

## Engineering drawing and cutaway models



Engineering drawings present a very abstract image of the components or devices with precise specifications. Using geometric and graphical features such as lines and symbols, as well as alphanumeric characters such as digits and letters, a three-dimensional object is described in two dimensions.

Reading and understanding engineering drawings is a fundamental element in the development of professional competence in all engineering disciplines.

### Engineering drawing course

The engineering drawing course is composed of two modules. The first module uses geometric models to develop spatial concepts. The second offers the application of rules and standards in technical communication with selected components, cutaway models and assembly exercises that help with the understanding of functions and assembly. An important educational objective of the course is the presentation of specific

applications and the use of real workpieces and standard parts. This is intended to develop engineering-related communication skills. The actual drawing tasks are developed from a larger technological environment.

#### Model sets for developing spatial concepts



Model constructed in a corner of a room with folded representations

The representation of a body and the "folding" (or changing of the direction of projection) causes difficulties for many students. It requires a large capacity for abstraction and spatial imagination. These skills can be developed with appropriate training. The GUNT geometric models have been designed to teach spa-

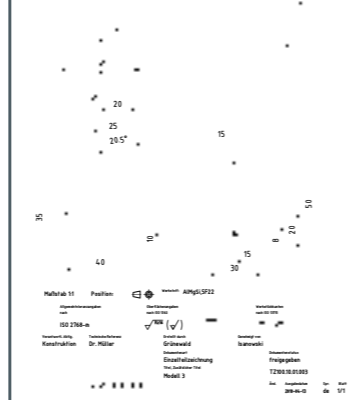
tial imagination. These skills are vital for creating perspective drawings and interpreting drawings and sketches, known as the ability to "read" drawings.

#### Components and assembly exercises for teaching rules and standards in engineering communication

The creation of an engineering drawing, whether manually or computer assisted, follows binding rules – the drafting standards – that do not permit any ambiguity. The drafting standards of the DIN (Deutsches Institut für Normung, German Institute for Standardization) take account of the standards and recommendations of the ISO (International Organization for Standardization) and are therefore applicable internationally. The published drafting standards, identified by the name DIN, ISO or EN ISO, include, for example:

- precise identification and use of line styles, hatches and colours as well as the representation of views and sections
- isometric and diametric representation; simplified representation
- dimension inscriptions, tolerance abbreviations
- drawing-sheet formats, title blocks, standard font
- fits; basic terms of tolerances and fits
- surface characteristics

#### Standards-compliant engineering drawing

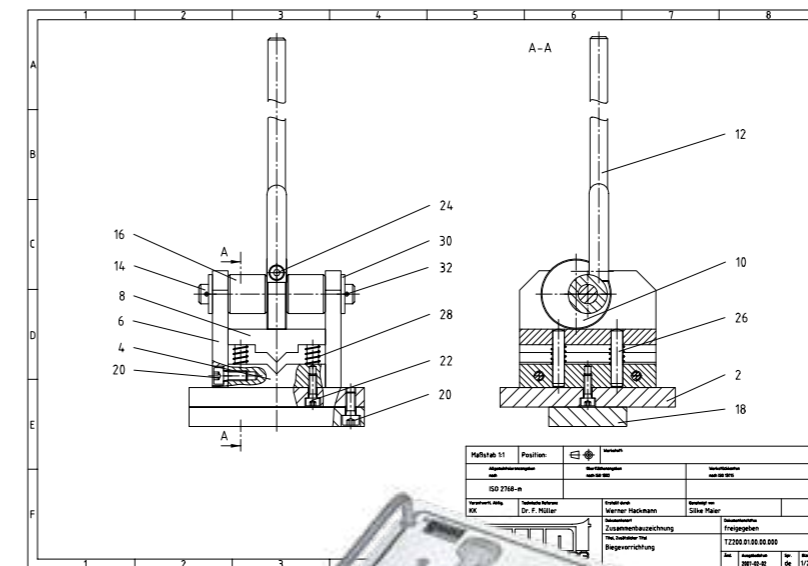


#### Cutaway models and assembly exercises to demonstrate the functions

Using assembly exercises links engineering communication to the associated technical operations such as assembly and manufacturing. In this way, theoretical and practical learning content supports the skills of reading and understanding drawings, graphs and schematics.

Real understanding can only be achieved by doing and by one's own drawing activity.

Engineering animations such as cutaway models are ideally suited to representing processes and functions. GUNT uses up-to-date original parts for its cutaway models. Movement and switching functions are maintained.



General arrangement drawing

#### The components and assembly exercises of GUNT teach:

- the standards-compliant execution of engineering drawings
- the recognition of standardised representations
- the understanding of contexts of individual components

#### The ability to read drawings is demonstrated using:

- general arrangement drawings and exploded drawings
- raw casting drawing, production drawings

The types of drawings and their role and content in terms of standardisation are precisely explained.



Assembled lever press

## TZ 100

### Engineering drawing: three-dimensional display



#### Description

- GUNT course: engineering drawing
- model set for developing spatial concepts
- fundamentals of three-dimensional display

In order to describe a spatial body adequately and thereby fulfil a basic principle of exact replication and repeatable production, several views of the body are usually necessary. To do this, bodies are shown in three planes: front view, side view and plan or bottom view. The presentation follows fixed rules that are defined in the standards. Even for simple bodies, the presentation in three planes requires a considerable degree of abstraction ability and spatial imagination on the part of students. This ability is a prerequisite for both creating and interpreting engineering drawings or sketches and is taught by means of geometric models.

The TZ 100 model set provides a learning concept with which to introduce students to the discipline of descriptive geometry.

A corner of a room, comprising three flat Plexiglas sheets, holds the models. The corresponding view is inserted into each plane of the room corner, so that it is possible to directly compare model (workpiece) and drawing.

A total of ten models of varying difficulty are included. One model is made of Plexiglas in order to develop an understanding of hidden edges. The other models are made of aluminium.

The models are precision-manufactured so that measuring exercises can also be conducted. All parts are clearly laid out and well protected in a storage system.

The exercises are ideally performed by the students themselves. Two students can comfortably work with one model set.

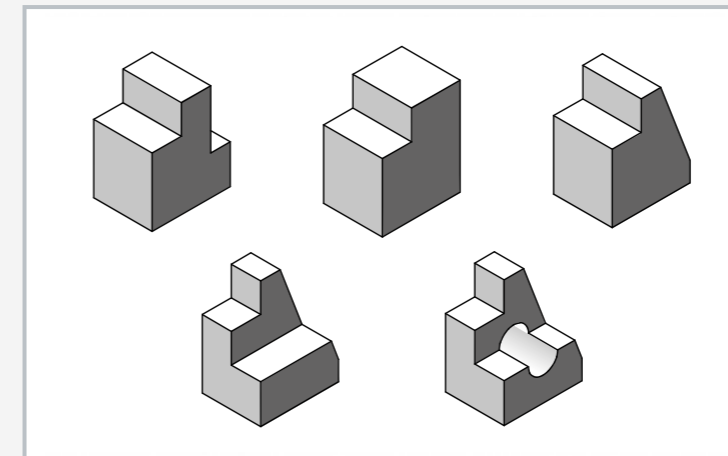
The instructional materials include a complete set of drawings. A representation in three views, the 3D view and the production drawing are included for each model.

#### Learning objectives/experiments

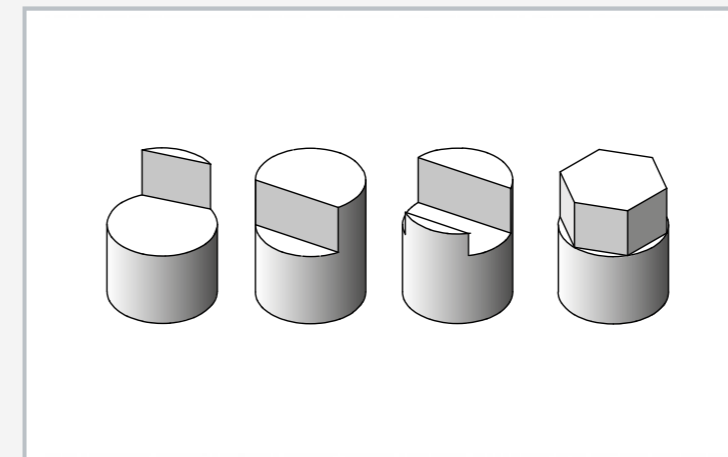
- familiarisation with three-dimensional display as a basic principle of engineering drawing
- step-by-step development of spatial thinking: from the concrete situation to the abstract representation in an engineering drawing
- measuring exercises



Room corner made of three Plexiglas planes with inlaid drawing and a prismatic model



Prismatic models



Cylindrical models

#### Specification

- [1] set of models from the descriptive geometry discipline to develop spatial concepts
- [2] introduction to engineering drawing
- [3] precision manufacture of the models allows measuring exercises
- [4] room corner comprising three Plexiglas planes
- [5] 9 aluminium geometric models; cylindrical and prismatic shapes
- [6] 1 Plexiglas model
- [7] storage system for parts

#### Technical data

- 5 prismatic models  
 ■ LxWxH: 40x30x50mm

- 4 cylindrical models  
 ■ ØxH: 40x50mm

- 1 transparent model  
 ■ LxWxH: 40x30x50mm

- 3 Plexiglas planes  
 ■ LxWxH: 100x100x100mm

- LxWxH: 335x240x71mm (storage system)  
 Weight: approx. 3kg

#### Scope of delivery

- 1 storage system with foam inlay
- 1 set with 10 geometric models
- 3 Plexiglas planes for constructing a room corner
- 1 rod for holding the models
- 1 paper punch
- 1 set of instructional material, complete set of drawings included

**TZ 200.61****Engineering drawing: rotationally symmetrical components****Description**

- **GUNT course: engineering drawing**
- **consists of drilling jig and workpiece**
- **introduction to sectional views**

Reading and understanding complex engineering drawings are core skills. They are at least equivalent to drawing ability itself, and are the aim of this GUNT course. The use of concrete applications and real-world workpieces and standard parts is intended to develop engineering communication skills. The actual drawing tasks are developed from a larger technological environment.

TZ 200.61 provides an introduction to the graphical representation of rotationally symmetrical components and the representation of sections. The central element is a drilling jig that can be used, in this case, to drill into a bearing cap. A quarter has been cut out of the base of the drilling jig. This illustrates the concepts of "section" and "half-section".

The cut-out quarter is also provided on the base plate, so that the difficult topic of sectional views can be demonstrated clearly.

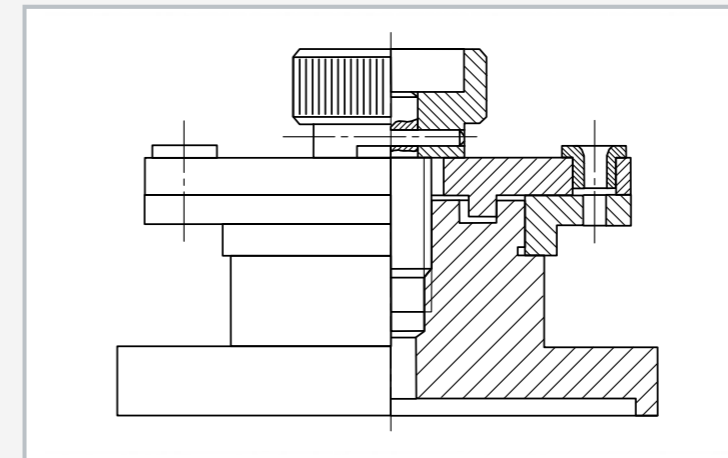
All parts are clearly arranged on a base plate. An exploded view, attached to the base plate, illustrates the overall arrangement.

The manufactured parts are precision-manufactured and therefore are also suitable for measuring exercises.

Ideally, the parts should be used in the classroom as an exercise. Two or three students can work meaningfully with one kit.

**Learning objectives/experiments**

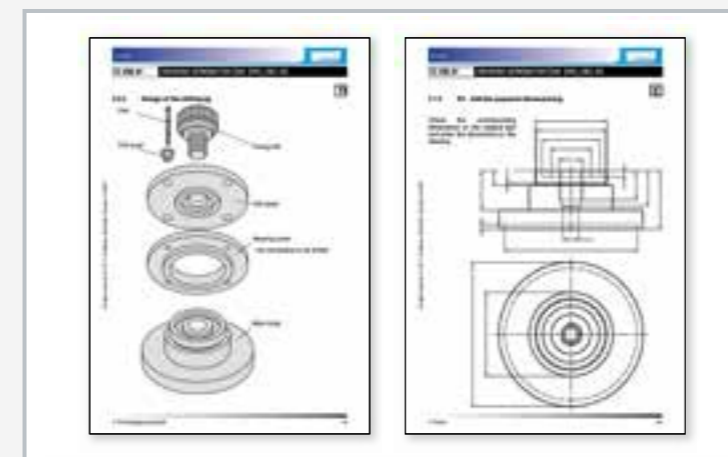
- introduction to graphical representation of rotationally symmetrical components
- familiarisation with sectional views: full section and half section
- dimensioning of rotating parts and threads
- production engineering aspects
  - ▶ devices as aids for drilling and reaming
  - ▶ complete machining on modern tooling machines
  - ▶ tolerances, fits, surface specifications
- classification of the workpiece (bearing cap) in a larger technological context



Sectional view of the drilling jig with the workpiece to be drilled (bearing cap)



Assembled drilling jig with workpiece:  
1 fastening screw, 2 drill plate, 3 drill bush, 4 workpiece (bearing cap), 5 base



Instructional material

**Specification**

- [1] part of the GUNT course on engineering drawing
- [2] rotationally symmetrical components using the example of a practical drilling jig for machining of a workpiece (bearing cap)
- [3] base of the drilling jig prepared as a half section
- [4] all individual parts of the drilling jig precision-manufactured from aluminium
- [5] PVC bearing cap as workpiece
- [6] base plate with printed exploded drawing
- [7] storage system for parts
- [8] accompanying instructional material considers practical and interdisciplinary forms of teaching

**Technical data**

LxWxH: 420x300x75mm (storage system)  
Weight: approx. 2kg

**Scope of delivery**

- 1 base plate with the individual parts of the drilling jig
- 1 workpiece (bearing cap)
- 1 set of standard parts (drill bush, pin, O-ring)
- 1 set of instructional material

## TZ 200.02

### Engineering drawing: casting



Machined (left) and raw casting (right)

#### Learning objectives/experiments

- engineering drawing
  - ▶ cast drawings and their features: machining allowances, mould draughts, shrinkage, sectional views
  - ▶ from casting to finished part: production-based and standards-compliant dimensioning for the subsequent machining
- technology
  - ▶ manufacture of castings in sand casting; production processes
  - ▶ tool and machine selection; longitudinal measuring exercises
  - ▶ machine elements and their function

#### Specification

- [1] part of the GUNT course on engineering drawing
- [2] graphical representations: from raw casting to finished machine part
- [3] 2 models showing the development of the manufacturing process: 1 raw casting, 1 cutaway model
- [4] accompanying instructional material considers practical and interdisciplinary forms of teaching

#### Technical data

LxWxH: 100x100x125mm (per model)  
Weight: approx. 3kg

#### Scope of delivery

- 2 models
- 1 set of instructional material

#### Description

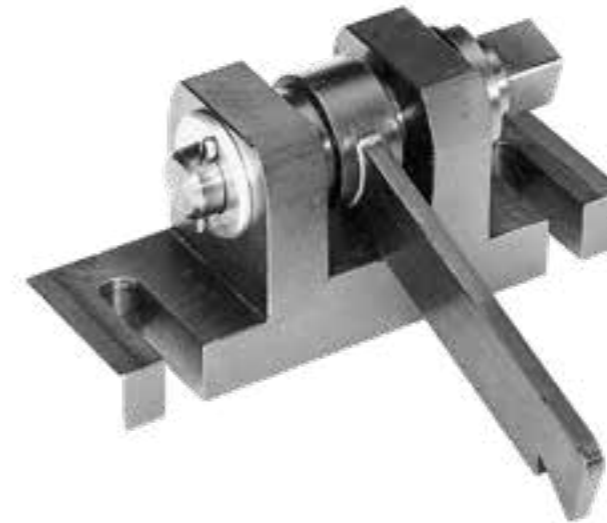
- **GUNT course: engineering drawing**
- **from raw casting to finished machine part**

A bearing housing made from sand-cast aluminium is used in teaching as an example to illustrate the subject of cast parts in a detailed and practical way. TZ 200.02 comprises a raw casting of a bearing housing, manufactured and polished in a foundry, and a finished part of the same bearing housing, which has been machined after being cast. The machined part has also been prepared as a cutaway model.

The two components can be used to describe the process from forming to machining. An ideal learning situation would be to allow two or three students to study the model set together.

## TZ 200.08

### Engineering drawing: safety catch



#### Learning objectives/experiments

- readily understandable engineering drawings and lists of parts
- production-based and standards-compliant representation of single parts: dimensioning, surface and tolerance specifications
- technological aspects: material selection, functions, production processes, work planning and more

#### Specification

- [1] part of the GUNT course on engineering drawing
- [2] practical functional model of a safety catch
- [3] all production parts made from precision-manufactured burnished steel surfaces
- [4] accompanying instructional material considers practical and interdisciplinary forms of teaching

#### Technical data

LxWxH: 130x100x60mm  
Weight: approx. 1kg

#### Scope of delivery

- 1 safety catch
- 1 set of instructional material

#### Description

- **GUNT course: engineering drawing**
- **complete production-ready drawing set**

The model of a safety catch is part of the extensive GUNT course providing an introduction to engineering drawing. The didactic approach is based on a real-world component and systematically develops transferable learning content.

The manufactured parts are precision-manufactured and therefore also suitable for measuring exercises. The surfaces of the manufactured parts are burnished to prevent corrosion.

Ideally, the part should be used in the classroom as an exercise. Two or three students can work meaningfully with one kit.

## TZ 300

### Assembly of lever press



#### Description

- GUNT course: engineering drawing
- lever press as assembly kit
- exercise for interdisciplinary teaching

A drawing is the most important means of information and communication in engineering. The ability to read and understand drawings, graphics and schematics is a fundamental element in the development of professional competence in all engineering disciplines. Linking engineering communication to the associated technical operations such as assembly structure, work plans and manufacturing is just as important.

The TZ 300 assembly kit is an interdisciplinary and practical project. In addition to the primary learning area of "engineering drawing", it is also possible to deal with the topics of machine elements, assembly processes and in particular production engineering.

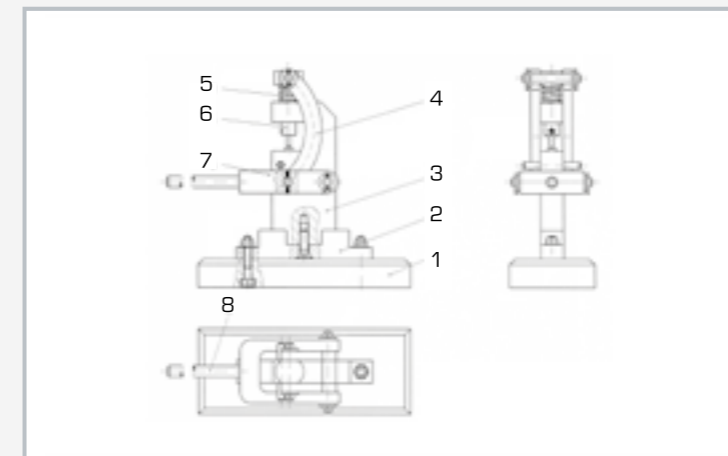
The assembly kit includes all single parts required to assemble a functional lever press. The parts are clearly displayed on a base plate. All single parts and the corresponding drawings are available in a standards-compliant and practical form.

The manufactured parts are precision-manufactured from original materials and with common tolerances and surfaces. The surfaces of the manufactured parts are burnished to prevent corrosion. All parts are clearly laid out and well protected in a storage system. Multiple storage systems can be stacked on top of each other, allowing space-saving storage.

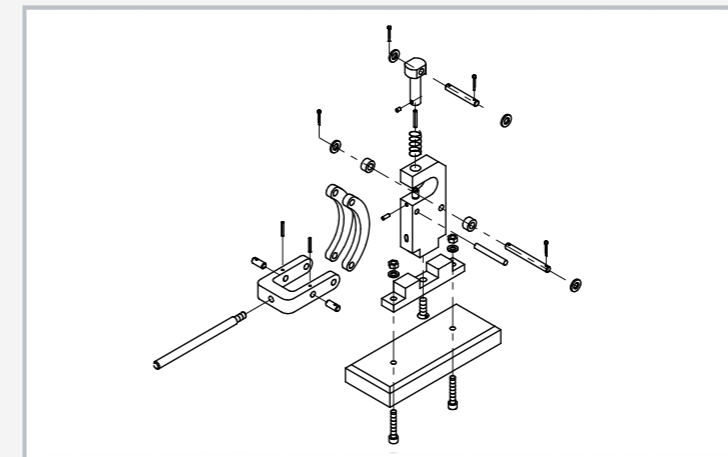
Usage in the classroom should ideally be as a practical exercise, in which two or three students can work comfortably on one assembly kit.

#### Learning objectives/experiments

- introduction to engineering drawing
  - ▶ read and understand engineering drawings
  - ▶ three-dimensional display
  - ▶ sectional views
  - ▶ drawing types
  - ▶ 3D representation
  - ▶ lists of parts
  - ▶ dimensioning
  - ▶ surface and tolerance specifications
  - ▶ difference between standard and production parts
  - ▶ materials specifications
- planning and execution of simple assembly operations
  - ▶ plan and describe operations
  - ▶ evaluate results
- measuring exercises
  - ▶ longitudinal measurements
  - ▶ angular measurements
- manufacturing processes
  - ▶ working examples of handmade production and production on machine tools



1 base plate, 2 foot, 3 stand, 4 arch, 5 compression spring, 6 pressure pin, 7 fork, 8 handle



Exploded drawing of the lever press



Functional groups of the lever press: fork, pressure pin, main body

#### Specification

- [1] part of the GUNT course on engineering drawing
- [2] assembly kit of a functional lever press
- [3] all production parts of the lever press made from steel, precision-manufactured, burnished surfaces
- [4] storage system for parts
- [5] multiple storage systems can be stacked on top of each other
- [6] accompanying instructional material considers practical and interdisciplinary forms of teaching

#### Technical data

LxWxH: 420x300x70mm (storage system)

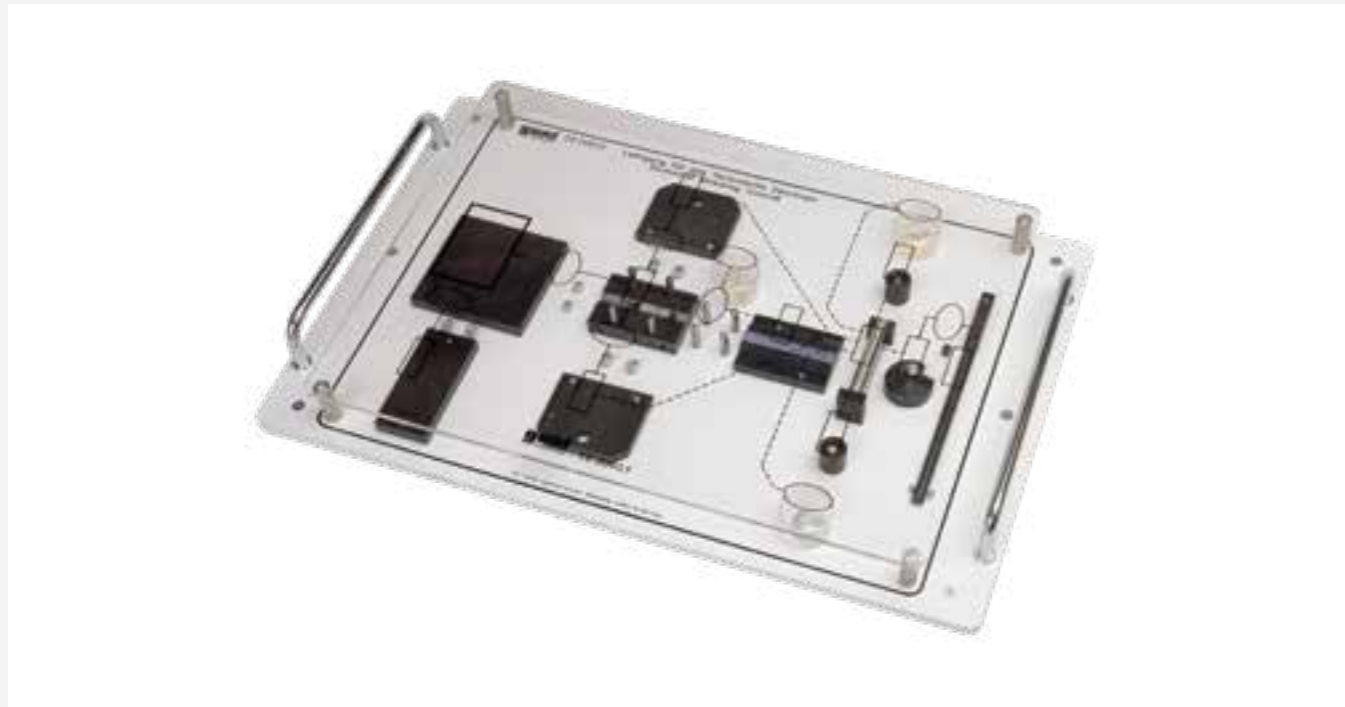
Weight: approx. 3kg

#### Scope of delivery

- 1 storage system with the individual parts of the lever press
- 1 set of tools for assembly and disassembly
- 1 set of small parts
- 1 set of instructional material

## TZ 200.11

### Assembly of bending device



#### Description

- GUNT course: engineering drawing
- bending device as assembly kit
- exercise for interdisciplinary teaching

A drawing is the most important means of information and communication in engineering. The ability to read and understand drawings, graphics and schematics is a fundamental element in the development of professional competence in all engineering disciplines. Linking engineering communication to the associated technical operations such as assembly structure, work plans and manufacturing is just as important.

The TZ 200.11 assembly kit is an interdisciplinary and practical project. In addition to the primary learning area of "engineering drawing", it is also possible to deal with topics such as assembly planning and execution as well as measuring exercises. The assembly kit includes all single parts required to assemble a functional bending device.

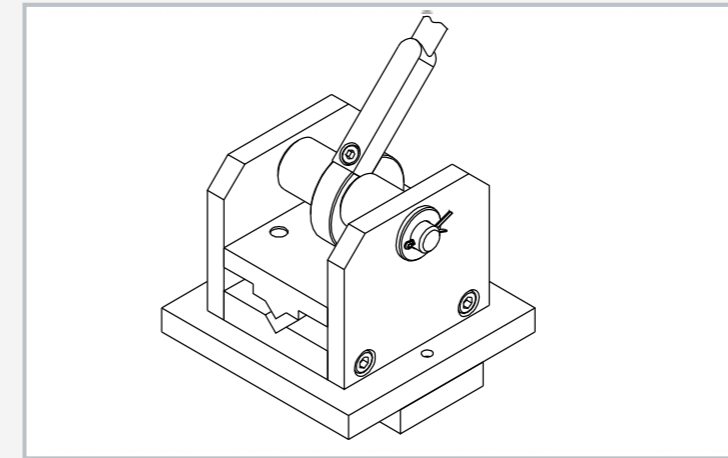
The parts are grouped on a base plate so that individual assembly sequences are clearly displayed. Above the base plate is a transparent cover plate with a graphical representation of the assembly structure. The graphic symbolizes standard and production parts and displays fixed and moving connections differently. All single parts and the corresponding drawings are available in a standards-compliant and practical form.

The manufactured parts are precision-manufactured from original materials and with common tolerances and surfaces. The surfaces of the manufactured parts are burnished to prevent corrosion. All parts are clearly laid out and well protected in a storage system. Multiple storage systems can be stacked on top of each other, allowing space-saving storage.

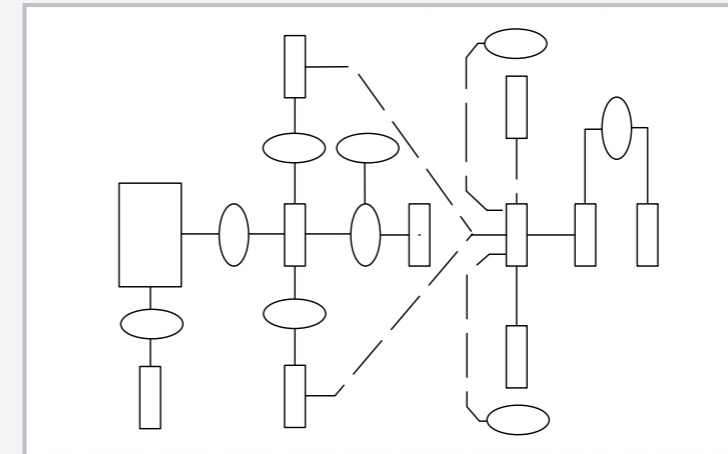
Usage in the classroom should ideally be as a practical exercise, in which two or three students can work comfortably on one assembly kit.

#### Learning objectives/experiments

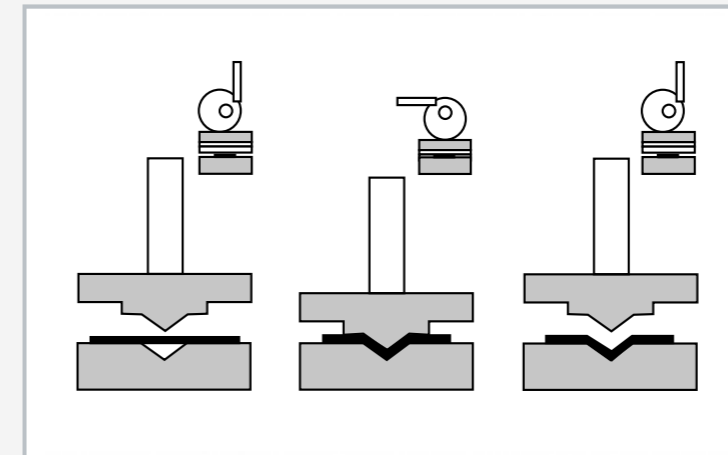
- introduction to engineering drawing
  - ▶ read and understand engineering drawings
  - ▶ three-dimensional display
  - ▶ sectional views
  - ▶ drawing types
  - ▶ 3D representation
  - ▶ lists of parts
  - ▶ dimensioning
  - ▶ surface and tolerance specifications
  - ▶ difference between standard and production parts
  - ▶ materials specifications
- planning and execution of simple assembly operations
  - ▶ plan and describe operations
  - ▶ evaluate results
- measuring exercises
  - ▶ longitudinal measurements
  - ▶ angular measurements



3D representation of the assembled bending device



Graphical representation of the assembly structure



Bending process

#### Specification

- [1] part of the GUNT course on engineering drawing
- [2] assembly kit of a functional bending device with eccentric operation
- [3] all production parts made from precision-manufactured burnished steel surfaces
- [4] assembly structure on transparent cover plate
- [5] storage system for parts
- [6] multiple storage systems can be stacked on top of each other
- [7] accompanying instructional material considers practical and interdisciplinary forms of teaching

#### Technical data

LxWxH: 540x350x75mm (storage system)  
Weight: approx. 6kg

#### Scope of delivery

- 1 storage system with the individual parts of the bending device
- 1 cover plate with assembly structure
- 1 set of tools for assembly and disassembly
- 1 set of instructional material

## TZ 200.71

### Assembly of lever shears



#### Description

- GUNT course: engineering drawing
- lever shears as assembly kit
- exercise for interdisciplinary teaching

A drawing is the most important means of information and communication in engineering. The ability to read and understand drawings, graphics and schematics is a fundamental element in the development of professional competence in all engineering disciplines. Linking engineering communication to the associated technical operations such as assembly structure, work plans and manufacturing is just as important.

The TZ 200.71 assembly kit is an interdisciplinary and practical project. In addition to the primary learning area of "engineering drawing", it is also possible to deal with the topic of assembly processes, in particular production engineering.

The assembly kit includes all single parts required to assemble functional lever shears. The parts are grouped on a base plate so that individual assembly sequences are clearly displayed.

Above the base plate is a transparent cover plate with a graphical representation of the assembly structure.

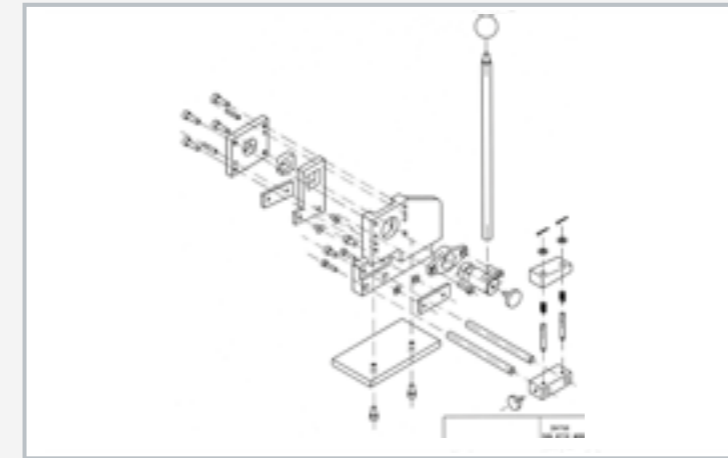
The graphic symbolizes standard and production parts and displays fixed and moving connections differently. All single parts and the corresponding drawings are available in a standards-compliant and practical form.

The manufactured parts are precision-manufactured from original materials and with common tolerances and surfaces. The surfaces of the manufactured parts are burnished to prevent corrosion. All parts are clearly laid out and well protected in a storage system. Multiple storage systems can be stacked on top of each other, allowing space-saving storage.

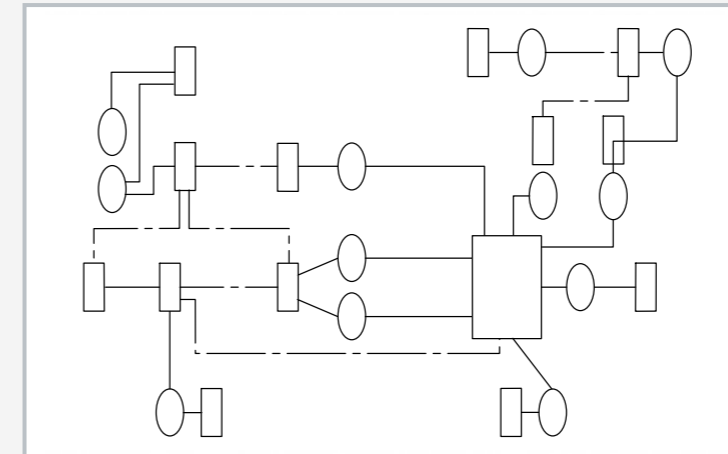
Usage in the classroom should ideally be as a practical exercise, in which two or three students can work comfortably on one assembly kit.

#### Learning objectives/experiments

- introduction to engineering drawing
  - ▶ read and understand engineering drawings
  - ▶ three-dimensional display
  - ▶ sectional views
  - ▶ drawing types
  - ▶ 3D representation
  - ▶ lists of parts
  - ▶ dimensioning
  - ▶ surface and tolerance specifications
  - ▶ difference between standard and production parts
  - ▶ materials specifications
- planning and execution of simple assembly operations
  - ▶ plan and describe operations
  - ▶ evaluate results
- measuring exercises
  - ▶ longitudinal measurements
  - ▶ angular measurements
- manufacturing processes
  - ▶ working examples of handmade production and production on machine tools



Exploded drawing of lever shears



Graphical representation of the assembly structure



Functional groups of the lever shears: shear body, base, stop

#### Specification

- [1] part of the GUNT course on engineering drawing
- [2] assembly kit of functional lever shears
- [3] all production parts of the lever shears made from precision-manufactured burnished steel surfaces
- [4] assembly structure on transparent cover plate
- [5] storage system for parts
- [6] multiple storage systems can be stacked on top of each other
- [7] accompanying instructional material considers practical and interdisciplinary forms of teaching

#### Technical data

LxWxH: 540x350x70mm (storage system)  
Weight: approx. 7kg

#### Scope of delivery

- 1 Weight: approx. with the individual parts of the lever shears
- 1 cover plate with assembly structure
- 1 set of tools for assembly and disassembly
- 1 set of small parts
- 1 set of instructional material