

**Chipping – Course: Technique for Manual Working of Materials.
Methodical Guide for Instructors**

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Chipping – Course: Technique for Manual Working of Materials. Methodical Guide for Instructors

Institut für berufliche Entwicklung e.V.
Berlin

Original title:
Methodische Anleitung für den Lehrenden
"Meißeln"

Author: Frank Wenghöfer

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Institut für berufliche Entwicklung e.V.
Parkstraße 23
13187 Berlin

Order No.: 90–32–3110/2

1. Objectives and contents of practical vocational training in the working technique of "Chipping"

By concluding their training, the trainees shall have a good command of the working technique of "Chipping". Therefore, the following objectives have to be achieved:

Objectives

- Knowledge of purpose and application of chipping.
- Proper command of the various working techniques of chipping and capability of separating or, resp., cutting workpieces.
- Capability of selecting the appropriate tools and accessories and of using them appropriately.
- Capability of making decisions on quality independently.

The following contents have to be imparted to the trainees:

Contents

- Purpose of chipping
- Tools, accessories and means of protection for chipping
- Action and working techniques of chipping

2. Organizational preparations

In order to guarantee a trouble-free development of the instructions, exercises and practical work it is necessary to prepare this training properly.

The following steps have to be taken:

2.1. Preparations for instructions on labour safety

Prior to the exercises the trainees have to be given a brief instruction on the proper use of tools and

equipment. This comprises also hints for accident-free work.

The following points should be emphasized:

- Use proper hammers and chisels only!
- Chisel heads must be free from burrs!
- Protect your hands from accidents by providing the chisel with an impact guard (cover)!
- Wear safety goggles to protect your eyes from injuries!
- Enclose your workplace in the direction of impacts by means of protective gratings or protective screens.

Familiarity with these hints has to be confirmed by the trainees' signatures in a control book.

2.2. Provision of teaching aids

- For demonstration purposes during the instructions a vice should be installed at the place of instruction.
- The "Trainees' Handbook of Lessons – Chipping" is to be handed out to the trainees in sufficient numbers.
- When using the transparencies series of "Chipping", check whether they are complete (transparencies nos. 10.1 – 10.5.) and whether the overhead projector is in working order. (Check the operating conditions at the place of instruction and make sure of the proper mains supply!)
- Surveys etc. which have to be written on the blackboard must be completed prior to the instruction.
- All the tools and accessories for chipping mentioned in section 3 should be kept ready for illustration purposes.

2.3. Provision of working tools and materials

- Sufficient copies of the "Instruction Examples for Practical Vocational Training – Chipping" must be handed out to the trainees to provide them with the theoretical foundations for the exercises to be carried out.
- The initial materials required for the exercises must be prepared and laid out in sufficient numbers on the basis of materials mentioned in the "Instruction Examples...".
- Each trainee is to be provided with a workbench at which a vice, the required steel supports and good lighting are available.
- The instructor has to check whether the workbenches of the trainees are fully equipped with tools and accessories necessary for the planned exercises.

Recommended basic equipment:

- steel rule, protractor, depth gauge, vernier caliper
- steel scriber, prick-punch, double-point punch
- hammer, hand hacksaw
- flat chisel, cape chisel, half-round grooving chisel, mortise chisel
- bastard and smooth files – 300 mm (flat)
- C-clamps

Bench- or column-type drilling machines and the required clamping tools (machine vice, holding clamps, C-clamps) must be provided for the necessary preliminary work (drilling) in some of the exercises.

Based on the regulations on labour safety, the instructor has to check that the drilling machines are in good working order prior to the exercises..

2.4. Time schedule

Time planning is recommended for the following training stages

- introduction to the working techniques in the form of instructions
- necessary demonstrations
- job–related instructions to prepare the exercises
- carrying out the exercises
- recapitulations and tests.

The necessary time share depends on the respective training conditions. The biggest time share must be allocated to the exercises.

3. Recommendations for practical vocational training in the working technique of "Chipping"

The following paragraphs comprise proposals on conducting trainee instructions, demonstrations of working techniques, exercises and tests..

Two course variants are recommended:

Variant no. 1

This variant should be chosen for trainees with generally good achievements and receptiveness.

- 1.1. Introductory instruction for the whole subject, with demonstrations based on the "Trainees' Handbook of Lessons".
- 1.2. Exercises in chiselling based on the "Instruction Examples 10.1. – 10.5." with subsequent evaluation.
- 1.3. Final test of theory knowledge based on the "Examples for recapitulation and tests".

Variant no. 2

This variant should be chosen for trainees with little previous knowledge or poor achievements.

- 2.1. Introductory instruction with demonstrations based on the "Trainees" Handbook of Lessons"
- 2.2. Exercises in cutting–off chipping based on the "Instruction examples nos. 10.1. – 10.3." with subsequent evaluation.
- 2.3. Additional instruction in the working technique of chipping chiselling.
- 2.4. Exercises in cutting–off and chipping chiselling based on the "Instruction examples 10.4. and 10.5." with subsequent evaluation.
- 2.5. Final test on theory knowledge based on the "Example for recapitulation and tests"

Practical skills should be checked immediately after handing over the finished workpieces. Theory knowledge can be checked constantly; however, it is recommended to have a final test written (item 1.3. to 2.5.) after the exercises.

3.1. Introductory instruction

If possible, this instruction should be conducted in a classroom.

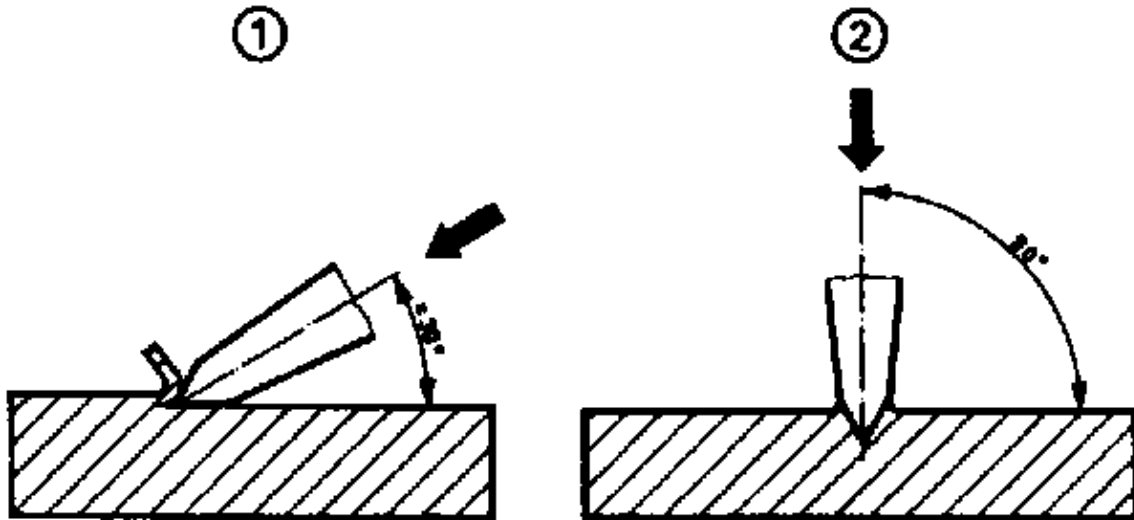
Make sure that the trainees put down necessary and supplementary notes or answers to questions in their "Trainees' Handbook of Lessons".

The instruction can be given based on the main points contained in the "Trainees" Handbook of Lessons".

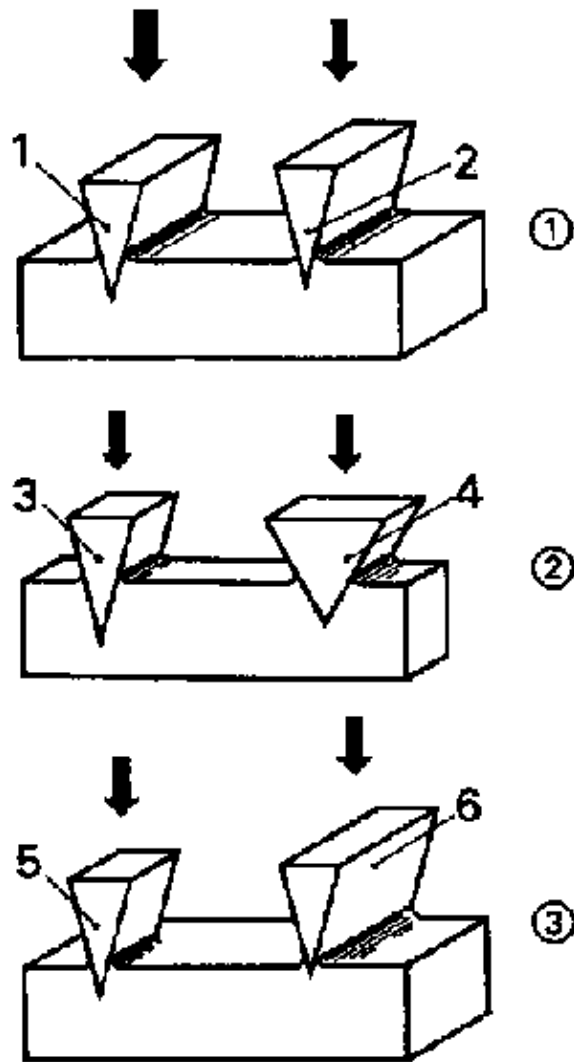
Purpose of chipping:

The trainees have to learn that cutting-off and chipping by chiselling are energy and time-consuming activities. The instructor has to give examples of such cases where it will not be possible to employ machining techniques and where, therefore, chipping is required.

Based on the transparencies nos. 10.1, and 10.2, the instructor can describe the positions and actions of chisels.



Transparency 10.1



Transparency 10.2

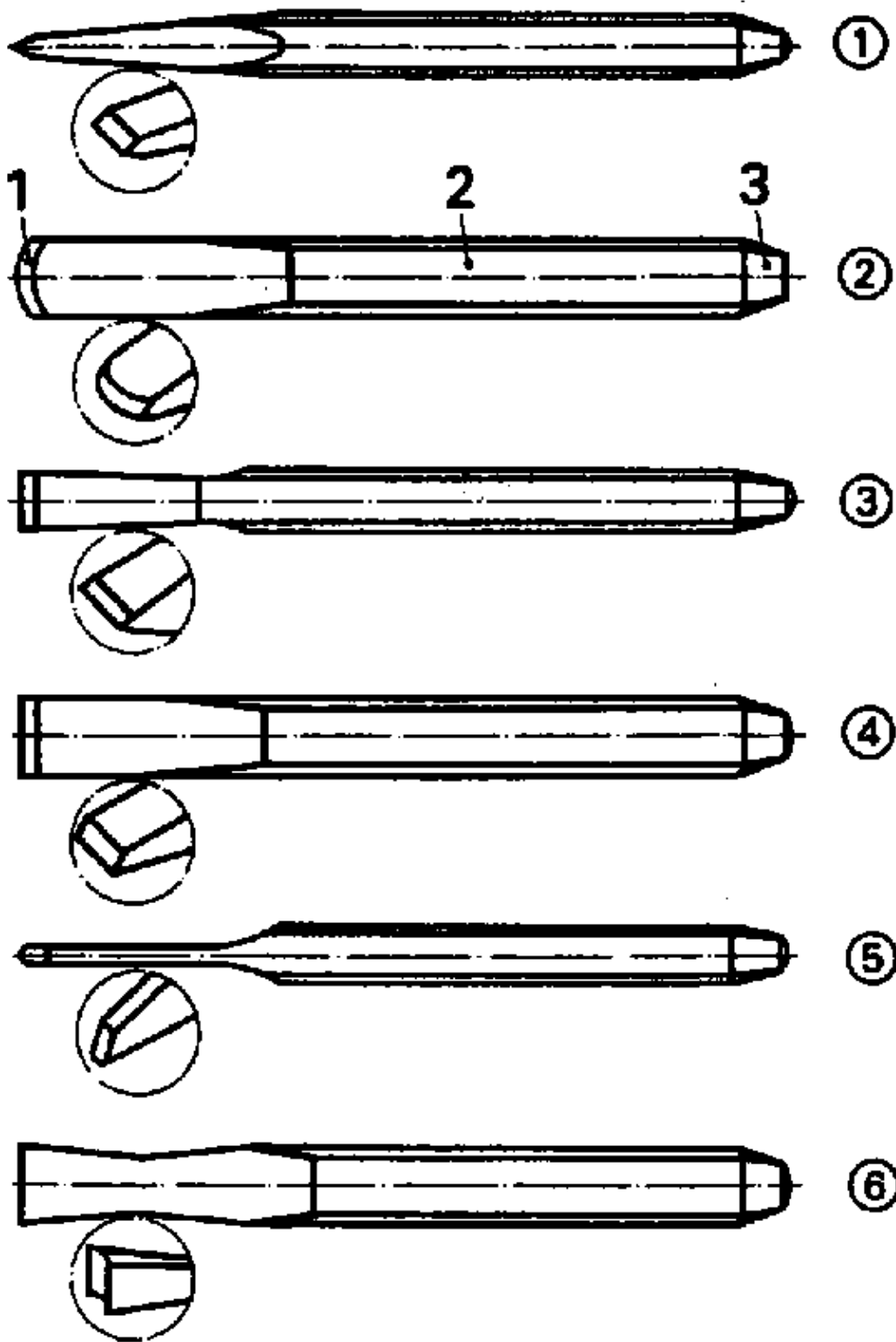
Tools, accessories and protective means for chipping:

The following original tools should be shown and the instructor has to explain when to use them:

- flat chisel (chipping chisel)
- round chisel
- cape chisel
- shear chisel
- grooving chisel
- mortise chisel
- punching tool

If it is not possible to show all the chisels as original tools, transparency no. 10.3. can be used as a teaching aid. The respective illustrations are also contained in the "Trainees' Handbook of Lessons"

When explaining the kinds of chisels the instructor has to mention how chisels are ground.



Transparency 10.3

This includes a description of the relation between the wedge angle of the tool edge and the material properties:

material property	wedge angle
soft (aluminium)	30° – 50°
medium-hard (steel)	60°
hard (tool steel)	

	60° – 70°
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Other tools and accessories to be mentioned are:

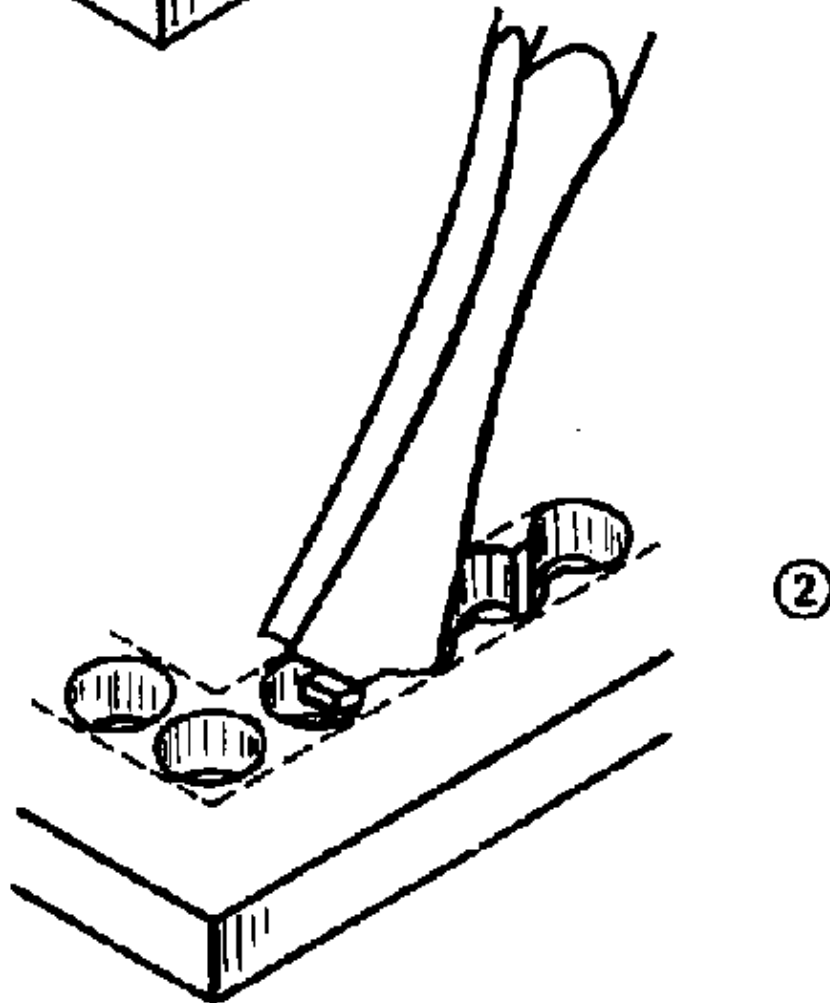
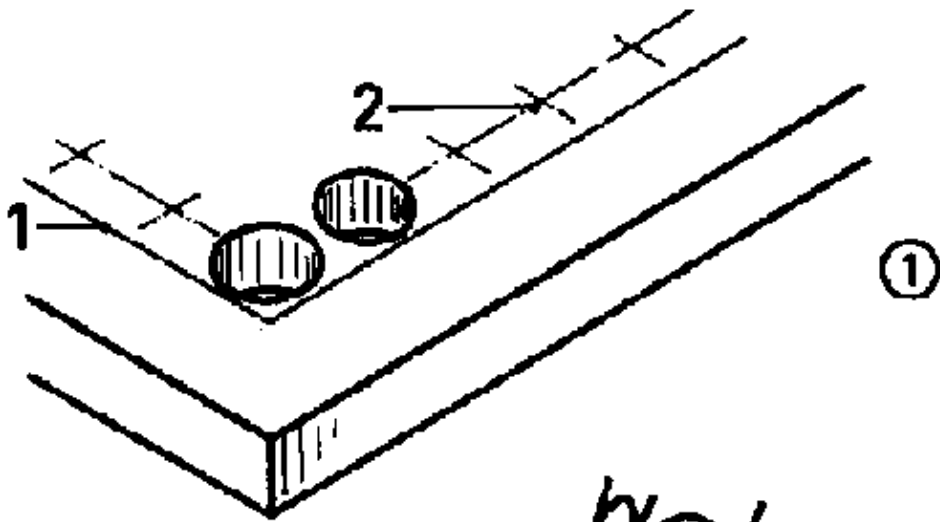
- locksmith's hammer
- supports (steel plates and blocks, anvil)
- vice.

The instructor has to stress that surface plates must never be used as a support, because the chisel edge would destroy the surfaces of the plates. The following means of protection should be mentioned:

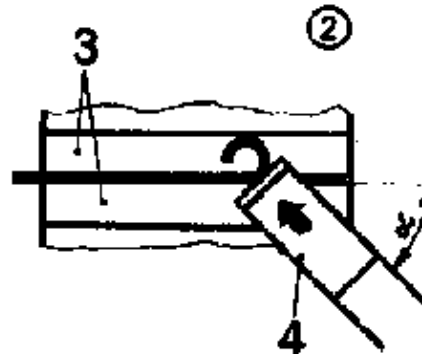
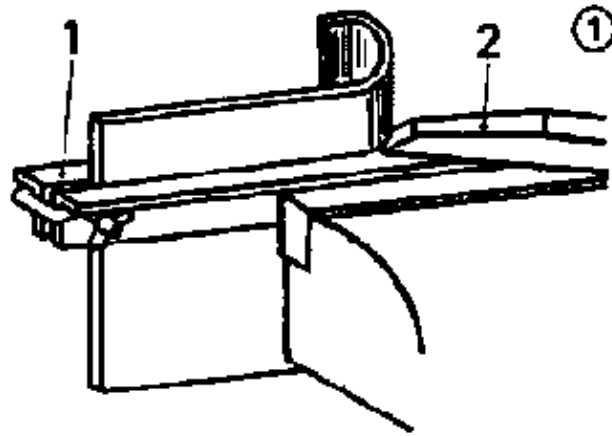
- protective gratings and screens
- safety goggles and impact protection

Action and working techniques of chipping:

This subject can be clearly explained by using transparencies nos. 10.1. and 10.2. as teaching aids. The instructor has to deal in detail with handling the chisel when chipping and cutting-off. This instruction can be supported by the hints contained in the "Trainees' Handbook of Lessons" and the respective illustrations, as well as by using transparencies nos. 10.4. and 10.5. as teaching aids.



Transparency 10.4



Transparency 10.5

If possible, the instructor has to give a demonstration of chipping and cutting-off chiselling on small-size steel parts. When speaking about cutting-off chiselling of curved contours the instructor has to refer to the preparation of this work by scribing a bore line. He has also to refer to the necessary formulae, and a calculation should be done using the available widths of a double-point punch.

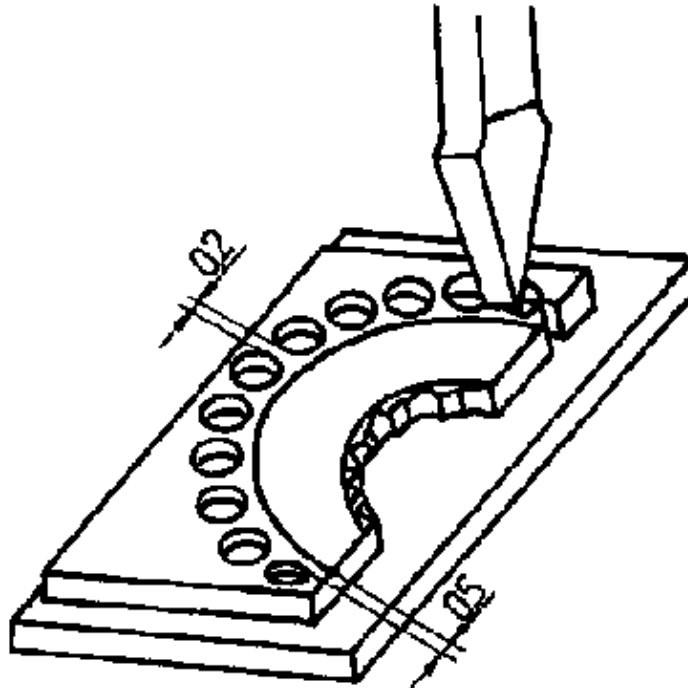
D = diameter of drill

y = width of double-point punch

x = distance of bore line from scribed line

$$D = y - 0.2 \text{ mm}$$

$$x = \frac{D}{2} + 0.5 \text{ mm}$$



Drilling and chiselling out of curved contours

3.2. Exercises

If it has not been possible to include demonstrations in the instructions, this should be done right now prior to the exercises.

Subsequently, the trainees can begin with their first exercises based on the "Instruction examples for practical vocational training".

However, it is necessary to prepare every individual exercise by a brief "job-related instruction" in the course of which the trainees are shown a finished workpiece in order to demonstrate the objectives and purpose of the exercise.

The instructor must have made such a workpiece himself in order to be familiar with all the problems which might arise from producing such a workpiece.

Thus, the main points of evaluating the achievements can be clearly defined, and the instructor can inform about difficult areas in the exercise. During these instructions the sequences of operations and the working drawings should be placed on the desks so that the trainees can put down additional notes therein.

All the trainees can perform these exercises simultaneously, provided that the necessary tools etc. are available. In this case the trainees can carry out all the individual exercises by themselves. Each trainee should be given as much time as required.

If there are not enough tools available, the instructor has to form groups of trainees. It is recommended to divide these groups on the basis of applying the various kinds of chisels:

- group no. 1 – working with flat chisels only
- group no. 2 – working with flat, cape and grooving chisels.

If there are still trainees who cannot take part in these exercises, they should perform additional exercises to consolidate working techniques acquired earlier.

3.3. Examples for recapitulation and tests

This section comprises questions which are to consolidate and test the previously acquired knowledge and skills. Each question is provided with the respective answer. Questions which are also contained in the "Trainees' Handbook of Lessons" are marked with the letter "A".

1. What is the purpose of chipping?

(Cutting–off or chipping of material.)

2. When do we employ the chipping technique?

"A" (If it is not possible to employ mechanical techniques or if these are too costly.)

3. What is the material chisels are made of?

"A" (Unalloyed tool steel with hardened cutting edge.)

4. What are the criteria for selecting chisels?

"A" (The criteria are: kind of work and hardness of material–of the workpiece.)

5. What kinds of chisels do we know?

(flat, round, cape, shear, grooving, mortise and punching chisels (tools).)

6. What is the purpose of using flat chisels?

"A" (Flat chisels are the most common tools for cutting–off and chipping chiselling)

7. What is the purpose of using cape chisels?

"A" (They are used for cutting out horizontal grooves and for cutting–off the webs in bore lines.)

8. What is the recommended wedge angle of cutting edges for working on medium–hard steel?

"A" (60°)

9. Which additional tools and accessories do we need for chipping?

"A" (Hand hammer, supports, vice.)

10. What is the basic principle for selecting the hammer?

"A" (The hammer must have double the weight of the chisel.)

11. Which property must supports have?

"A" (They must not be hardened so that they can absorb the impact of blows.)

12. Why must surface plates never be used as supports?

"A" (The penetrating chisel edge would leave notches and uneven spots on the plates so that they could no longer be used for their proper purpose.)

13. What do you have to take into account when chiselling a workpiece in a vice?

(You must hammer against the fixed jaw of the vice and use a firm counter–support.)

14. Which protective means are used to prevent accidents?

(Protective gratings or screens, goggles and impact protection.)

15. What is the task of protective screens and safety goggles?

"A" (To protect people from being hit by flying chips and fragments of workpieces.)

16. What is the action of chiselling?

(The impact of the hammer on the chisel head is transferred to the cutting edge, which **can** perform its chipping work now.)

17. What is the position of the chisel in a chipping operation?

"A" (The chisel inclination towards the surface of the workpiece is about 30°.)

18. How are metal sheets chiselled which are clamped in a vice?

(The chisel must be in an inclined position – with an angle of inclination of 45°.)

19. What is the position of the chisel in a cutting–off operation?

"A" (Perpendicular to the surface of the workpiece.)

20. How can we chisel off curved contours from thicker workpiece?

"A" (Scribing and punching of a bore line with a double–point punch; drilling; chiselling off the webs with mortise chisel.)

4. Application of the working technique of "Chipping"

Based on the variants mentioned in section 3, the exercises can be designed as a single subject–oriented instruction or in several stages.

Based on the "Instruction examples for practical vocational training – Chipping" the trainees can carry out 5 exercises with an increasing degree of difficulty.

These "Instruction examples ..." also comprise a list of materials (initial material, hand tools, measuring and testing tools, accessories) as well as a sequence of operations associated with the exercise. Also contained is an illustrative working drawing. Thus, the trainees avail of all the necessary information in order to begin their exercise–related work.

If the course of the exercise reveals that the quality of the workpieces does not meet the requirements, the trainees must carry out comprehensive preliminary exercises.

In this case they should use any waste parts. After having practised the skill sufficiently, the envisaged workpiece can be manufactured.

The following hint for organising the work should be taken into account:

The trainee has to carry out all the necessary work by himself – from cutting the initial material up to the completion of the workpiece.

This is the only way to guarantee a just evaluation of the achievements.

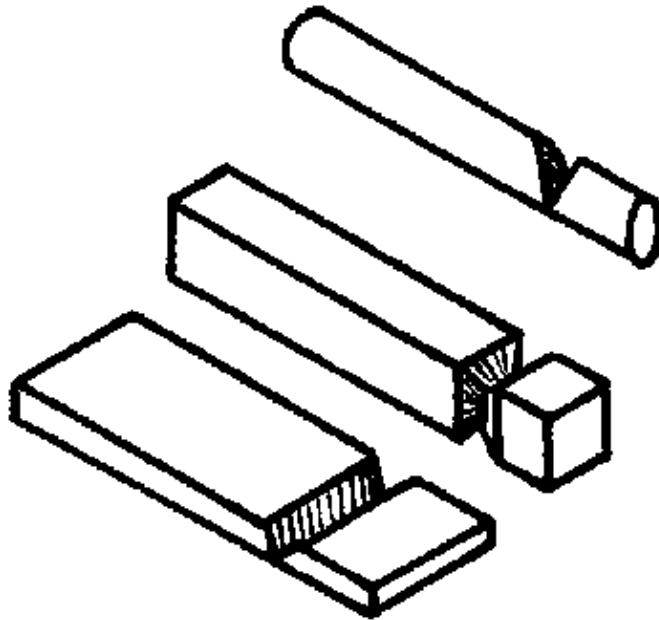
If the proposed instruction examples cannot be used for the exercises, it will be possible to select other workpieces. In this case the instructor has to make sure that the trainees can practise all the working techniques mentioned earlier.

4.1. Instruction examples

What follows is a brief description of the individual instruction examples in order to give a survey of those workpieces on which the knowledge previously acquired can be practised.

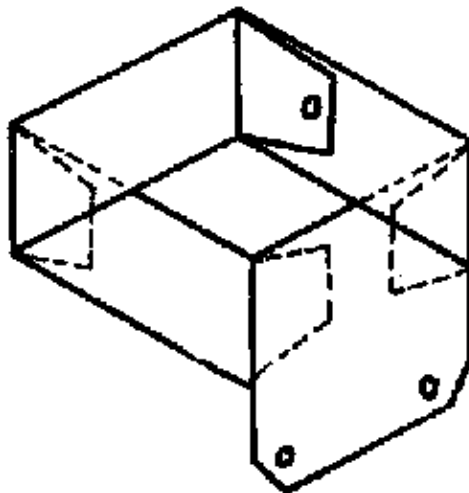
Instruction example 10.1.

Training workpieces for cutting–off chiselling



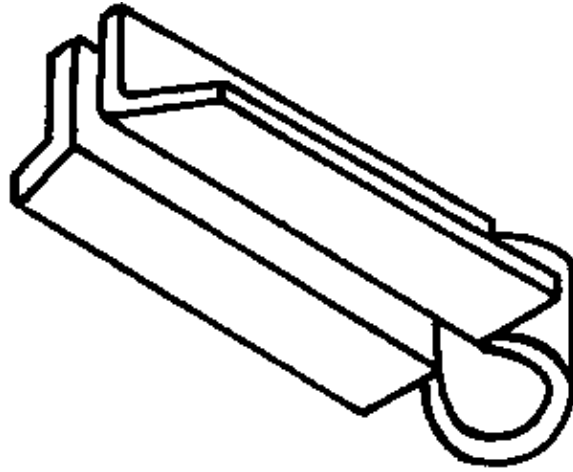
The technique of cutting-off chiselling will be practised at various cross-sections of steel.

Instruction example 10.2.
Case for safety goggles



Cutting-off and shearing chiselling practises are employed to form a metal sheet in such a way that it can be bent to form a case. This case for safety goggles must be properly dimensioned. It can be fixed close to the drilling or grinding machines.

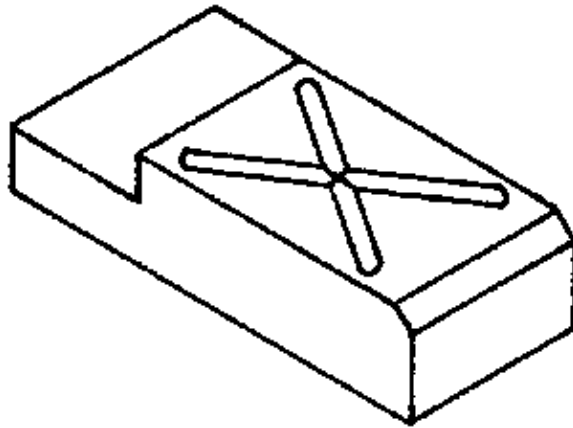
Instruction example 10.3.
Dog vice for sheet metal



The trainee has to produce a bore line on angle steel and to chisel off sections and cut-outs. This workpiece can be used for clamping metal sheets in a workshop vice..

Instruction example 10.4.

Drilling support

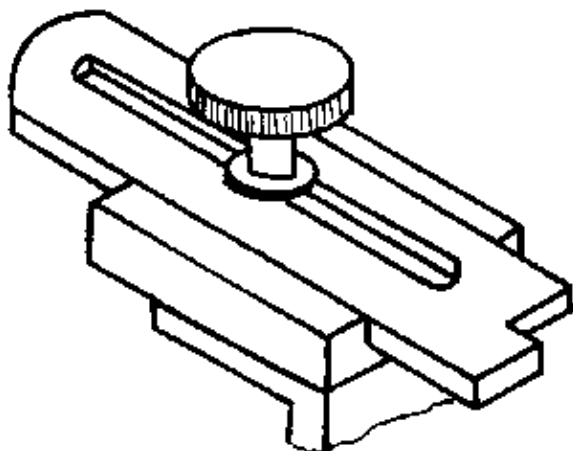


The trainees practise the chipping chiselling of surfaces and grooves on cast iron. They employ cape and grooving chisels.

After its completion this workpiece can be used as an accessory for drilling machines.

Instruction example 10.5.

Marking gauge



Several flat steel components serve to practise cutting-off and chipping chiselling by producing break-throughs and by working on surfaces. After its completion this device can be used as an accessory for marking-out operations.

4.2. Criteria for practical training

It is recommended to determine some crucial points of evaluation and supervision. The following criteria can serve as a guideline:

Cutting-off chiselling

- Is the chisel position precisely perpendicular?
- Does the trainee drill the corner points in thin metal sheets and continue by chiselling on a hardened support?
- Does the trainee notch thicker sections from all sides in order to break them?
- Does the trainee prepare long dividing lines by producing a guide notch?
- Does the trainee prepare curved contours, which are to be chiselled off, by providing a bore line?

Chipping Chiselling

- Is the chisel position properly inclined?
- Does the trainee chisel off thin layers at narrow surfaces with the chisel in an angular position?
- Does the trainee chisel off thicker layers in several stages?

5. Captions and legends of the "Chipping" transparencies aeries

Transparency no. 10.1. Position of chisel in chipping and cutting-off operations

- (1) chipping chiselling
- (2) cutting-off chiselling

Transparency no. 10.2. Principle of wedge penetration (chisel edge) into the material

- (1) equal wedge angles – unequal action of force
 - 1 action of higher force
 - 2 action of lower force (smaller depth of penetration)
- (2) different wedge angles – equal action of force
 - 3 smaller wedge angle
 - 4 bigger wedge angle (smaller depth of penetration)
- (3) different edge lengths – equal action of force and equal wedge angle
 - 5 smaller length of edge
 - 6 bigger length of edge (smaller depth of penetration)

Transparency no. 10.3. Kinds of chisels

- (1) flat chisel (chipping chisel)
- (2) round chisel (3) cape chisel

- (4) shear chisel
- (5) grooving chisel
- (6) mortise chisel

Transparency no. 10.4. Chiselling–off of thin metal sheets

(1) Scribing and drilling

1 scribed line

2 bore line

(2) Chiselling out of "webs" with a mortise chisel

Transparency no. 10.5. Shearing–off of metal sheets

(1) shearing–off of longer metal sheets by shearing chisel and dog vice for sheet metal (angle steel with clamp)

1 dog vice for sheet metal

2 shearing chisel

(2) shearing process in a vice

3 vice jaws

4 chisel angle of inclination of about 45°