



Module

## Production of mechanical subassemblies by manual production

MD 01

GDVT



gtz

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Training module:  
**Production of mechanical subassemblies by manual work**

**Code of Module: MD01**

**Time: 120 h.**

(Theory: 26h; Practice: 94h)

### **I. Position and characteristics of the module**

- The overall idea of this module is the production of a mechanical qualification project, for example a sub-assembly, by manual work.
- The sub-assembly consists of several work pieces, which are to be assembled and checked for function. Each work piece contains specific skills to be trained. From special importance is the fact, that all work pieces have to fit together, thus emphasizing the importance of accuracy, tolerances and fits.
- Every work piece, as well as the complete sub-assembly, is to be produced in such a way, that the trainee will be qualified for independent planning, conduction and checking of his work.
- As it is to be expected, that the learning speed of the trainees varies, they will reach a different progress in the project. Lessons 1 to 16 are the minimum performance, which every student has to reach. The following lessons 17 to 20 are optional for especially qualified trainees.
- The following module-structure and the contents are derived from the qualification project “pick and place device” from the South Westfalia Chamber of Commerce and Industry, Germany.
- The module could follow other qualification projects if they contain the same objectives and comparable contents.

### **II. Objectives of the module**

After finishing this module, the trainees are able to;

- Determine working steps for production of work pieces and assemblies according to functional, manufacturing and economical criteria.
- Read and apply component,- group and assembly drawings.
- Determine tolerances from technical drawings and observe for production.
- Select and operate measuring – and testing instruments for lengths, angles and areas.
- Scribe, centre-punch and mark work pieces under consideration of properties of materials.
- Select and provide tools corresponding to work order.

- Saw and shear sheet metal and sectional bars corresponding to scribing lines.
- Produce areas and forms at work pieces with given accuracy by manual work.
- Produce holes and counterbores in work pieces with given accuracy.
- Produce internal and external threads manually.
- Produce boreholes in work pieces by reaming.
- Form sheet metal from steel and non-ferrous metals cold.
- Join work pieces with screws, nuts, washers and screw locking devices.
- Join work pieces by brazing and soldering.
- Arrange their work place functional, safe and accessible.
- Read components-lists, assign designations to components and select components from catalogues.
- Describe and follow safety regulations, particularly those arising from mechanical production.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.
- Solve problems systematically in a team.

### III. Contents of the module

#### 1. Content overview and time allocation:

No.	Name of lesson in the module	Duration			
		Sum	Theory	Practice	Tests
1	Cutting and filing channel piece	30	6	24	0
2	Scribing guide block	4	1	3	0
3	Chiseling manifold block	4	1	3	0
4	Drilling manifold block	6	4	2	0
5	Boring manifold block	3	2	1	0
6	Tapping manifold block	3	1	2	0
7	Notching and drilling channel piece and clamping bar	5	0	5	0
8	Bending supports	6	4	2	0
9	Drilling reaming and boring guide block	4	1	3	0
10	Producing flanges	4	0	4	0
11	Mounting sub-assembly 1-horizontal guide	4	1	3	0
12	Bending of bearing plate	4	0	4	0
13	Production of gripper jaws	6	0	6	0

14	Producing clamping rail and square	4	0	4	0
15	Winding of compression spring	2	1	1	0
16	Mounting sub-assembly 2 - gripper	2	0	2	0
17	Cutting guide block	3	0	3	0
18	Production of guide frame	5	1	4	0
19	Production of guide carriage	8	1	7	0
20	Mounting sub-assembly 3 – vertical guide	4	0	4	0
21	Module examination	9	2	7	9

## 2. Detailed contents:

### Lesson 1: Cutting and filing channel piece

(30h)

#### Objectives:

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read and parts-drawings.
- Determine tolerances from technical drawings and observe for production.
- Select and operate measuring – and testing instruments for lengths, angles and areas.
- Scribe, centre-punch and mark work pieces under consideration of properties of materials.
- Select and provide tools corresponding to work order.
- Saw sectional bars corresponding to scribing lines.
- Produce areas and forms at work pieces with given accuracy by filing.
- Arrange their work place functional, safe and accessible.
- Describe and follow safety regulations, particularly those arising from mechanical production.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

#### Content:

- 1.1 Technical parts drawing
- 1.2 Working plan
- 1.3 Scribing
- 1.4 Stamping ID-number
- 1.5 Sawing with hacksaw
- 1.6 Rough and finish filing
- 1.7 Checking and measuring

**Lesson 2:****Scribing guide block**

(4h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing.
- Determine tolerances from technical drawings and observe for production.
- Select and operate measuring – and testing instruments for lengths, angles and areas.
- Scribe the work piece with scribing block.
- Produce areas and forms at work pieces with given accuracy by filing.
- Arrange their work place functional, safe and accessible.

*Content:*

- 2.1 Technical parts-drawing
- 2.2 Types of steel bars, form and accuracy
- 2.3 Reference planes
- 2.4 Scribing with scribing block
- 2.5 Filing guide block

**Lesson 3:****Chiseling manifold block**

(4h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing.
- Determine tolerances from technical drawings and observe for production.
- Chisel grooves
- Produce areas and forms at work pieces with given accuracy by filing.
- Arrange their work place functional, safe and accessible.

*Content:*

- 3.1 Filing reference surface
- 3.2 Scribing with scribing block
- 3.3 Chiseling grooves

**Lesson 4:****Drilling manifold block**

(6h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing.
- Scribe and centre-punch work pieces under consideration of properties of materials.
- Select and provide drilling tools corresponding to work order.
- Drilling and counterboring of holes in work pieces.
- Operate drilling machines.
- Determine and adjust drilling speed at drilling machine.
- Clamp drilling tools in chucks and taper sleeves
- Clamp work pieces in machine vice.
- Arrange their work place functional, safe and accessible.
- Describe and follow safety regulations, particularly those arising from operation of drilling machines.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 4.1 Technical parts-drawing with sectional views
- 4.2 Scribing with scribing block, centre punching
- 4.3 Function and operation of drilling machine
- 4.4 Determination and adjustment of cutting and drilling speed.
- 4.5 Construction and types of twist drills
- 4.6 Clamping of work pieces
- 4.7 Safety regulations for drilling machines
- 4.8 Cooling lubricant
- 4.9 Drilling operations

**Lesson 5:**

**Boring manifold block**

(3h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of drilling profile recesses.
- Read technical parts-drawing with sectional views.
- Select and provide tools for countersinking and counterboring.
- Produce profile recesses at holes by countersinking and counterboring .
- Determine and adjust drilling speed for countersinking and counterboring.
- Arrange their work place functional, safe and accessible.

- Describe and follow safety regulations, particularly those arising from operation of drilling machines.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 5.1 Technical parts-drawing with sectional views
- 5.2 Countersinks and counterbores for screw heads.
- 5.3 Construction and types of countersinks and counterbores
- 5.4 Determination and adjustment of cutting and drilling speed.
- 5.5 Cooling lubricants
- 5.6 Boring operation

**Lesson 6:**

**Tapping manifold block**

(3h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of internal threads.
- Read technical parts-drawing with sectional views.
- Describe standards and characteristic dimension of threads
- Select and provide tools for tapping.
- Cut internal threads manually.
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 6.1 Technical parts-drawing with sectional views and threads
- 6.2 Standards and dimensions of threads
- 6.3 Tools for tapping
- 6.4 Tapping operation

**Lesson 7:**

**Notching and drilling channel piece and clamping bar**

(5h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing with sectional views.

- Produce notches by sawing and filing.
- Produce holes and threads by drilling, countersinking and tapping .
- Produce corresponding holes by clamping the work pieces together
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 7.1 Technical parts-drawing with sectional views
- 7.2 Scribing notches and holes
- 7.2 Production of notches in channel piece
- 7.3 Filing clamping bars
- 7.4 Drilling and countersinking channel piece and clamping bar

**Lesson 8:**

**Bending supports**

(6h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production supports.
- Read technical parts-drawing.
- Cut sheet metal by shearing.
- Describe bending process and calculate stretched lengths.
- Arrange their work place functional, safe and accessible.
- Describe and follow safety regulations, particularly those arising from metal shears machines.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 8.1 Technical parts-drawing.
- 8.2 Scribing form of developed view.
- 8.3 Cutting with hand lever shears
- 8.4 Producing of cut-outs at sheet metal
- 8.5 Process of bending, neutral axis
- 8.6 Calculation of stretched length.
- 8.6 Bending in vice with bending block
- 8.7 Drilling together with channel piece and clamping bar.

**Lesson 9:****Drilling, reaming and boring guide block**

(4h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing with sectional views.
- Select and provide tools for drilling, counterboring, reaming and tapping.
- Produce fitting holes by reaming .
- Check fitting holes with limit plug gauges.
- Determine and adjust drilling speed for reaming.
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 9.1 Technical parts-drawing with sectional views
- 9.2 Basics of tolerances and fits.
- 9.3 Checking of tolerances with limit plug gauges
- 9.4 Construction and types of reamers
- 9.5 Scribing and centre punching
- 9.6 Drilling and boring
- 9.7 Reaming operation

**Lesson 10:****Producing flanges**

(4h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing with sectional views.
- Produce profile recesses at holes by countersinking and counterboring .
- Produce chamfers by filing
- Produce square cutouts.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 10.1 Technical parts-drawing with sectional views
- 10.2 Filing outside dimensions

- 10.3 Scribing and centre punching
- 10.4 Drilling, sinking and boring
- 10.5 Producing of square cut-out
- 10.6 Filing of chamfers

**Lesson11:****Mounting sub-assembly 1**

(4h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for mounting assemblies.
- Read group- and assembly drawings.
- Select and provide tools for assembling.
- Connect components with screws and fitting connections.
- Check the function of moving parts.
- Check components for flush mounting
- Adjust components for mounting and rework
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 11.1 Assembly drawings.
- 11.2 Components list.
- 11.3 Standard part, especially types of screws
- 11.4 Joining components with screws and washers.
- 11.5 Mounting sub-assembly 1
- 11.6 Checking of function

**Lesson 12:****Bending of bearing plate**

(4h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of bearing plate.
- Read technical parts-drawing.
- Scribe outline with radii on sheet metal.
- Shear sheet metal on hand lever shears.
- File outline with radii.

- Bend sheet metal with bending block in vice.
- Drill sheet metal
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 12.1 Technical parts-drawing
- 12.2 Working plan for production of bearing plate.
- 12.3 Scribing outline with radii
- 12.4 Cutting outline with hand lever shears.
- 12.5 Drilling
- 12.6 Bending with bending block
- 12.6 Drilling

**Lesson 13:****Production of gripper jaws**

(6h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of gripper jaws.
- Read technical parts-drawing with sectional views.
- Select and provide tools for production
- Scribe outlines and centre punch holes.
- Produce work pieces by sawing, filing and drilling.
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 13.1 Technical parts-drawing with sectional views
- 13.2 Working plan for production of gripper jaws.
- 13.3 Scribing slopes
- 13.4 Drilling through and blind holes
- 13.5 Sawing slopes.
- 13.6 Filing slopes and radii

**Lesson 14: Producing clamping rail and square**

(4h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of clamping rail and square.
- Read technical parts-drawing with sectional views.
- Select and provide tools for production
- Scribe outlines and centre punch holes.
- Produce work pieces by filing and drilling.
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 14.1 Technical parts-drawing with sectional views
- 14.2 Working plan for production of clamping rail and square.
- 13.3 Scribing and centre punching
- 13.4 Filing to finished size
- 13.5 Drilling and tapping.
- 13.6 Filing chamfers

### **Lesson1 5:**

#### **Winding of compression spring**

(2h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Wind a compression spring

*Content:*

- 15.1 Compression spring as standard part
- 15.2 Winding of compression spring.

### **Lesson16:**

#### **Mounting sub-assembly 2: gripper**

(3h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for mounting assemblies.
- Read group- and assembly drawings.
- Select and provide tools for assembling.
- Connect components with screws and fitting connections.
- Check the function of moving parts.

- Check components for flush mounting
- Adjust components for mounting and rework
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 16.1 Assembly drawings.
- 16.2 Components list.
- 16.3 Joining components with screws and washers.
- 16.4 Mounting sub-assembly 1
- 16.5 Checking of function

**Lesson17:****Cutting guide block**

(3h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing
- Scribe outlines of work pieces.
- Cut sectional bars by sawing
- Produce areas at work pieces with given accuracy by filing.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 17.1 Technical parts-drawing
- 17.2 Dismantling sub-assembly 2
- 17.3 Scribing
- 17.4 Sawing
- 17.5 Filing to new dimensions

**Lesson18:****Production of guide frame**

(5h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing with sectional views

- Scribe outlines and centre lines of work pieces.
- Produce areas at work pieces with given accuracy by filing.
- Find drilling diameters for tapping and reaming from tables.
- Produce holes, profile recesses and threads by drilling, counterboring, tapping and reaming
- Observe rules for production of pin connections such as fits and drilling and reaming of components in assembled condition.
- Join components with pins and screws.
- Follow safety regulation arising from operation of drilling machines.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 18.1 Technical group- and parts-drawing
- 18.2 Filing guide blocks and guide bars to finished size.
- 18.3 Scribing
- 18.4 Drilling and counterboring
- 18.5 Tapping
- 18.6 Mounting and adjustment of components
- 18.7 Reaming
- 18.8 Joining with dowel pins

**Lesson19:****Production of guide carriage**

(8h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces.
- Read technical parts-drawing with sectional views
- Scribe outlines of work pieces.
- Produce areas at work pieces with given accuracy by filing.
- Produce holes, profile recesses and fit holes by drilling, counterboring, tapping and reaming
- Observe rules for production of pin connections such as fits and drilling and reaming of components in assembled condition.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 19.1 Technical parts-and group-drawing
- 19.2 Filing, drilling and counterboring of guide plate
- 19.3 Filing, drilling and counterboring of guides
- 19.4 Filing surfaces of guide block, guide plate and guides flush to each other
- 19.5 Drilling and reaming of guide and guide block together

**Lesson 20:****Mounting of subassembly 3 –guide carriage**

(4h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for mounting assemblies.
- Read group- and assembly drawings.
- Select and provide tools for assembling.
- Connect components with screws and fitting connections.
- Check the function of moving parts.
- Check components for flush mounting
- Adjust components for mounting and rework
- Arrange their work place functional, safe and accessible.
- Communicate with partners (customers, suppliers and colleagues)
- Develop readiness for self learning to improve knowledge and working skills.

*Content:*

- 20.1 Assembly drawings.
- 20.2 Components list.
- 20.3 Mounting guide frame on channel piece.
- 20.4 Adjust and rework components of guide carriage flush
- 20.5 Mounting of guide carriage in guide frame
- 20.6 Checking of function

**Lesson 21:****Module examination**

(8h)

*Objectives:*

After finishing this lesson, the trainees are able to;

- Determine working steps for production of work pieces and assemblies according to functional, manufacturing and economical criteria.
- read and apply component,- group and assembly drawings.
- Determine tolerances from technical drawings and observe for production.

- Select and operate measuring – and testing instruments for lengths, angles and areas.
- Scribe, centre-punch and mark work pieces under consideration of properties of materials.
- Select and provide tools corresponding to work order.
- Saw and shear sheet metal and sectional bars corresponding to scribing lines.
- Produce areas and forms at work pieces with given accuracy by manual work.
- Produce holes and counterbores in work pieces with given accuracy.
- Produce internal and external threads manually.
- Produce boreholes in work pieces by reaming.
- Form sheet metal from steel and non-ferrous metals cold.
- Join work pieces with screws, nuts, washers and screw locking devices.
- Join work pieces by brazing and soldering.
- Arrange their work place functional, safe and accessible.
- Describe and follow safety regulations, particularly those arising from mechanical production.

*Content:*

- 16.1 Written test
- 16.2 Assembly and parts drawings of examination device.
- 16.3 Developing working plan
- 16.4 Scribing of outlines and centre lines
- 16.5 Production of components
- 16.6 Mounting and joining of examination device
- 16.7 Checking of function

#### **IV. Prerequisites for implementation of module**

- **Mechanical workshop:**

- For every trainee:
  - Working bench with vice
  - Drawer cabinet under working bench
  - Standard tool set for metal working
  - Standard set of measuring instruments
- For every group of 4 to 6 trainees:
  - Table-top or column drilling machine with accessories
  - Marking plate with scribing block
  - Tool set for drilling , countersinking and counterboring, tapping and reaming.
- For the entire workshop:
  - 1 machine saw (hacksaw, ribbon-saw or circular-saw)

- Material store
  - Store for standard parts
  - 2 hand-lever shears
  - 1 gas welding station
- **Basic equipment for workshop**
    - Compressed air supply ( 2 safety sockets)
    - Electrical power 230V
    - 3-phase power 400 V
    - Emergency switch-off for complete workshop
    - Instructors desk
    - Cabinets for tools and didactic materials
    - Store for spare tools and consumables
  - **Classroom or teaching corner (in the workshop or directly beside the workshop)**
    - Blackboard, min. 2.5 x 1.2m
    - Overheadprojector and projection screen
    - Students chair with writing desk
  - **Consumables**
    - Flat rolled steel, bright steel
    - Profile steel
    - Sheet metal (steel, aluminum, brass)
    - Tools (hacksaw blades, drills, tapers)
    - Cooling lubricant, cutting oil
    - Solder, fluxing agents, oxygen, acetylene

## **V. Evaluation methods and contents of tests**

- The evaluation of this modules contains:

### **1. Accompanied evaluation**

Every task-element (lesson) is evaluated in an evaluation form. The evaluation contains function check, visual inspection and dimension check.

### **2. Written examination**

The written examination takes place at the end of the module.

The trainee solves in max. 120min questions and exercises, related to objectives and contents of this module, either in form of multiple choice questions or essay questions.

### 3. Examination work piece

The trainee shall fabricate a sub-assembly under usage of prefabricated parts in max 420min by manual cutting, drilling, bending and joining.

## VI. Guide for implementation of the module

- **Fields of implementation of this module:**

- This module is used to qualify the trainees of vocational training programme at 2-year intermediate level for mechatronic trade on the level of skilled worker.
- This module is a basic module, that could be also used to train:
  - mechatronic trade on college level
  - trades in the field of mechanical engineering

- **Organization:**

- The lessons of this module should be organized in large blocks of at least one week up to 4 weeks duration to guarantee a steady work.

- **Some main guides in view of teaching methods for this module:**

- Before implementation of this module, the teaching staff should prepare all necessary prerequisites based on contents of individual lessons to ensure the teaching quality.
- The teaching staff should guide the trainees to the ability to plan, execute and monitor their work independently.
- The teaching staff should guide the trainees to arrange their working place functional, safe and accessible.
- The teaching staff should guide the trainees to time management, this means that the trainees should finish the work pieces in a given time frame.
- The teaching staff should instruct, give examples and correct errors while the trainees practice.
- The teaching staff should especially watch the quality and accuracy of the work and the observation of tolerances.
- The teaching staff should guide the trainees to self-evaluation of their work pieces.

- Teaching and learning materials for module 01:

- " Qualification Project Pick & Place Device"  
published by: South Westphalia Chamber of Commerce and Industry, Hagen (Germany) Technical Training Centers, 1993



