mounting plate for test pump, 5 flange connections for test pump, 6 manometer, 7 valve, 8 flow meter



1 HL 962.01 pump, 2 pump base plate, 3 bracket for dial gauge, 4 dial gauge, 5 motor base plate, 6 electric motor



Aligning the electric motor (height, x and y direction):
1 electric motor, 2 base plate, 3 fitting plates to adjust the height H

Specification

- [1] stand for mounting of various pumps
- [2] asynchronous motor with variable speed via frequency converter
- [3] electric motor with positioning frame and fit plates for alignment
- [4] base plate prepared for mounting of various pumps
- [5] alignment of motor and pump with straight-edge or by dial gauges
- [6] switch box with speed adjuster and digital display of speed and power output
- [7] frame with adjustable feet for levelling
- [8] PVC piping
- [9] water supply from tank system HL 962.30
- [10] the system forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Three-phase AC asynchronous motor
- power output: 4kW, speed range: 0...1450min⁻¹
- Connecting flanges for water supply
- intake side: DN50
- delivery side: DN50
- intake side channel pump: DN32
- Fit plates as motor chocks
- 43x43mm
- 4 different thicknesses: 0,1-0,2-0,5-1,0mm, 20 of each

Measuring ranges

- pressure (inlet): -1...1bar
- pressure (outlet): 0...16bar
- rotameter: 0...11m³/h
- speed: 0...3000min⁻¹
- power meter: 0...4kW
- dial gauge: 0...3mm, resolution: 0,01mm

Dimensions and Weight

LxWxH: 1300x750x1800mm
Weight: approx. 220kg

Required for Operation

400V, 50/60Hz, 3 phases or 230V, 60Hz, 1 phase

Scope of Delivery

- 1 assembly stand
- 1 set of tools
- 1 set of measuring aids: 2 dial gauges with attachment, 1 straight-edge
- 80 fit plates, differing thicknesses
- 1 set of instructional material

Order Details

065.96200 HL 962 Assembly Stand for Pumps

HL 962.01 Standard Chemicals Pump



* Centrifugal pump according to ISO 5199 as accessory for installation in assembly stand HL 962

Technical Description

The standard pump used here is a centrifugal pump commonly used in the chemical and process engineering industries. The media being carried are often corrosive, toxic, explosive or volatile, or are carried at very high or very low temperatures. This places extreme stress on the pump.

The standard pump is a single-stage spiral casing pump in process configuration. The process configuration ensures quick and easy exchanging of wearing parts. The spiral housing is the most common design for single-stage pumps. Its design is precisely adapted to the flow of the pump. This enables the optimum efficiency levels to be attained. The hydraulic design and connecting dimensions of the pump conform to ISO 2858; the technical requirements are to ISO 5199.

Learning Objectives / Experiments

- in conjunction with HL 962, HL 962.30 and HL 962.32
- operation of a standard pump
- recording the pump characteristic
- leak testing
- alignment of pump and drive motor

Scope of Delivery

1 pump, 1 instruction manual

Specification

- [1] centrifugal pump as accessory for installation in HL 962
- [2] drive and water supply provided by HL 962
- [3] process configuration permits easy exchange of wearing parts
- [4] pump hydraulic design according to ISO 2858
- [5] pump technical requirements according to ISO 5199

Technical Data

- Centrifugal pump (at nominal speed: 1450min⁻¹)
- max. flow rate: 9,5m³/h
- max. head: 9,5m
- power consumption: 0,5kW
- Connecting flange
- delivery side: DN32
- intake side: DN50
- Materials
- housing, impeller: grey cast iron
- shaft: stainless steel

Dimensions and Weight

LxWxH: 570x240x300mm
Weight: approx. 43kg

Order Details

065.96201 HL 962.01 Standard Chemicals Pump

HL 962.02 Canned Motor Pump



* Hermetic centrifugal pump, particularly suitable for pumping liquid gases
* Accessory for installation in assembly stand HL 962

Technical Description

Canned motor pumps are used primarily in process engineering to pump aggressive, toxic, fire-hazard, explosive, delicate or volatile liquids (such as liquid gases). They are also suitable for pumping extremely hot or cold products, and liquids under high system pressure or under vacuum.

The pump is a fully self-contained centrifugal pump with no shaft seal, the drive is provided electro-magnetically via the canned motor. Its design means it is completely leak-tight and largely maintenance-free. Part of the primary flow is branched off by way of a self-cleaning filter to cool the motor and lubricate the journal bearings, and to provide hydraulic compensation for the axial thrust. After passing through the hollow shaft and the rotor chamber, the cooling medium is returned to the primary flow on the delivery side.

Learning Objectives / Experiments

- in conjunction with HL 962, HL 962.30 and HL 962.32
- operation of a canned motor pump
- recording the pump characteristic
- leak testing

Scope of Delivery

1 pump, 1 instruction manual

Specification

- [1] hermetic pump for aggressive liquids
- [2] accessory for installation in HL 962
- [3] drive: three-phase squirrel-cage motor
- [4] water supply provided by HL 962
- [5] maintenance-free pump

Technical Data

- Canned motor pump
- max. flow rate: 12m³/h
- max. head: 39m
- power consumption: 3kW
- nominal speed: 2900min⁻¹
- Connecting flange
- delivery side (radial): DN32
- intake side (axial): DN50

Dimensions and Weight

LxWxH: 510x240x305mm
Weight: approx. 62kg

Required for Operation

400V, 50Hz, 3 phases

Order Details

065.96202 HL 962.02 Canned Motor Pump

HL 962.03 Side Channel Pump



The illustration shows the pump with a fitting from HL 962.30 on the intake (grey elbow + manometer).

- * **Self-priming three-stage centrifugal pump**
- * **Accessory for installation in assembly stand HL 962**

Technical Description

Side channel pumps are self-priming centrifugal pumps, and are in widespread use. They can attain relatively high pressures at low flow rates. They are able to intake and deliver liquids containing gases. The pump can be started even when there is no head of liquid in the intake pipe. The side channel stage removes the air from the intake pipe and generates the necessary suction to intake the liquid.

The pump used here is three-stage. Drive and water supply are provided by the assembly stand HL 962.

Learning Objectives / Experiments

- in conjunction with HL 962, HL 962.30 and HL 962.32
- operation of a side channel pump
 - recording the pump characteristic
 - leak testing
 - alignment of pump and drive

Scope of Delivery

1 pump, 1 instruction manual

Specification

- [1] three-stage self-priming pump for installation in HL 962
- [2] drive and water supply provided by HL 962
- [3] pump can intake and deliver air/water mixture
- [4] relatively high head at low flow rate

Technical Data

- Side channel pump
- 3 stages
 - max. flow rate: 4,5m³/h
 - max. head: 122m
 - power consumption: 3kW
 - nominal speed: 1450min⁻¹
 - max. speed: 1800min⁻¹
- Connecting flange
- delivery side: DN32
 - intake side: DN50
- Materials
- housing: grey cast iron
 - shaft: stainless steel

Dimensions and Weight

LxWxH: 470x220x240mm
Weight: approx. 30kg

Order Details

065.96203 HL 962.03 Side Channel Pump

HL 962.04 Standard Chemicals Pump with Magnetic Clutch



- * **Hermetic centrifugal pump according to ISO 5199**
- * **Accessory for installation in assembly stand HL 962**

Technical Description

Magnetic drive pumps are used primarily in process engineering to pump aggressive, toxic and flammable liquids. Leakage of such liquids could result in major problems. Its design means it is completely leak-tight, even at continuous operation and under difficult usage conditions.

The viscosity of the delivered liquid is a key criterion in selecting a pump, as it determines the coupling torque to be transmitted. The torques transmitted by magnetic couplings are limited. As a result, magnetic drive pumps are not suitable for all operating conditions and media.

The pump is a fully self-contained centrifugal pump with no shaft seal. It is fitted with a permanent-magnetic synchronous drive complete with clutch. Drive and water supply are provided by the assembly stand HL 962.

Learning Objectives / Experiments

- in conjunction with HL 962, HL 962.30 and HL 962.32
- operation of a standard chemicals pump with magnetic clutch
 - recording the pump characteristic
 - leak testing
 - alignment of pump and drive

Scope of Delivery

1 pump, 1 instruction manual

Specification

- [1] single-stage centrifugal pump with magnetic clutch as accessory for installation in HL 962
- [2] drive and water supply provided by HL 962
- [3] permanent-magnetic synchronous drive inside pump
- [4] pump technical requirements according to ISO 5199

Technical Data

- Pump (at nominal speed: 2900min⁻¹)
- max. flow rate: 12m³/h
 - max. head: 39m
 - power consumption: 3,7kW
- Connecting flange
- delivery side: DN32
 - intake side: DN50

Dimensions and Weight

LxWxH: 625x240x300mm
Weight: approx. 60kg

Order Details

065.96204 HL 962.04 Standard Chemicals Pump with Magnetic Clutch

HL 962.30 Tank System



The illustration shows the complete layout of a pump system, comprising four HL 962 assembly stands, each with one pump (HL 962.01 - HL 962.04), the piping system HL 962.32 and the tank system HL 962.30.

- * Water supply for a complex piping and pump system
- * Large high-level tank for normally primed pumps
- * Low-level tank for self-priming pumps

Technical Description

The HL 962 assembly stands are connected with piping elements from HL 962.32 to form a complex piping and pump system. The tank system HL 962.30 is required so that the system can operate as a closed process.

The tank system consists of a large high-level tank with a mounting frame, a low-level tank and connections with shut-off devices to the PVC piping system HL 962.32.

The high-level tank has a capacity of approximately 1,5m³ of water. A manometer close to the base of the tank measures the base pressure, thereby indicating the fill level. The high-level tank supplies the intake pipes of normally primed centrifugal pumps, and ensures an adequate inflow head. Its inlet and outlet distribution points are located at a height of about 2m.

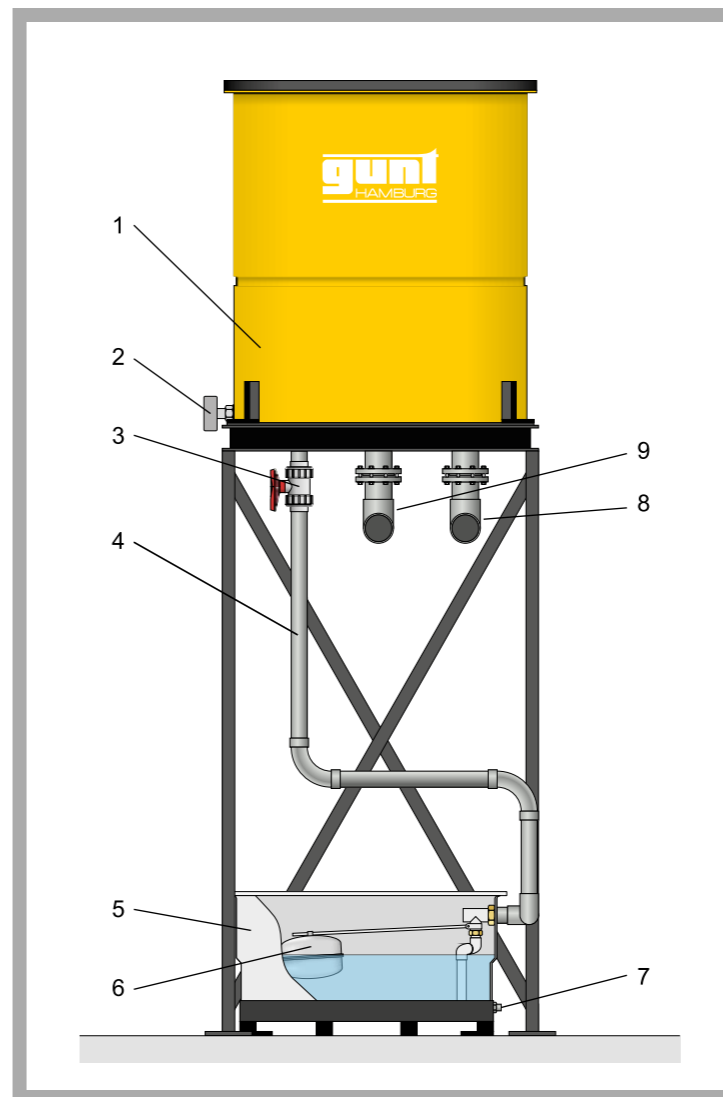
The low-level tank is also supplied with water from the high-level tank. It is used for the self-priming side channel pump. A float valve ensures an adequate water level. All pumps transfer the water back to the high-level tank via the piping system.

All materials in the tank system are fully corrosion-proof, as they are all manufactured from plastic.

The assembly stand (HL 962), tank system (HL 962.30) and piping system (HL 962.32) are interconnected by way of flanges. It is possible to expand the system and connect more assembly stands.

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HL 962.30 Tank System



1 high-level tank, 2 manometer, 3 ball valve, 4 pipe to low-level tank, 5 low-level tank, 6 float valve, 7 connection for side channel pump, 8 distributor tank outlet, 9 distributor tank inlet

Specification

- [1] water supply for a complex piping and pump system
- [2] high-level tank with cover and manometer on solid frame for supply to normally primed pumps
- [3] low-level tank with cover and float valve to supply the self-priming side channel pump HL 962.03
- [4] PVC piping to supply the low-level tank from the high-level tank
- [5] connection between the HL 962.30, HL 962.32 and HL 962 elements via flanges
- [6] high-level tank with frame

Technical Data

- High-level tank with cover
- capacity: 1500L
- material: polyethylene
- distributor to pipes in base
- height of delivery side distributor: approx. 2m
- 1 manometer on supply tank: 0...1,6mWC
- Low-level tank with cover
- capacity: 280L
- material: glass fibre-reinforced plastic
- 2 manometers to check the pressure at inlet of the side channel pump HL 962.03: -1...1,5bar
- PVC pipes from HL 962.32
- tank inlet and outlet: DN80
- connection to side channel pump: DN32

Dimensions and Weight

LxWxH: 1350x1350x3860mm
Weight: approx. 350kg

Scope of Delivery

- 1 mounting frame
- 1 high-level tank with cover
- 1 low-level tank with cover
- 1 PVC pipe to interconnect the two tanks
- 1 set of assembly drawings

Order Details

065.96230 HL 962.30 Tank System

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RT 395 Maintenance of Valves and Fittings and Actuators



The illustration shows RT 395 with 3 of 4 fittings (segmented ball valve not shown).

- * **Trainer for maintenance work on industrial valves and fittings**
- * **Comparison of 4 different actuators**

Technical Description

Various types of valves and fittings are used in industry. They are suitable for gaseous and liquid media.

A distinction is made between valves, plug valves, gates and butterfly valves. Plug valves isolate a pipeline quickly, acting transverse to the flow. A quarter revolution is sufficient for full actuation. Valves adjust the flow rate and require several turns of the spindle for full opening or closing. Gates are not intended to seal off the pipeline completely, but serve to restrict the flow. When one of these valves and fittings is combined with a driving mechanism, the resulting control device is known as an actuator.

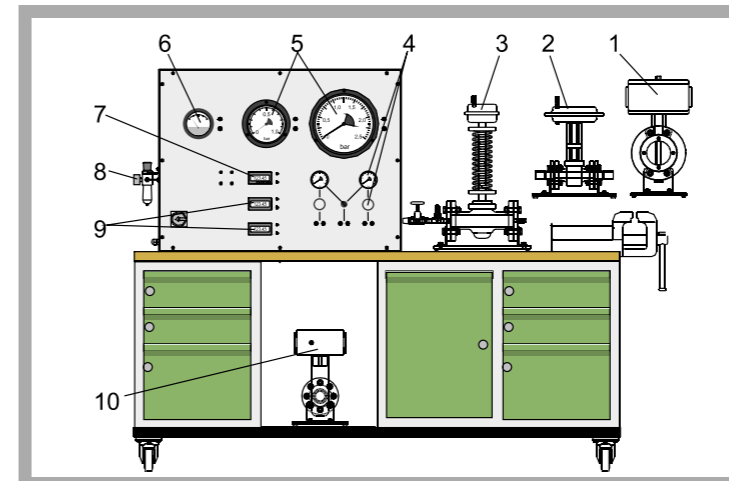
RT 395 presents three various types of valves and fittings. The trainer investigates the operating response of a segmented ball valve, a butterfly valve, a pneumatic control valve and a pressure reducing valve. The switch cabinet allows the necessary electrical and pneumatic parameters to be set to test and calibrate the valves and fittings. Instruments indicate pneumatic pressures, voltage and current. There is a vice on the workbench for maintenance and assembly work. The workbench also incorporates the necessary tools, and small parts such as seals, for the carrying out of testing procedures.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

Learning Objectives / Experiments

- function and mode of operation of various valves and fittings
- * pneumatic butterfly valve
- * pneumatic segmented ball valve
- * pneumatic control valve with electro-pneumatic positioner
- * pressure reducing valve
- pneumatic connection
- electrical connection
- familiarisation with linear and equal-percentage valve characteristics
- planning, execution and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

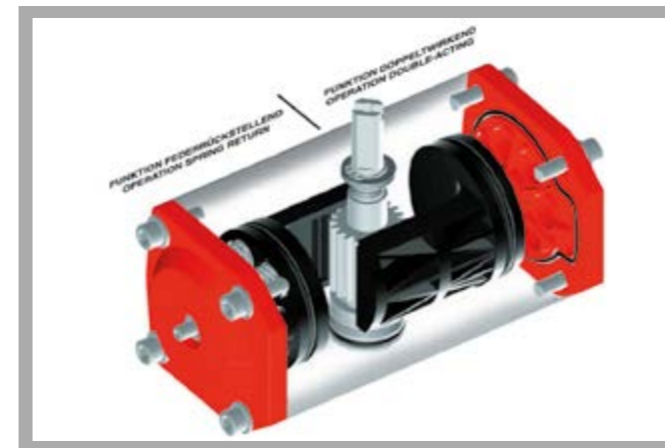
RT 395 Maintenance of Valves and Fittings and Actuators



1 butterfly valve, 2 pneumatic control valve, 3 pressure reducing valve, 4 fine pressure regulator with manometer, 5 manometer, 6 differential pressure meter, 7 display of adjustable current source, 8 compressed air maintenance unit, 9 digital displays for voltage and current, 10 segmented ball valve



Segmented ball valve with single-action pneumatic swivel drive



Principle of a swivel drive
left: spring-return; right: dual-action

Specification

- [1] maintenance work on industrial valves and fittings
- [2] pneumatic control valve with electro-pneumatic positioner DN25 / PN16
- [3] butterfly valve with swivel drive DN100 / PN16
- [4] pressure reducing valve DN15 / PN16
- [5] segmented ball valve with swivel drive DN40 / PN16
- [6] 2 compressed air ranges, adjustable by fine pressure regulator
- [7] instrumentation: analogue pressure meter, digital ammeter and voltmeter
- [8] electric signal transmitter for positioner in the form of an adjustable current source
- [9] the trainer forms part of the GUNT assembly, maintenance and repair training line

Technical Data

Pneumatic swivel drive
- single-action with spring return

Measuring ranges

- pressure (bourdon tube manometer)
 - 0...1,0bar (D=160mm)
 - 0...1,6bar (D=60mm, fine pressure regulator)
 - 0...2,5bar (D=250mm)
 - 0...6,0bar (D=60mm, fine pressure regulator)
- differential pressure: 0...10kPa
- current (digital display): 0...20mA
- voltage (digital display): 0...20VDC

Dimensions and Weight

LxWxH: 2200x750x1660mm
Weight: approx. 321kg

Required for Operation

230V, 50/60Hz, 1 phase or 120V, 60Hz/CSA, 1 phase
Compressed air connection: 8bar

Scope of Delivery

- 1 workshop trolley with cabinets under and switch cabinet
- 1 butterfly valve
- 1 pneumatic control valve
- 1 pressure reducing valve
- 1 segmented ball valve
- 1 manometer
- 1 set of cables
- 1 set of compressed air hoses
- 1 set of tools and small parts (bolts, seals etc.)
- 1 set of instructional material

Order Details

080.39500 RT 395 Maintenance of Valves and Fittings and Actuators

RT 396 Pump and Valves and Fittings Test Stand



- * Plotting characteristics of industrial valves and fittings
- * Comparison of different valves and fittings
- * Characteristics of a centrifugal pump

Technical Description

RT 396 allows the characteristics of different valves and fittings to be compared. The typical kinds of valves and fittings are represented by a ball valve, a butterfly valve, a gate valve, a shut-off valve and a control valve. A safety valve and a dirt trap are also investigated. All valves and fittings are flanged, and can be installed in a pipe section with variable length. The pipe section is part of a closed water circuit. Pressure measurement points upstream and downstream of the valve and fitting under test are linked by a differential pressure manometer. This manometer is fitted with a pressure switch which activates a warning lamp if the pressure difference becomes excessive, such as when the filter is clogged. An electromagnetic flow rate sensor permits precise recording of the flow rates.

The closed water circuit contains three butterfly valves, to isolate the pump, and to adjust the pressure upstream and downstream of the test fitting. Differential pressures across the pump and test fitting, the power consumption and speed of the pump, and the flow rate and opening angle of the control valve are recorded and displayed. The measured data can also be used to plot pump characteristics.

A vice is included, on a separate workbench, for maintenance and assembly work. The workbench also incorporates the necessary tools and connecting hoses.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

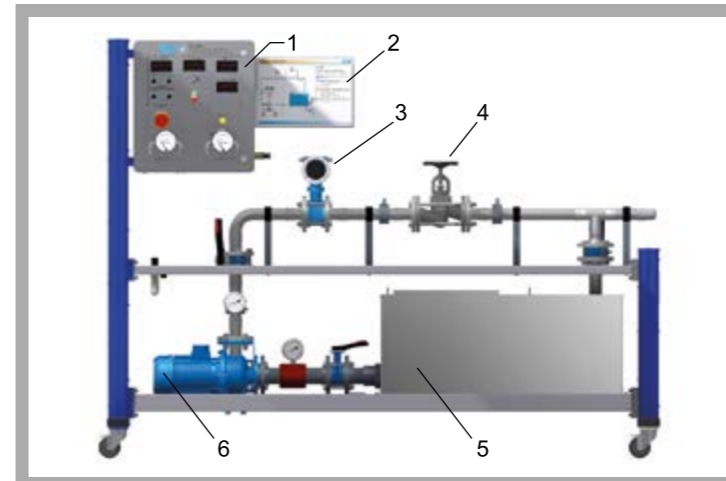
Learning Objectives / Experiments

- characteristics of a centrifugal pump
- behaviour during operation and function of
 - * ball valve
 - * butterfly valve
 - * shut-off valve
 - * wedge gate valve
 - * control valve
 - * safety valve
 - * dirt trap
- valve characteristics
- determining the Kvs value of the control valve
- pressure losses at the dirt trap depending on the filter

and its load

- planning, execution and assessment of maintenance and repair operations
- reading and understanding engineering drawings and operating instructions

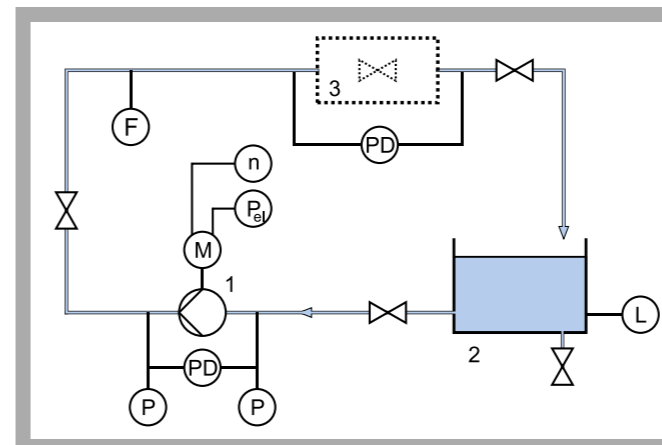
RT 396 Pump and Valves and Fittings Test Stand



1 switch cabinet with displays and controls, 2 process schematic, 3 flow rate sensor, 4 pipe section with place for test fitting, 5 supply tank, 6 pump



Supplied valves and fittings: 1 dirt trap, 2 ball valve, 3 safety valve, 4 butterfly valve, 5 shut-off valve, 6 wedge gate valve, 7 control valve



1 pump, 2 tank, 3 test fitting; sensors: E power, F flow rate, L level, P pressure, PD differential pressure, n speed

Specification

- [1] trainer for testing various valves and fittings
- [2] installation of the test fitting in a pipe section of variable length
- [3] centrifugal pump with variable speed via frequency converter
- [4] fine pressure regulator adjusts compressed air pressure
- [5] tank cover as collecting tray under test device
- [6] manometers at inlet and outlet of centrifugal pump
- [7] pressure measuring points upstream and downstream of test device for differential pressure manometer with pressure switch
- [8] digital displays for flow rate, power output, speed, position of control valve

Technical Data

- Centrifugal pump
 - power consumption: 4kW
 - max. flow rate: 72m³/h
 - max. head: 26,5m
 - speed: 1450...2900min⁻¹
- Supply tank with cover: capacity: 400L
- Test valves and fittings:
 - safety valve 1", 1,5bar
 - shut-off valve DN50 / PN16
 - ball valve with pneumatic drive DN50
 - butterfly valve DN50 / PN16
 - wedge gate valve DN50 / PN16
 - electric control valve DN50 / PN16
 - dirt trap DN50 / PN16 with 2 filter elements

Measuring ranges

- differential pressure manometer: 0...2,5bar / 0...4bar
- manometer: 0...4bar / -1...0,6bar
- flow rate: 35...1100L/min
- opening range of control valve: 0...100%
- power output: 0...4000W
- speed: 0...2900min⁻¹

Dimensions and Weight

- LxWxH: 2510x790x1900mm (test stand)
- Weight: approx. 245kg (test stand)
- LxWxH: 1200x670x1100mm (workbench)
- Weight: approx. 100kg (workbench)

Required for Operation

- 400V, 50/60Hz, 3 phases
- Compressed air supply 8bar

Scope of Delivery

- 1 trainer with centrifugal pump
- 1 control valve, 1 dirt trap, 1 safety valve, 1 shut-off valve, 1 ball valve, 1 butterfly valve, 1 wedge gate valve
- 1 workbench with tools and hoses
- 1 set of instructional material

Order Details

080.39600 RT 396 Pump and Valves and Fittings Test Stand

MT 210 Assembly & Maintenance Exercise: Refrigeration



Technical Description

Using MT 210 trainees can learn working within a complex project. This involves the planning, implementation and checking of processes related to assembly, commissioning and maintenance. The assembly relates to refrigeration installation: installation of the LP and HP pressure switches, the expansion valve and the pipework of the refrigeration circuit. The pipe joints are not soldered but bolted. The electrotechnical installation includes the wiring and connection of all units and switching elements.

For assembly the tool set ET 150.02, for commissioning the system the filling and evacuation equipment ET 150.01 are required.

The fully assembled system MT 210 represents a fully functional, temperature-controlled refrigeration system with refrigeration chamber and electrical thermostat. Repeated assembly and disassembly are possible.

The experiment is arranged on a workbench with drawers for storing the components and tools. Assembly panel and refrigeration chamber are mounted on a frame. Frame, condensing unit and switch cabinet are bolted permanently to the working surface. The refrigeration and electrical components are attached to the aluminium assembly panel.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the exercises.

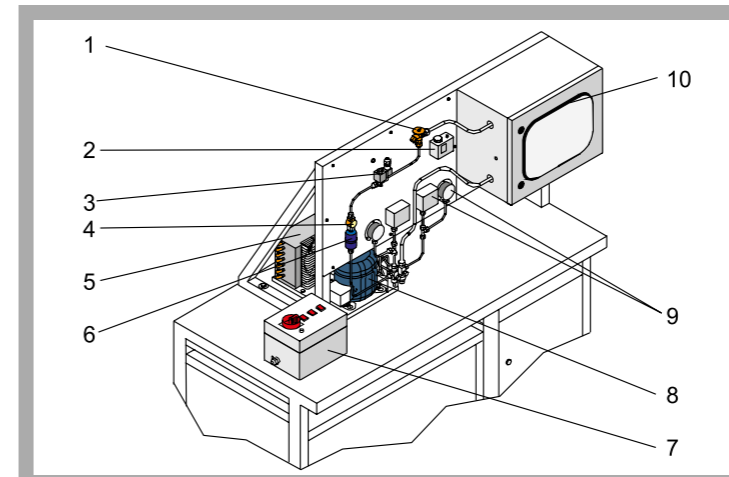
Learning Objectives / Experiments

- reading and understanding technical documentation
- planning and executing assembly steps and processes
- making pipe joints in accordance with a system diagram
- carrying out electrical installation in accordance with a circuit diagram
- commissioning and checking the refrigeration system after successful assembly (in conjunction with ET 150.01)
- familiarisation with the function of a refrigeration system as a system and its components as system components
- fault analysis: fault finding, fault evaluation and repair
- planning, executing and evaluating maintenance processes

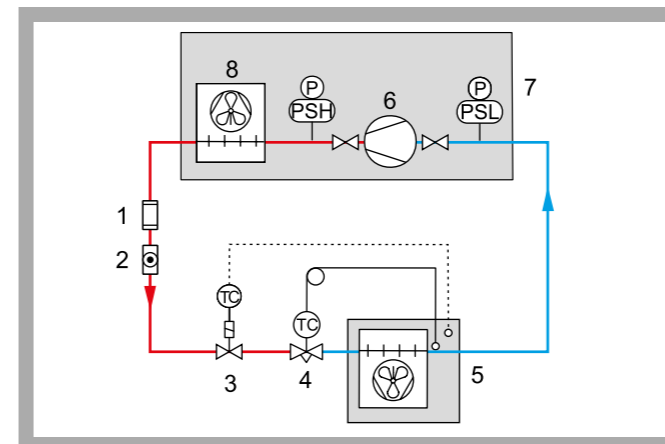
In conjunction with ET 150.01
 - evacuating and filling refrigeration systems

- * Study project with high practical relevance
- * Suitable for training in metal and electrical professions
- * Interdisciplinary and covering several subject areas
- * Setup of a refrigeration system from individual components

MT 210 Assembly & Maintenance Exercise: Refrigeration



1 expansion valve, 2 thermostat, 3 solenoid valve, 4 sight glass, 5 condenser with fan, 6 filter/drier, 7 switch cabinet, 8 compressor, 9 pressure switch with manometer, 10 refrigeration chamber with sight window and integrated evaporator



1 filter/drier, 2 sight glass, 3 thermostat, 4 expansion valve, 5 refrigeration chamber with evaporator, 6 compressor, 7 condensing unit, 8 condenser; P pressure, PSL, PSH pressure switch; blue: low pressure, red: high pressure



Leak test at the expansion valve of the fully assembled system

Specification

- [1] assembly project for the training of mechatronics engineers for refrigeration
- [2] setup of a refrigeration system with refrigeration chamber from a complete set of components
- [3] temperature control via thermostat
- [4] air-cooled condensing unit with compressor
- [5] refrigeration chamber with integrated show case evaporator and fan
- [6] refrigeration chamber with large sight window
- [7] assembly panel to mount the refrigeration and electrical components
- [8] electrical assembly in accordance with the circuit diagram
- [9] easy pipeworking of the refrigeration circuit using bolted pipe joints
- [10] workbench with drawers to store the components
- [11] refrigerant R134a, CFC-free
- [12] the training set is part of the GUNT practical series for assembly, service and maintenance

Technical Data

Condensing unit
 - power consumption: 190W
 - refrigeration capacity: 373W at 5°C evaporation temperature
 - receiver: approx. 1L
 Show case evaporator
 - capacity: 50W at $t_0 = -6^\circ\text{C}$, $\Delta T = 8\text{K}$
 - transfer area: 1,06m²
 Refrigeration chamber with sight window
 - LxWxH: 480x280x390mm
 Aluminium assembly panel
 - LxW: 710x500mm
 Thermostatic expansion valve, adjustable
 Thermostat, adjustable: -30...15°C

Dimensions and Weight

LxWxH: 1530x750x1670mm
 Weight: approx. 155kg

Required for Operation

230V, 50Hz, 1 phase or 120V, 60Hz, 1 Phase

Scope of Delivery

1 workbench with drawers, switch cabinet, condensing unit, assembly panel and refrigeration chamber
 1 kit consisting of all necessary components and installation material
 1 set of instructional material, consisting of: technical system description, set of drawings with individual components and parts list, description of the assembly, service and maintenance processes

Order Details

051.21000 MT 210 Assembly & Maintenance Exercise: Refrigeration

MT 190

Assembly Project: Materials Tester



* **Highly practice-oriented assembly project for training in the metalworking trades**

* **Assembly kit to build a unit for carrying out materials testing experiments**

* **Range of tasks can be expanded to include electronic data acquisition (MT 190.01)**

* **Comprehensive, well-structured instructional material**

Technical Description

The fully assembled MT 190 system presents an actual fully functional materials tester which can be used for a wide range of materials testing. The test force is generated using a hand-operated hydraulic system. The test force is displayed using a large dial gauge indicator. The elongation of the test specimen is recorded on a dial gauge.

Using MT 190, students can develop skills in the carrying out of complex project work. In the course of the project they independently develop an appreciation for the fundamentals and correlations involved, then contribute to the overall outcome using teamworking skills. The skills acquired are the planning, execution and checking of assembly, commissioning, and maintenance operations.

MT 190 is supplied in kit form. The kit contains all the mechanical components, measuring devices, hydraulic components complete with sealing elements, and piping material complete with all connecting elements.

The assembly process involves basic mechanical construction, hydraulic assembly of the two cylinders, and assembly of the piping. All the necessary tools and aids, as well as comprehensive instructional material, are included.

Learning Objectives / Experiments

- reading and understanding technical documentation
- planning and execution of assembly operations and sequences
- familiarisation with machine elements and components
- commissioning and checking of a materials tester following assembly
- planning, execution and assessment of maintenance operations
- fault analysis: troubleshooting, fault assessment and repair

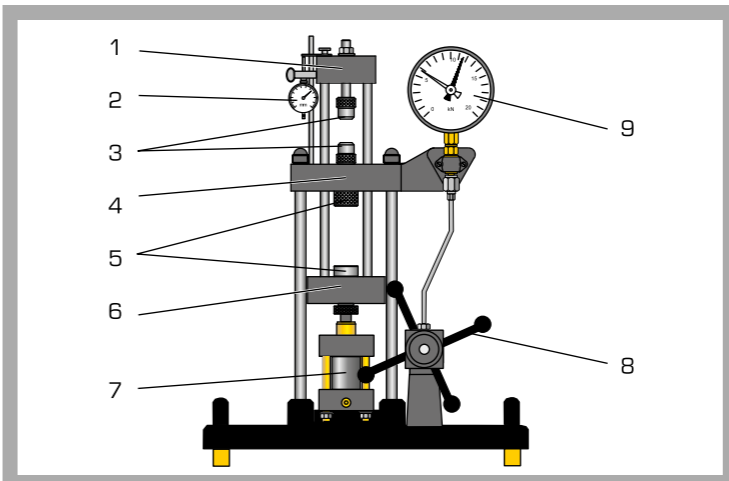
After assembly:

- tensile test of metallic specimens
- recording of stress-elongation diagrams
- Brinell hardness test

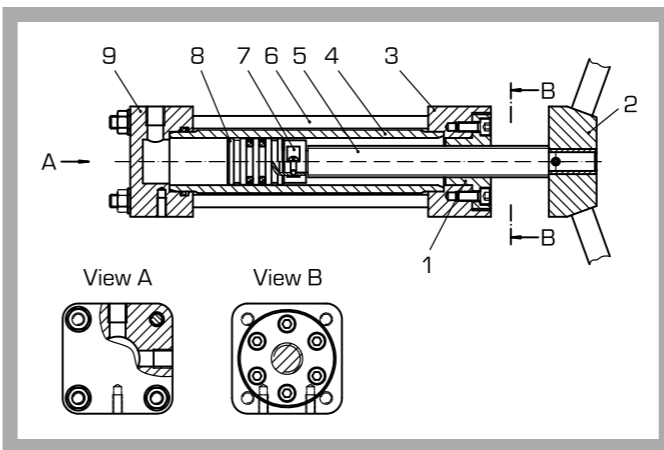
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MT 190

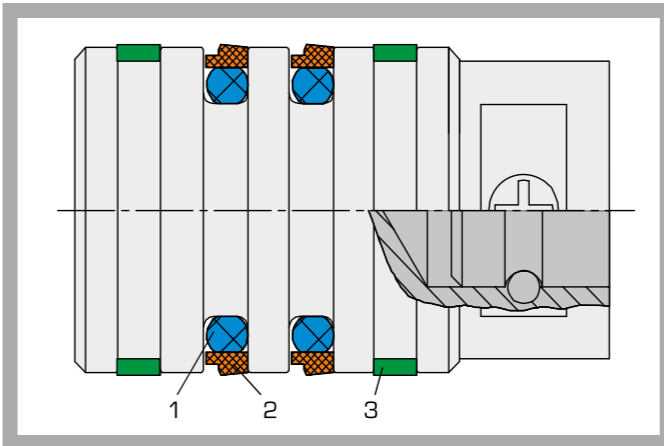
Assembly Project: Materials Tester



1 top cross-member, 2 dial gauge for deformation travel, 3 grip heads, 4 crosshead, 5 thrust pad and compression plate, 6 bottom cross-member, 7 hydraulic master cylinder, 8 hand wheel, 9 force indicator



Sectional drawing of the horizontal hydraulic cylinder: 1 trapezoidal nut, 2 hand wheel axle, 3 crank side flange, 4 cylindrical tube, 5 trapezoidal threaded spindle, 6 clamping bolt, 7 retainer, 8 piston, small, 9 delivery side flange



Piston in detail: 1 O-ring, 2 piston sealing ring, 3 guide ring

Specification

- [1] assembly project for training in the metalworking trades
- [2] complete set of parts for a universal materials tester
- [3] force generation using hand-operated hydraulic system, no power supply necessary
- [4] cross-member frame with ground steel pillars, compressive and tensile force can be generated
- [5] precise pillar guide located in linear ball bearings
- [6] hydraulic assembly of 2 cylinders
- [7] hydraulic system piping assembly
- [8] grey cast iron machine base
- [9] 2 measuring gauges: displacement dial gauge and dynamometer
- [10] space available for test specimens 165x65mm
- [11] complete assembly tool kit
- [12] the assembly project forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Max. test force: 20kN
- Max. stroke: 45mm
- Space available for test specimens: 165x65mm
- Dynamometer: 0...20kN, graduations: 0,5kN
- Displacement gauge: 0...20mm, graduations: 0,01mm
- Tensile specimens: B6x30 DIN 50125
- Test sphere diameter for Brinell test: D=10mm

Dimensions and Weight

- LxWxH: 610x520x850mm (assembled)
- Weight: approx. 51kg

Scope of Delivery

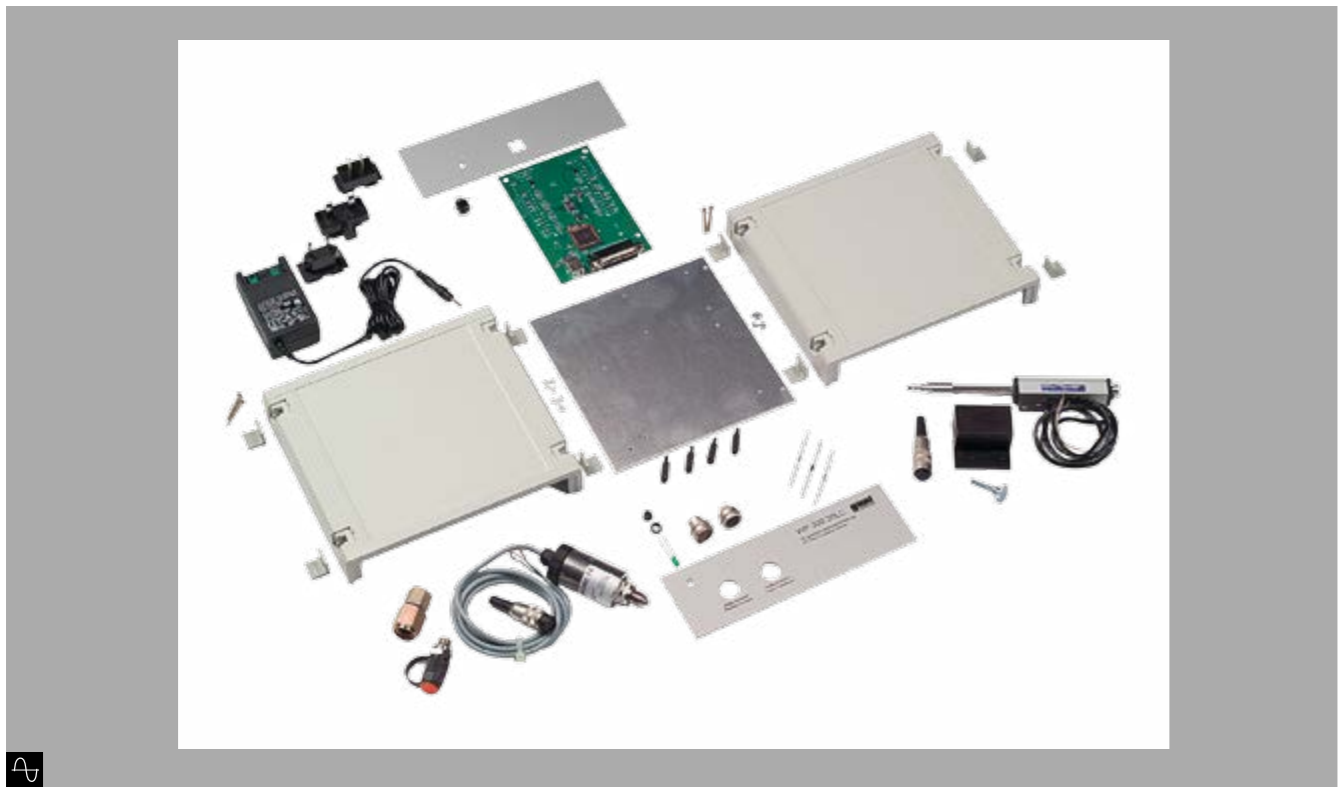
- 1 complete set of materials tester parts
- 1 dynamometer
- 1 displacement dial gauge
- 1 set of tools and assembly aids
- 1 set of small and replacement parts (e.g. seals)
- 1 set of tensile specimens
- 1 set of instructional material, consisting of
 - technical description of system, complete set of drawings with individual parts and parts list,
 - description of maintenance and repair processes,
 - suggested exercises

Order Details

051.19000 MT 190 Assembly Project: Materials Tester

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MT 190.01 Assembly Project: Data Acquisition for Materials Tester



- * Educational project with high practical affinity for training in metalworking and electrical trades
- * Interdisciplinary mechanical and electrical engineering assembly kit covering multiple learning fields
- * Fully functional data acquisition for a materials tester with USB port and software

Technical Description

The fully assembled MT 190.01 presents a real, fully functional data acquisition system for the measurement of pressure (forces) on, and changes in length of, a test specimen. The acquired data is processed by evaluation software on a PC. The data acquisition system significantly enhances the possibilities offered by the MT 190 assembly project. The two systems together form a state-of-the-art materials tester with data acquisition, suitable for a wide range of experiments.

Using MT 190.01, students can develop skills in the completion of a complex project. In the course of the project they independently develop an appreciation for the fundamentals and correlations involved, then contribute to the overall outcome using their teamworking skills. The skills acquired are the planning, execution and checking of assembly, commissioning, and maintenance operations.

MT 190.01 is supplied in kit form. The kit contains all the components and materials required to construct a professional data acquisition system.

The assembly process includes the basic mechanical construction and wiring as per the circuit diagram. All the necessary tools and aids, as well as comprehensive instructional material, are included.

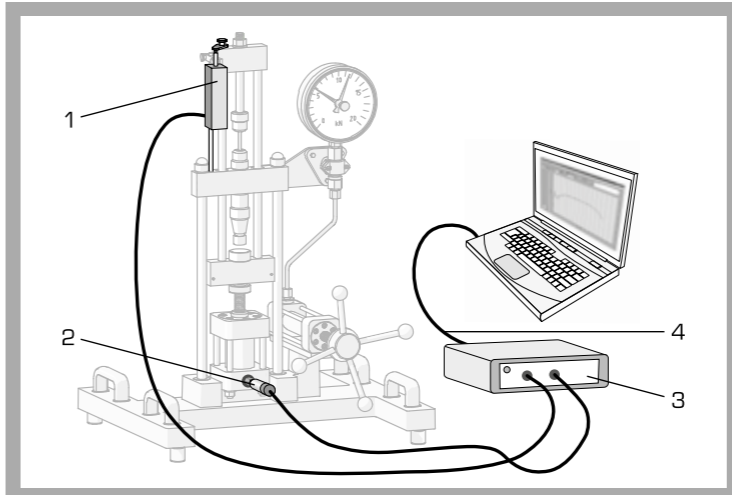
Learning Objectives / Experiments

- fundamentals of data acquisition
- familiarisation with sensors, electronics for recording and outputting data, interfacing, software
- reading and understanding technical documentation
- planning and execution of assembly operations and sequences
- commissioning and checking a data acquisition system following assembly
- system integration: linking of materials tester and data acquisition

- In conjunction with MT 190
- recording of force-elongation diagrams and stress-strain diagrams
 - processing, display and storage of data
 - output of diagrams to printer

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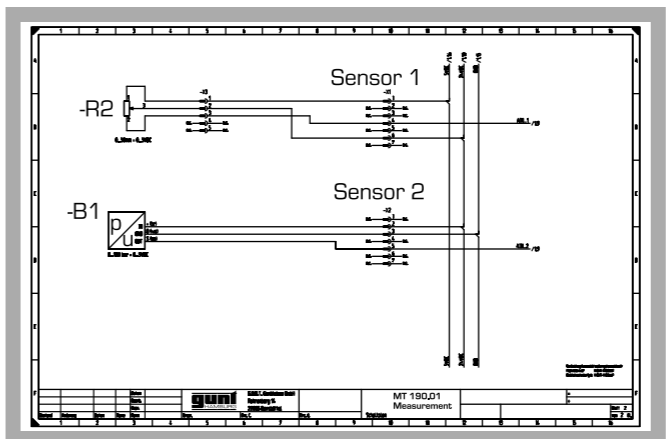
MT 190.01 Assembly Project: Data Acquisition for Materials Tester



Connection of data acquisition system to base unit: 1 displacement sensor, 2 pressure sensor for force measurement, 3 measuring amplifier, 4 USB cable



Fully assembled data acquisition system with software CD
foreground: left: pressure sensor; right: displacement sensor



Circuit diagram: connection of pressure and displacement sensors

Specification

- [1] assembly project for training in metalworking and electrical trades
- [2] complete parts set to construct a data acquisition system for a materials tester
- [3] assembly tool kit
- [4] linear potentiometer to measure displacement
- [5] force measurement by pressure sensor
- [6] GUNT software for data acquisition via USB under Windows Vista or Windows 7
- [7] software for acquisition, processing and storage of stress-strain diagrams
- [8] the assembly project forms part of the GUNT assembly, maintenance and repair practice line

Technical Data

- Pressure sensor for force measurement
 - 0...100bar
- Displacement sensor
 - 0...50mm
- Measuring amplifier with USB port
 - input: 0...5V
 - resolution: 12bit

Dimensions and Weight

LxWxH: 225x200x75mm (amplifier)
Weight: approx. 5kg

Scope of Delivery

- 1 complete set of measuring amplifier parts
- 1 pressure sensor, 1 displacement sensor
- 1 set of assembly tools
- 1 data acquisition program
- 1 set of instructional material, consisting of technical description of system, complete set of drawings with individual parts and parts list, circuit diagram, description of maintenance and repair processes, suggested exercises

Order Details

051.19001 MT 190.01 Assembly Project: Data Acquisition for Materials Tester

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GUNT training systems are proved and tested for many, many years. Go ahead and apply them.

Developping technical and professional skills in maintenance

Establishing fundamentals

Performing assembly exercises

Getting familiar with real-life maintenance procedures

ASSEMBLY PROJECTS – MAINTENANCE



You educate apprentice tradesmen in technical schools and factories...

...we offer you practice-oriented teaching and training systems for your education relating to

Assembly

Maintenance

Repair

INDUSTRIAL TRAINING AND VOCATIONAL QUALIFICATION

Maintenance is a Key Area in Apprentice Training

Plant and machinery should be operational...
 Therefore maintenance is an essential part of production and machine management.
 ...not sitting idle



You must have:
 :: Strategies and methods in place
 :: Qualified and trained staff
 GUNT supports you with our proven teaching systems regarding Assembly Projects and Maintenance. Our service will help you to make the education of your staff much more practice-oriented. This is hands-on tuition in practice.



A Selection of Assembly Exercises



MT 152 MT 154 GL 430

...there is much more at GUNT. On the following pages we show you some detailed examples.



MT 156 MT 157 MT 158



MT 140.02 MT 140.01 MT 110.02



MT 180 MT 181 MT 182



MT 183 MT 184 MT 185

Learning Concepts Relating to Industrial Maintenance

The maintenance

of industrial plant and machinery is a key field of activity for technicians and skilled tradesmen working in mechanical and electrical engineering.

Key area in technical training

The level of attention devoted to the subject of maintenance by the curricula is therefore high.

TEACHING AND LEARNING SYSTEMS RELATING TO MAINTENANCE

GUNT-Gerätebau GmbH offers you a wide range of wholly practice-oriented teaching and training systems relating to technical maintenance with which you can cover essential learning content:

Use of specific manufacturer's documentation for maintenance, inspection and repair	Planning and assessing maintenance sequences and steps
Reading and understanding engineering drawings	Practical execution and documentation of maintenance operations
Familiarisation with machine and system components	Testing and commissioning of repaired systems
Understanding maintenance as the interaction between inspection, maintenance and repair	Assessment of malfunctions, detection of faults

The GUNT training systems are ideally suitable for students' group working, and of course for project-oriented working methods.



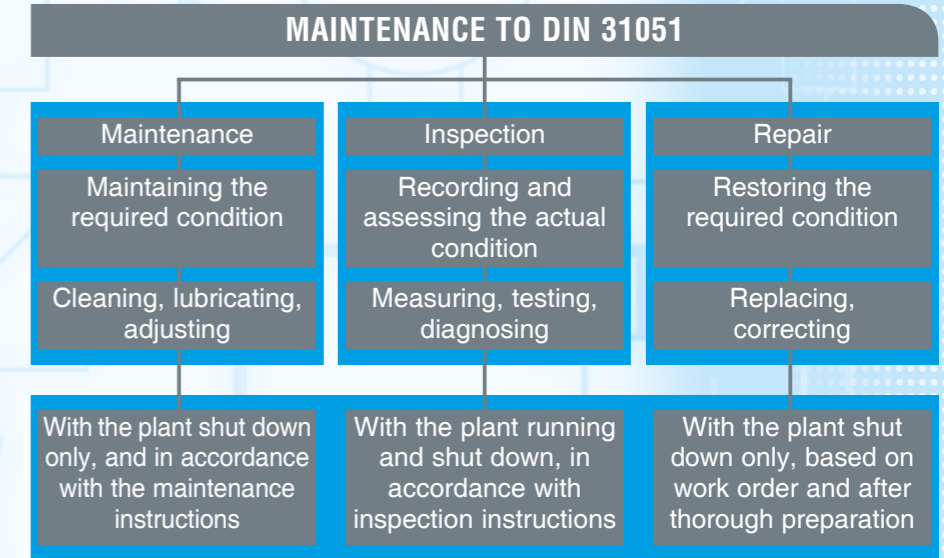
Things don't have to get this bad



It's possible to do something in time

What is maintenance?

'Maintenance' as defined by German industry standard DIN 31051 is a complex field, so the range of teaching and training systems we offer in this area is very diverse.



This theme should be read in close conjunction with the GUNT catalogue no. 2

LEARNING THROUGH PRACTICE...

This chapter deals with the process of familiarisation with component and their functions, reading and understanding engineering drawings or operating instructions, and familiarisation with technical terminology and language. The assembly exercises can be conducted in relatively short periods of time (within lesson units) and do not as yet require any particular technical experience. Fault diagnosis and maintenance measures are not yet central to the training systems.

MACHINERY DIAGNOSIS

The teaching systems familiarise trainees with the specific methods of monitoring plant/machinery condition, such as the early detection of bearing or gear damage. We work primarily with vibration analysis methods which constitute diagnostic steps for preventive maintenance or targeted repair.

MAINTENANCE

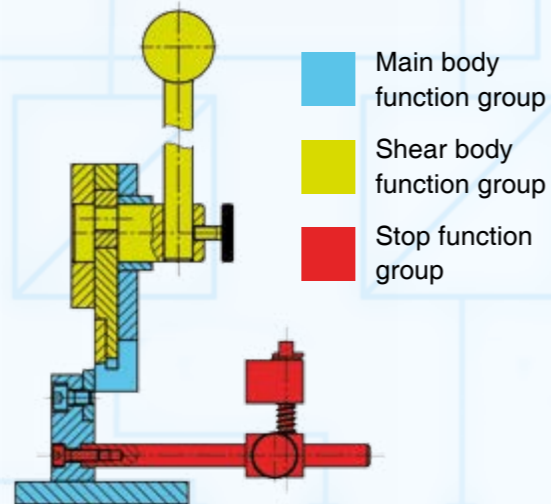
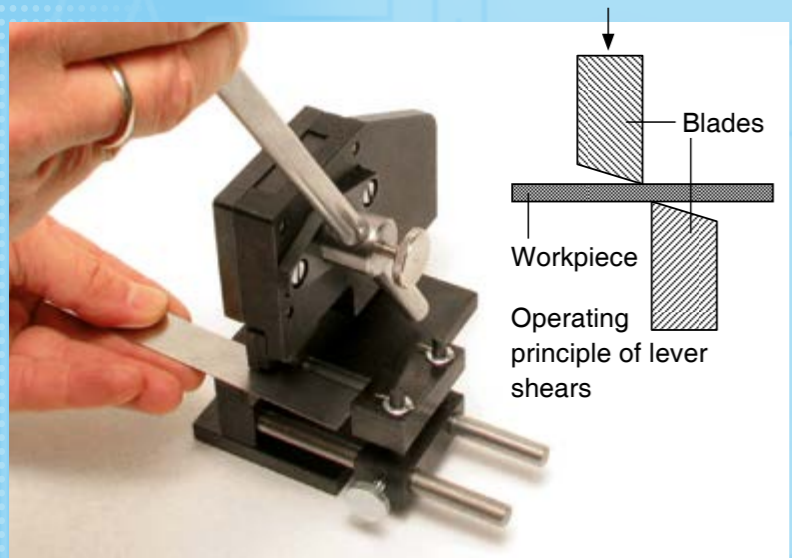
The real, industrial nature of the exercises is higher than in the Assembly Projects. Typical maintenance methods and testing procedures are offered as learning content. Some of the exercises take a lot of time to complete and amount to substantial project work. Demands are made on technical skills.

ASSEMBLY PROJECTS

...SO THE THEORY IS EASY!

TZ 200.71 Lever Shears Assembly Kit

Coverage of the fundamentals:
An assembly kit for introducing a course



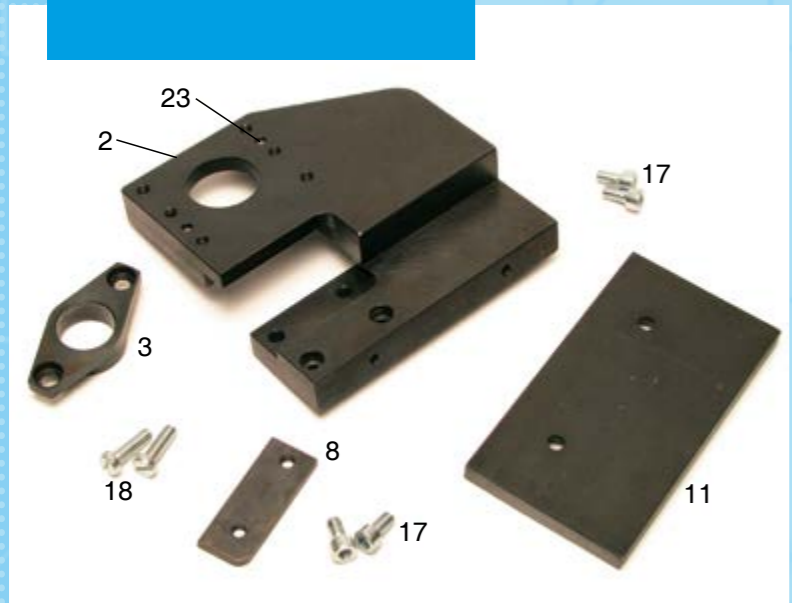
Lever shears function groups

Function group	Partial function	Movement
Main body	Carries, supports and guides all other parts	None
Stop	Sets the length to be cut off	None
Shear body	Transmits the shearing force to the workpiece	Rotary & linear motion

Learning Objectives / Experiments

- Introduction to technical drawing:
 - reading and understanding technical drawings
 - three-plane views
 - sectional views
 - drawing types
 - 3D views
 - parts lists
 - dimensioning
 - surface finish and tolerance specifications
 - differentiation between standard and production parts
 - material specifications
- Planning and execution of simple assembly operations:
 - planning and describing work sequences
 - assessing results
- Measurement exercises:
 - length measurements
 - angle measurements
- Manufacturing methods:
 - operational examples of handmade production and production on machine tools

- Interdisciplinary teaching possibilities.
- Learning in a small team is an effective learning format.
- Excellent instructional materials, including a CD, for printing and presentation.



Assembly step 1 (Main body) – Parts required for assembly

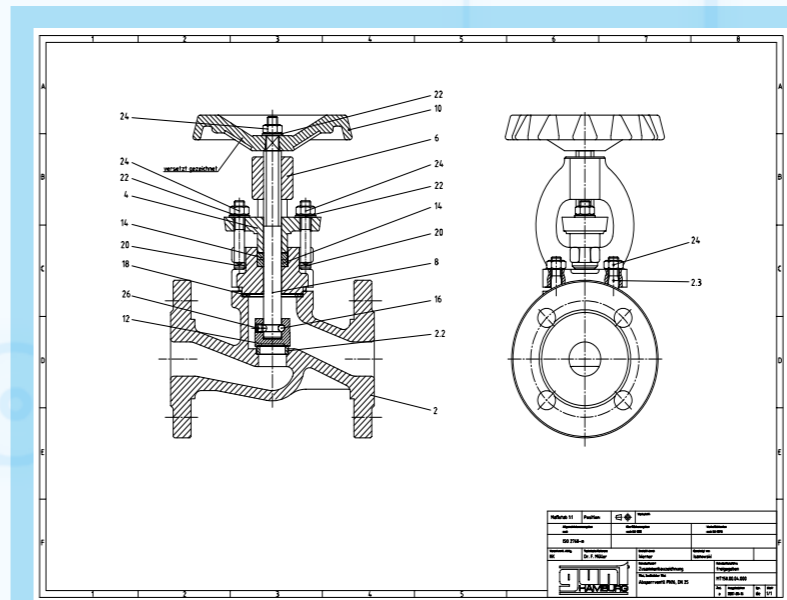
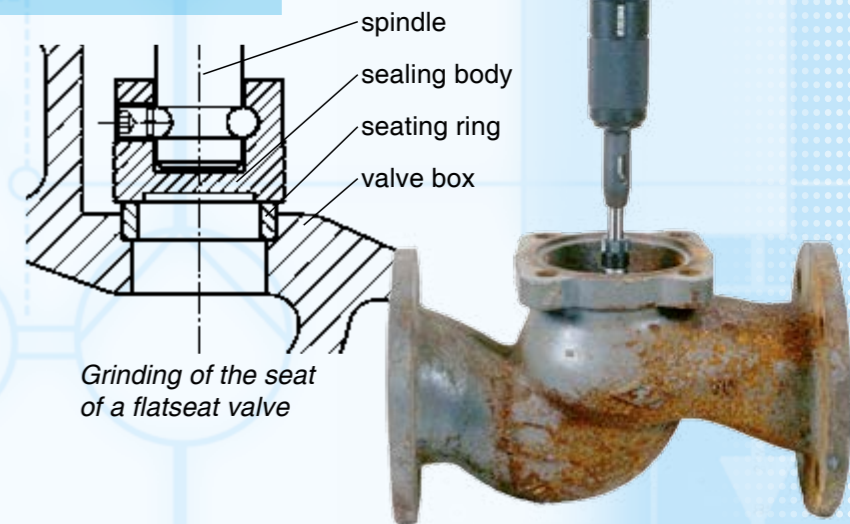
Pos.	Name	Pos.	Name
2	Main body	17	Cheese head screw
3	Bearing flange	18	Cheese head screw
8	Lower blade	23	Paralell pin
11	Base plate		

MT 158 Assembly Exercise: Ball Valve and Shut-off Valve



Two different valves and fittings in one assembly kit.
Parts are clearly and perfectly arranged.

- Exercises can be conducted in a classroom – no workshop environment necessary.
- Assembly exercises can be conducted in relatively short periods of time (within lesson units).
- Comprehensive and well-structured instructional material will impress you.



Replacement parts available according to part lists and drawings

Learning Objectives / Experiments

- Design and function of a ball valve
- Design and function of a valve
- Assembly and disassembly, including for the purposes of maintenance and repair
- Replacing components (e.g. seal)
- Comparison of 2 different valves and fittings
- Reading and understanding engineering drawings and operating instructions
- Leak testing (together with hydraulic valves and fittings test stand MT 162)

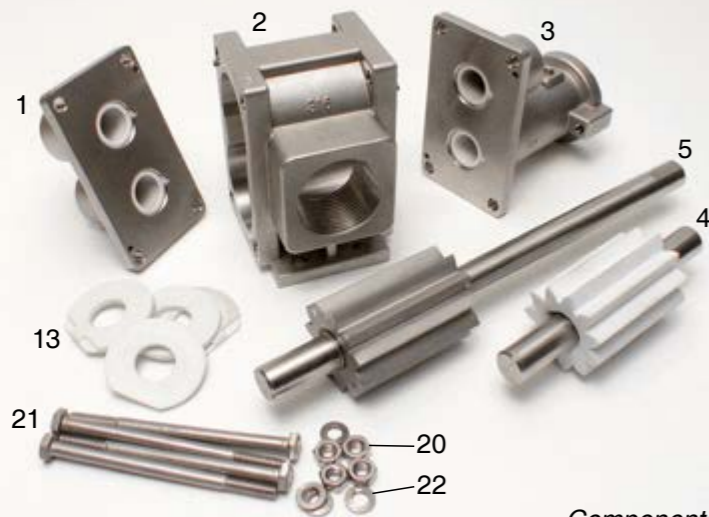
MT 186 Assembly & Maintenance Exercise: Gear Pump



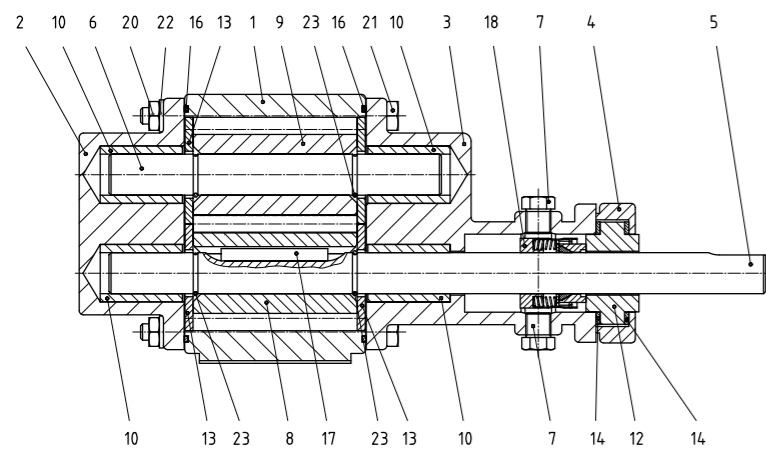
Installing the driven shaft



Mounting the wearing discs



Components included in the assembly kit



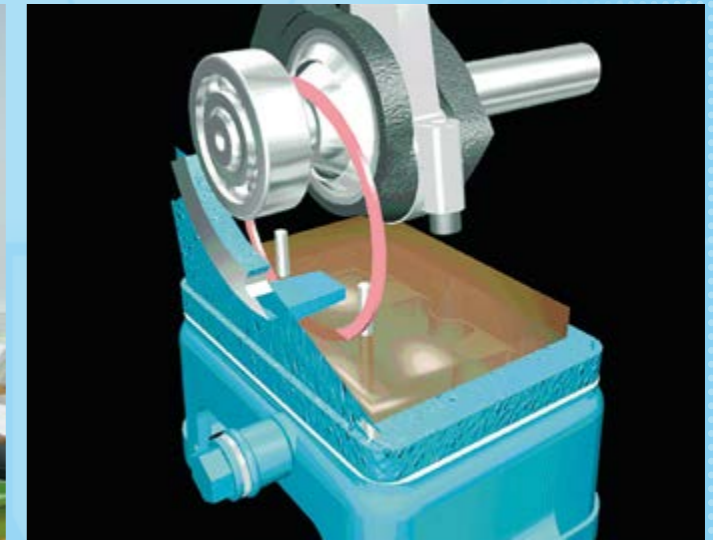
Learning Objectives / Experiments

- ⌘ Design and function of a gear pump and its components
- ⌘ Assembly and disassembly for maintenance and repair purposes
- ⌘ Replacing components (e.g. seals)
- ⌘ Troubleshooting, fault assessment
- ⌘ Planning and assessment of maintenance and repair operations
- ⌘ Reading and understanding engineering drawings and operating instructions

MT 140.02 Assembly Exercise: Piston Compressor



Students studying the assembly



Crankcase, crankshaft, oil distribution ring

The classic assembly project



An assembled compressor, to the right individual parts, exploded view in the background



Learning Objectives / Experiments

- ⌘ Design and function of a compressor
- ⌘ Reading and understanding engineering drawings
- ⌘ Familiarisation with components and assemblies, their design features and functions
- ⌘ Dimensioning exercises, gauging of parts
- ⌘ Work planning, particularly planning and presentation of the assembly process
- ⌘ Familiarisation with assembly aids and jigs
- ⌘ Assembly exercises: component and complete unit assembly
- ⌘ Analysis of faults and damage, in conjunction with maintenance and repair steps
- ⌘ Material selection criteria

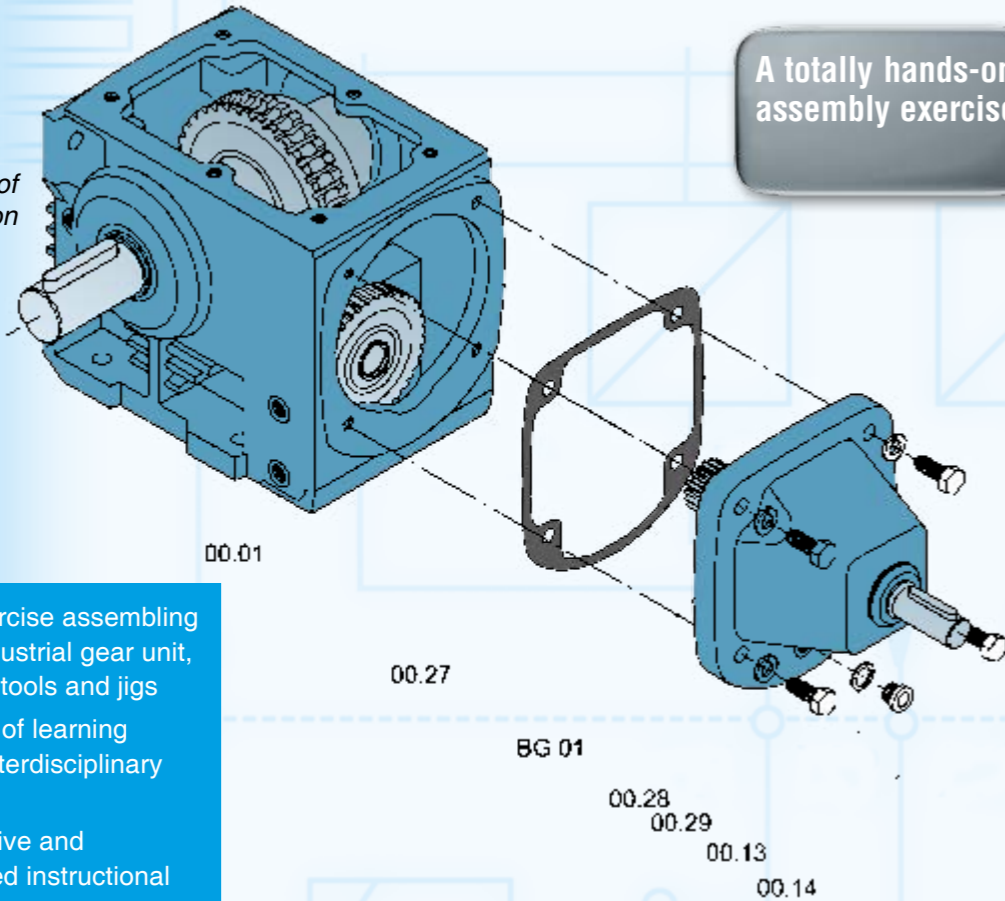
In conjunction with MT 140.01:

- ⌘ Functional testing of the assembled compressor

MT 110.02 Assembly Exercise: Spur Wheel/Worm Gear Mechanism

A totally hands-on assembly exercise

An example of assembly section



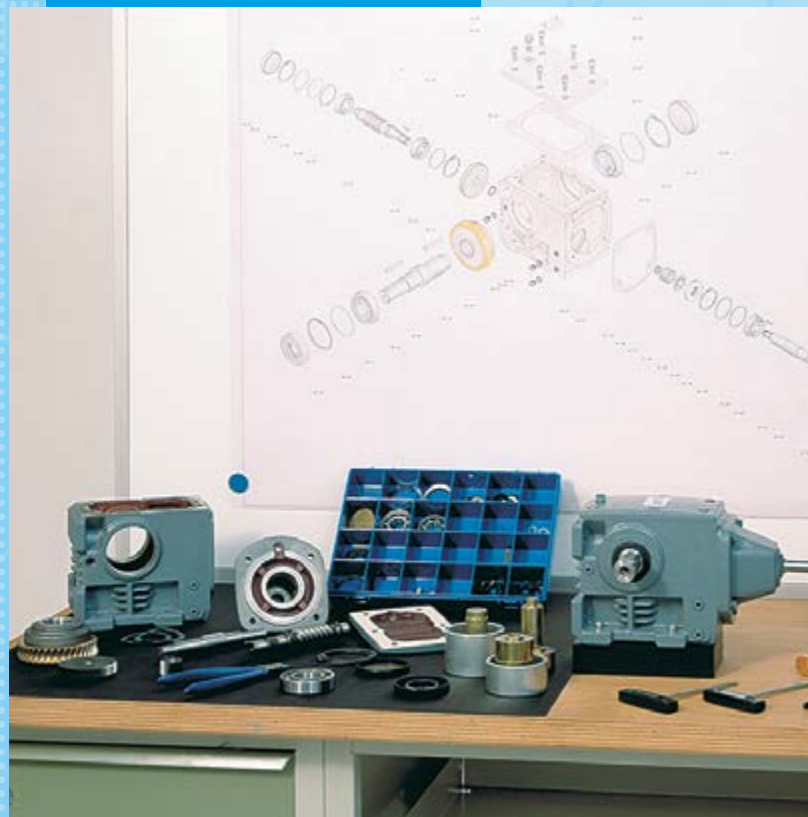
- ∴ Practical exercise assembling a modern industrial gear unit, using simple tools and jigs
- ∴ Broad scope of learning presenting interdisciplinary problems
- ∴ Comprehensive and well-structured instructional material

Learning Objectives / Experiments

- ∴ Design and function of a multistage gear combination
- ∴ Reading and understanding engineering drawings
- ∴ Familiarisation with component and assemblies, their design features and functions
- ∴ Dimensioning exercises, gauging of parts
- ∴ Work planning, particularly planning and presentation of the assembly process
- ∴ Familiarisation with assembly aids and jigs
- ∴ Assembly exercises: component and complete unit assembly
- ∴ Analysis of faults and damage, in conjunction with maintenance and repair steps
- ∴ Material selection criteria

In conjunction with MT 172:

- ∴ Functional testing of the assembled gear unit



Left hand: single parts of the gear
Right hand: fully assembled multistage gear

MT 190 Assembly Project: Materials Tester

Build your own materials tester



This is the assembly kit...



...and this is the result

Learning Objectives / Experiments

- ∴ Reading and understanding technical documentation
- ∴ Planning and execution of assembly operations and sequences
- ∴ Familiarisation with machine elements and components
- ∴ Commissioning and checking of a materials tester following assembly
- ∴ Planning, execution and assessment of maintenance operations
- ∴ Fault analysis: Troubleshooting, fault assessment and repair
- After assembly:**
- ∴ Tensile test of metallic specimens
- ∴ Recording of stress-elongation diagrams
- ∴ Brinell hardness test

MT 210 Assembly & Maintenance Exercise: Refrigeration



- 1 Fully hermetic compressor
- 2 Filter drier
- 3 Sight glass with humidity indicator
- 4 Delivery side manometer
- 5 HP (high pressure) pressure switch
- 6 LP (low pressure) pressure switch
- 7 Intake side manometer
- 8 Cooling chamber with evaporator and fan 2
- 9 Thermostat
- 10 Expansion valve
- 11 Assembly panel
- 12 Solenoid valve
- 13 Condenser with fan 1
- 14 Service valves
- 15 Electrical switch box

Fully assembled MT 210 unit



Leak testing at expansion valve

Maintenance, repair, troubleshooting of a refrigeration system ...totally practice-oriented

Learning Objectives / Experiments

- ∴ Reading and understanding technical documentation
- ∴ Planning and execution of assembly operations and sequences
- ∴ Making piping connections as per system diagram
- ∴ Electrical installation as per circuit diagram
- ∴ Commissioning and checking of a refrigeration unit following assembly (in conjunction with ET 150.01)
- ∴ Familiarisation with the function of the components of a refrigeration system and of the complete system
- ∴ Fault analysis: troubleshooting, fault assessment and repair
- ∴ Planning, execution and assessment of maintenance operations

In conjunction with ET 150.01:

- ∴ Evacuation and filling of refrigeration units

HL 960 Assembly Station: Pipes and Valves and Fittings

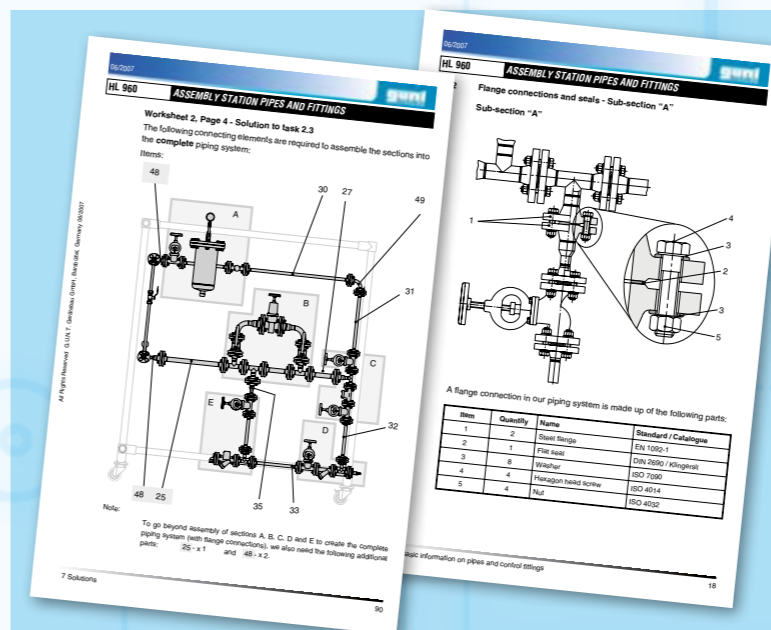


Service technician at work

Practically oriented assembly of piping and system installations

Maintenance Repair

... it is difficult to imagine a more hands-on training system



Two examples from our comprehensive training documentation

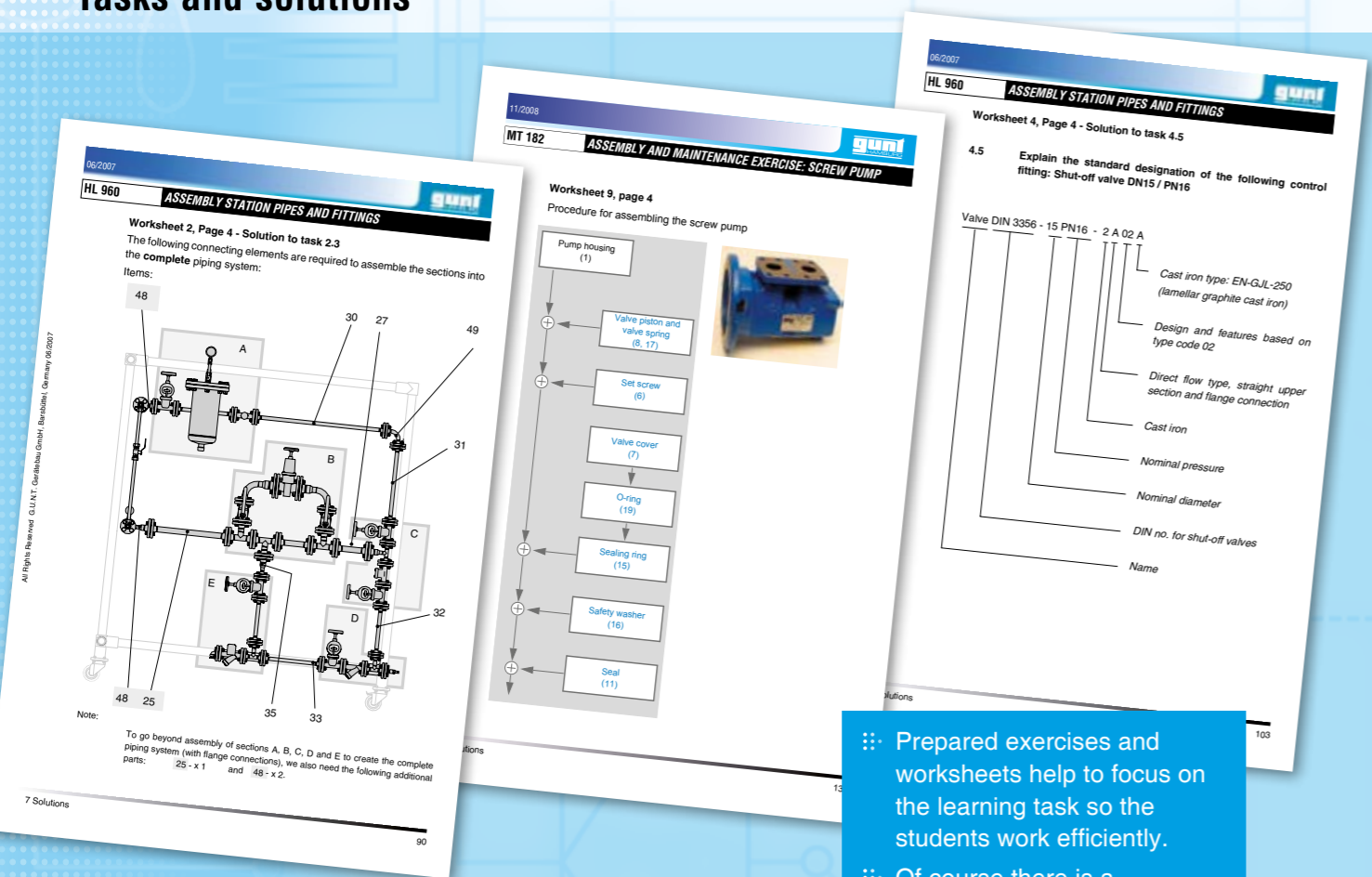
Learning Objectives / Experiments

- ∴ Design and function of valves and fittings, piping elements and system components
- ∴ Planning of piping and system installations according to specification, e.g. a process schematic
- ∴ Selection of components and drafting of requirement lists
- ∴ Technically correct preparation and execution of system assembly
- ∴ Reading and understanding engineering drawings and technical documentation
- ∴ Operational testing of the constructed systems (in conjunction with suitable water supply and disposal)

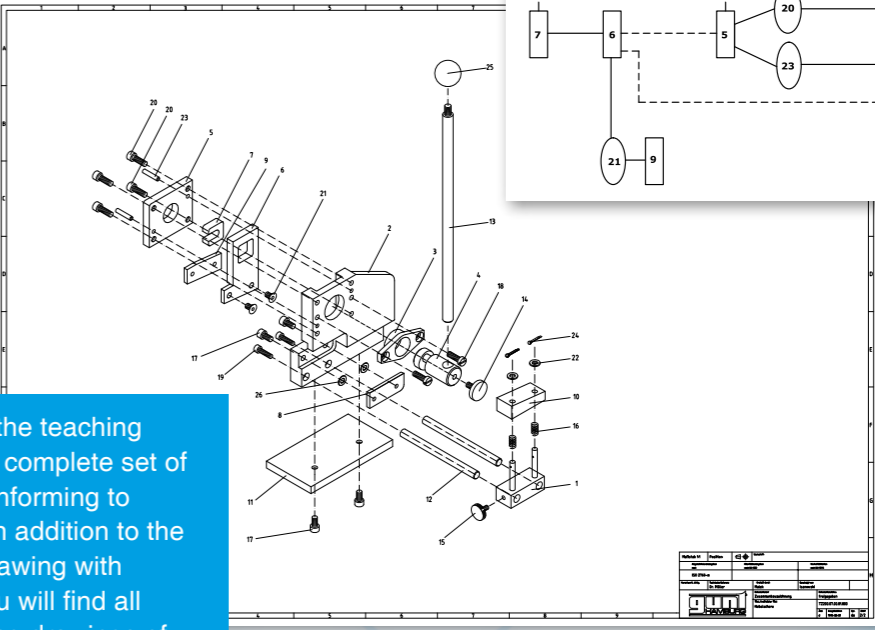
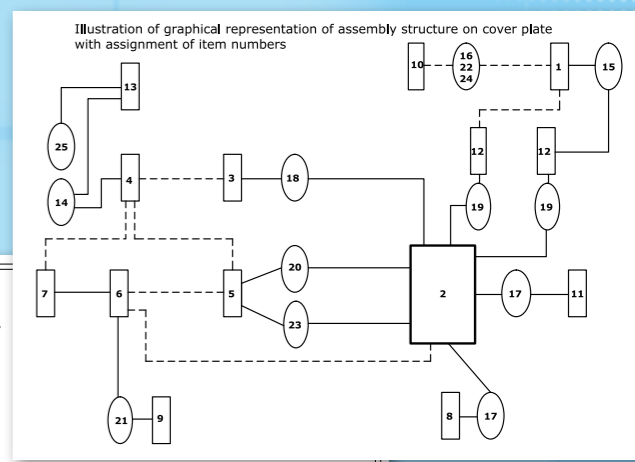
The Instructional Material will Impress You

Tasks and solutions

Complete set of drawings



Pos.	Quant.	Unit	Designation	Subject num./Specification	Comment
1	1	pce.	Guide block	TZ200.07.00.02.000	
2	1	pce.	Main body	TZ200.07.10.01.001	S235JRG2
3	1	pce.	Bearing flange	TZ200.07.10.01.002	95Mn28
4	1	pce.	Eccentric shaft	TZ200.07.10.01.003	X10CrNiS18-9
5	1	pce.	Bearing cover	TZ200.07.10.01.004	S235JRG2
6	1	pce.	Shear body	TZ200.07.10.01.005	S235JRG2
7	1	pce.	Eccentric guide	TZ200.07.10.01.006	CuZn39Pb3
8	1	pce.	Lower blade	TZ200.07.10.01.007	90MnCrV8
9	1	pce.	Upper blade	TZ200.07.10.01.008	90MnCrV8
10	1	pce.	Stop	TZ200.07.10.01.009	S235JRG2
11	1	pce.	Base plate	TZ200.07.10.01.010	S235JRG2
12	2	pce.	Guide bar	TZ200.07.10.01.011	X10CrNiS18-9
13	1	pce.	Lever rod	TZ200.07.10.01.012	X10CrNiS18-9
14	1	pce.	Knurled screw	DIN 653 M5x12	St. galv.
15	1	pce.	Knurled screw	DIN 653 M4x10	St. galv.
16	2	pce.	Compression spring	DIN 2098-	
17	4	pce.	Socket head cap screw	ISO 4762-	
18	2	pce.	Socket head cap screw	ISO 1207-1	
19	2	pce.	Socket head cap screw	ISO 4762-	
20	4	pce.	Socket head cap screw	ISO 4762-	
21	2	pce.	Countersunk screw	ISO 10642-	
22	2	pce.	Washer	ISO 7090 E	
23	2	pce.	Parallel pin	ISO 2338-	
24	2	pce.	Splint pin	ISO 1234-	
25	1	pce.	Ball knob D=25	0110 Gant	
26	2	pce.	Shim ring	DIN 988-5	

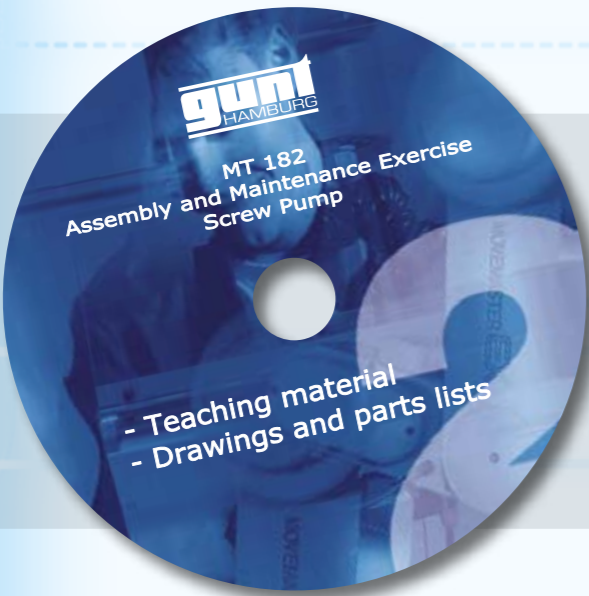


Prepared exercises and worksheets help to focus on the learning task so the students work efficiently.

Of course there is a recommended solution for every exercise.

The core of the teaching material is a complete set of drawings conforming to standards. In addition to the assembly drawing with parts list, you will find all manufacturing drawings of the individual parts.

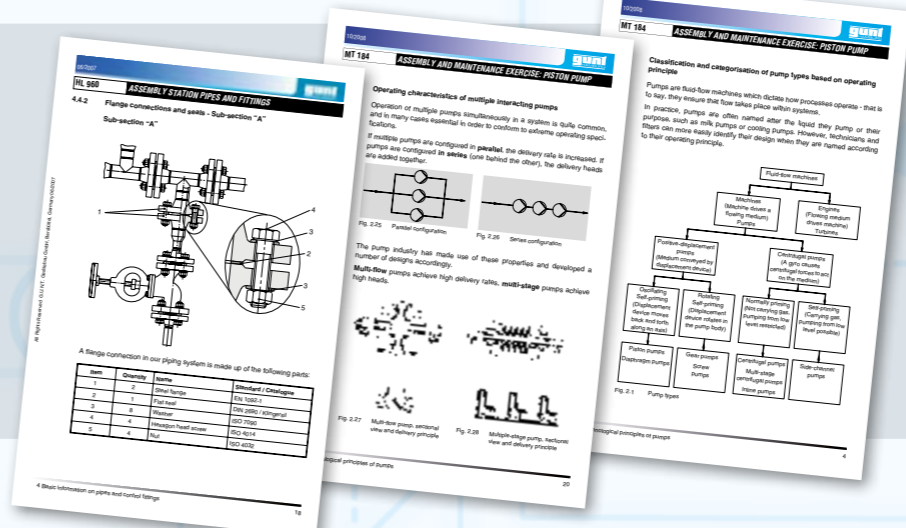
So you are able to produce your own parts, or have them manufactured for you.



The complete material on CD (PDF)

The complete instructional material is delivered in hardcopy form in a clearly arranged folder.

Additionally you receive the complete material as PDF-files. It includes all texts, graphics and drawings. That way you can conveniently print or present.



Fundamental principles presented in detail

The basic principles and technical descriptions are professionally illustrated with lots of graphics, photos and clear text.

The pages are suitable for printing out or using with a video projector.