Hammering and Marking – Course: Technique for Manual Working of Materials. Methodical Guide for Instructors

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Hammering and Marking – Course: Technique for Manual Working of Materials. Methodical Guide for Instructors

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Methodische Anleitung für den Lehrenden
“Hämmern und Kennzeichnen”

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1. Objectives and contents of practical vocational training in the working techniques of “Hammering and Marking”

By concluding their training the trainees shall have a good command of the working techniques of “Hammering and Marking”. Therefore, the following objectives are to be achieved:

Objectives

- Knowledge of the purpose and ranges of application of the hammering and marking techniques.
- Mastery of the various working techniques of hammering and marking.
- Capability of selecting the proper tools and accessories and of their proper use.
- Capability of evaluating the quality of their work.

The following contents have to be imparted to the trainees:

Contents

- Purpose of hammering and marking
- Tools and accessories
- Effect and working techniques of hammering
- Working techniques of marking.

2. Organizational preparation

To guarantee a trouble–free development of instruction, exercises and practical work it is necessary to prepare this training appropriately.

The following steps have to be taken:

2.1. Preparation of instructions on labour safety

Prior to the exercises, a brief instruction in the proper use of working tools and in guaranteeing an accident–free work has to be given.

The main emphasis is to be laid on:

Use of flawless hammers with well–fixed handles only.
Selection of the proper (hard and inflexible) support for hammering.
Use of burr–free punches.
Precautions for preventing fire damage in case of annealing the steel sheets.

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

2.2. Provision of teaching aids

For demonstration purposes during instruction, a vice and appropriate hammering supports have to be installed at the place.

The "Trainees' Handbook of Lessons – Hammering and Marking" has to be handed out to the trainees.

When using the transparencies series of "Hammering and Marking", check whether it is complete (transparencies 3.1. – 3.4.) and whether the overhead projector is functional. (Check the operating conditions at the place of use and make sure of the proper mains supply!)

Surveys which are to be written on the blackboard have to be completed prior to instruction.

All the tools and accessories mentioned in section 3 (for hammering and marking operations) should be kept ready for illustration purposes.

2.3. Provision of working tools and materials

The "Instruction Examples for Practical Vocational Training – Hammering and Marking" must be handed out to the trainees in sufficient copies to provide them with the theoretical foundations for the exercises to be performed.

The initial materials necessary for the exercises are to be prepared and laid out in sufficient numbers according to the specifications of the "Instruction Examples...".

Each trainee is to be provided with a workbench that is equipped with a flat hammering support and a firmly installed vice (check whether it has the appropriate working height).

It must be checked that all workbenches are fully equipped with tools and accessories specified for the planned exercises.

Recommended basic equipment:

– steel rule, vernier caliper, protractor

– steel scriber, centre punch, dividers

– hand hacksaw or hand–lever shear

– bastard and smooth files 200 mm (flat)

– locksmith's hammer (engineers' hammer) chasing hammer, curving hammer, wooden hammer

– sledge, bordering tool, marking punch (numbers and letters)

– surface plate or anvil, clamping devices.

2.4. Time schedule

Time planning is recommended for the following training stages:

– introduction to the working techniques by way of instruction
– necessary demonstrations
– job–related instructions for carrying out the exercises

– carrying out the exercises
– recapitulation and tests.

The necessary time share depends on the respective training conditions. Most of the time is to be allocated to the exercises.

3. Recommendations for practical training in the working techniques of "Hammering and Marking"

The following paragraphs comprise proposals on conducting trainee instruction, carrying out demonstrations of working techniques as well as exercises and tests. We recommend two course variants:

Variant No. 1.

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

1.1. Introductory instruction to the whole subject, accompanied by demonstrations specified in the "Trainees' Handbook of Lessons"

1.2. Exercises in hammering and marking as well as subsequent evaluation as specified in the "Instruction Examples 3.1. –3.7."

1.3. Test of theory knowledge based on the contents of "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 for the subjects of "Lengthening (elongating) and curving", accompanied by demonstrations specified in the "Trainees' Handbook of Lessons".

2.2. Exercises in lengthening and curving as specified in the "Instruction Examples 3.1. – 3.4." and subsequent evaluation.

2.3. Supplementary instruction in the subject of "Chasing and flanging (bordering)" as specified in the "Trainees' Handbook of Lessons".

2.4. Exercises in chasing and flanging as well as evaluation, as specified in the "Instruction Example 3.5.".

2.5. Supplementary instruction in the subject of "Marking" as specified in the "Trainees' Handbook of Lessons".

2.6. Exercises in marking, with subsequent evaluation as specified in the "Instruction Examples 3.6. and 3.7.".

2.7. Final test of theory knowledge as specified in the "Examples for Recapitulation and Tests".

The evaluation of practical skills should be done immediately after handing over the finished workpiece to the instructor. Knowledge of theory can be permanently checked, but it is advisable to have a final test paper (item 1.3. or. resp., 2.7.) after concluding the exercise.

3.1. Introductory instruction

If possible, this instruction should be given in a classroom. Make sure that the trainees put down necessary, supplementary hints or answers to questions in their "Trainees' Handbook of Lessons".

Instruction may be conducted on the basis of the main points contained in the “Trainees’ Handbook of Lessons”.

The main subjects of “purpose of hammering and marking” as well as “tools and accessories for hammering” should be accompanied by an intensive employment of all those teaching aids available.

Purpose of hammering and marking

To demonstrate the purpose of these working techniques, it is advisable to show such workpieces which had been formed, straightened or, resp,, marked by figures and letters. The instructor has to point out that this is mainly used in single–piece production. A summary can be given by using the “Trainees’ Handbook of Lessons” as a guideline.

Tools and accessories

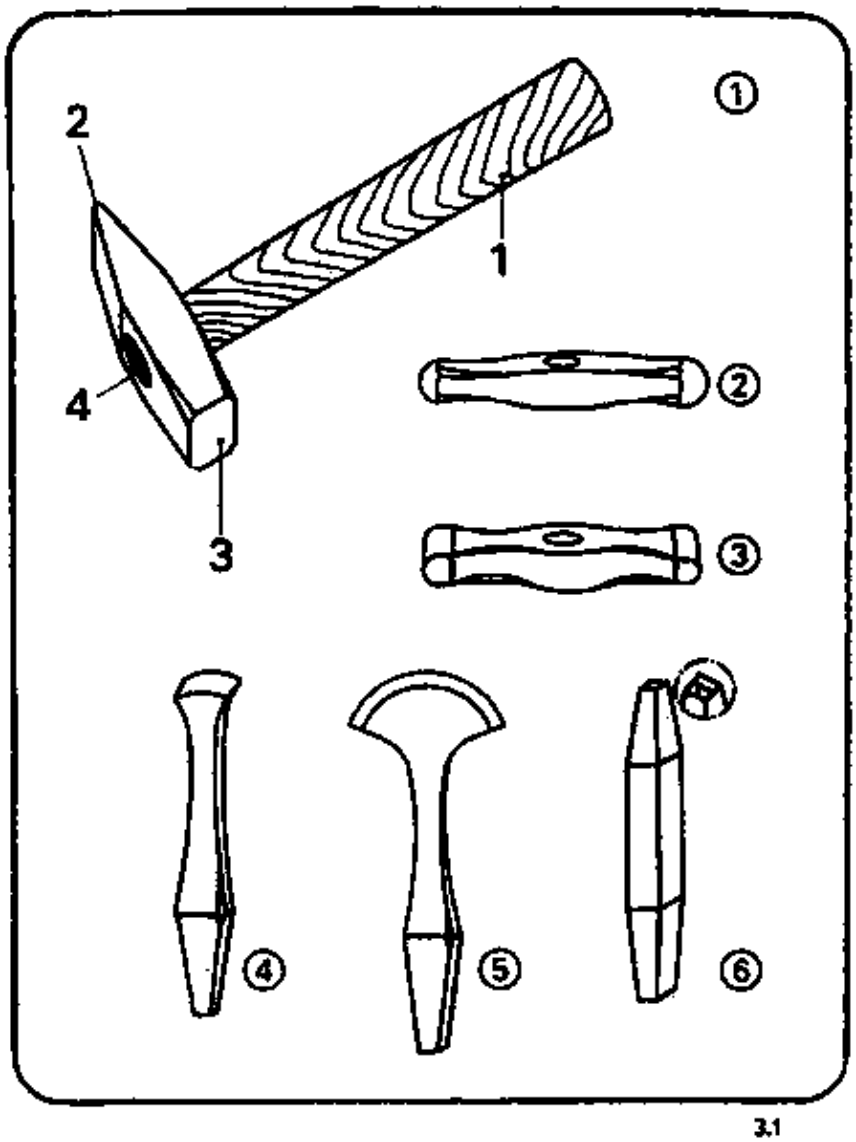
Transparency No. 3.1. can supplement the demonstration of original tools and accessories.

When describing the individual tools and accessories, their intended purpose has to be pointed out.

The following tools have to be shown and introduced:

– locksmith’s hammers
(hand hammer, riveting hammer, bench hammer)

– hammers for sheet metal working
(chasing, curving, finishing and planishing (or smoothing) hammers as well as wooden, rubber and aluminium hammers).



3.1

Following this instruction, the trainees should be in a position to describe the intended purpose of these hammers and to use their correct designations (using size and shape of hammers as distinctive marks).

This is followed by remarks on hammering supports:

– surface plate
– blacksmith's anvil
–special supports for sheet metal working (anvil tool, sledge, blacksmiths' hardy and bordering tool).

The intended purpose of using these supports is to be made quite clear.

The following marking tools should be included in the demonstrations:

– sets of letters (in an alphabetical order)
– sets of numbers
– punches with special numbers or words.

If not all of these tools and accessories are available as originals, the illustrations contained in the "Trainees' Handbook of Lessons" may be employed.

Effect of Hammering

The effects of hammering should be demonstrated by some examples A narrow strip of sheet metal should be worked with the face of a hammer and with the pane of a hammer. Thus, the trainees will learn that the

processes of lengthening and upsetting will be influenced by the form of the hitting area of the tool as well as by the form of the hammering support.

The trainee has to learn the technique of hardening the material by cold working, i.e. by many blows of the hammer. Annealing and the various types of cooling down depending on the kind of material should be mentioned in these instructions. The trainees should be shown how to position the hammer when performing the blows. It is recommended that each trainee does some blows with a hammer, so that mistakes can be corrected immediately.

Following this, the trainees should answer the questions contained in the "Trainees' Handbook of Lessons" in writing.

Working techniques of hammering

The various working techniques should be taught in the following order:

Lengthening

The trainees can be shown the hammering technique of using the face or pane of a hammer once again.

The trainees will understand that blows with the pane will lengthen the material, whereas the face will lengthen and widen the material.

Transparency No. 3.2. can illustrate this process.

Curving

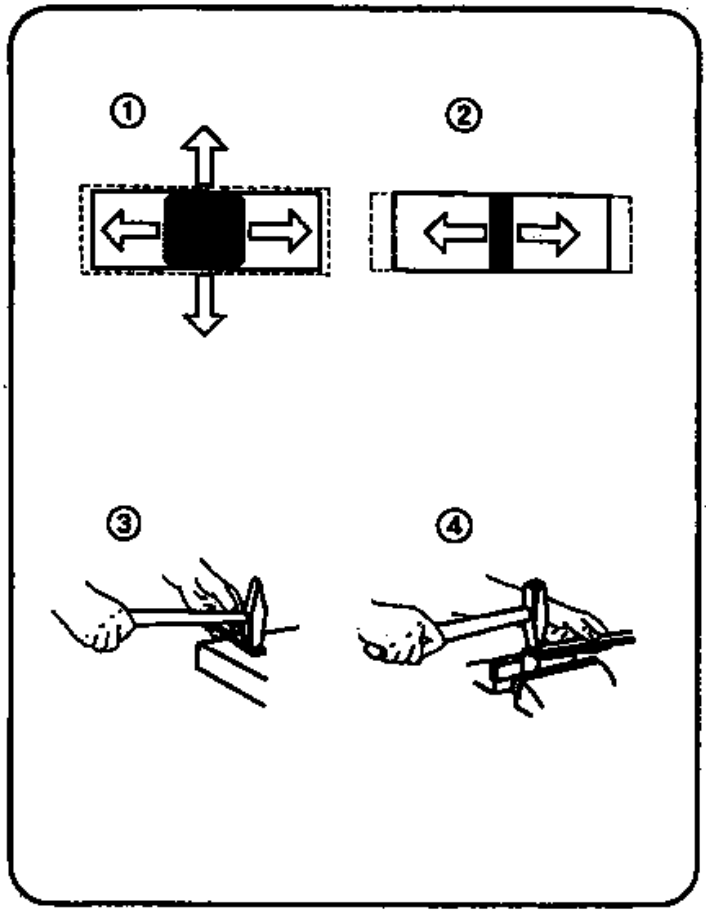
The trainees have to be shown the use of the pane of a locksmith's hammer or the faces of a curving hammer.

When demonstrating this working technique, emphasis is to be laid on evenly distributed hammer blows – the strip of sheet metal must show an arch–like curvature.

Transparency No. 3.3. will help to make this and the following working techniques clear.

Chasing

Two possible variants have to be demonstrated.



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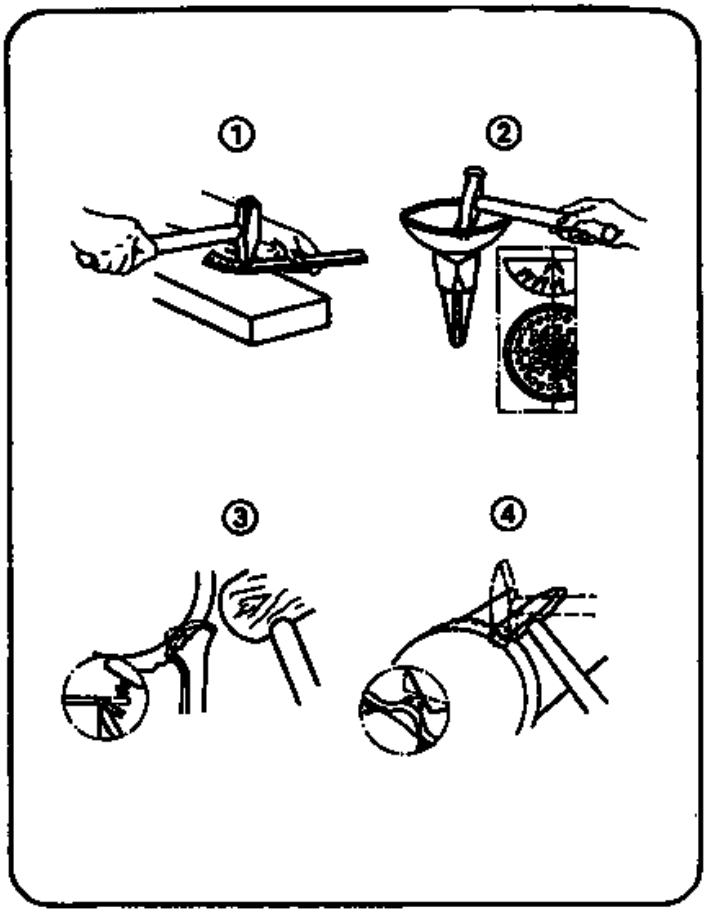


3.3

Variant No. 1

When using the face of a chasing hammer on a flat support, the instructor has to show that the hammer blows begin at the centre of the workpiece and then follow a spiral–like pattern to the outside of the workpiece.

Variant No. 2

When chasing with a rounded wooden hammer or chasing hammer on a hollow support, the instructor has to show that the hammer blows begin at the outside and advance to the centre in a spiral–like pattern.

This is followed by referring to the process of hardening by cold working again. The trainees have to learn that cracks will occur in the sheet metal, if this fact is neglected. Later on the trainees are shown the appropriate forms of annealing and cooling down in a workshop.

Flanging

The various techniques of outside and inside flanging can be explained in combination with the figures in the "Trainees' Handbook of Lessons".

It should be emphasised that this working technique is divided into two stages: rough–flanging and finish–flanging.

The use of various types of hammers (locksmith's hammer, bevelled wooden hammer, chasing hammer, curving hammer) has to be mentioned at the appropriate place.

Working technique of marking

When imparting the knowledge of placing and blowing the marking punch to the trainees, they have to be informed on the necessary preparation by appropriately scribed lines.

The interdependence of height of letters and space between the lines should be demonstrated briefly. This demonstration can refer to the following table and its recommended values:

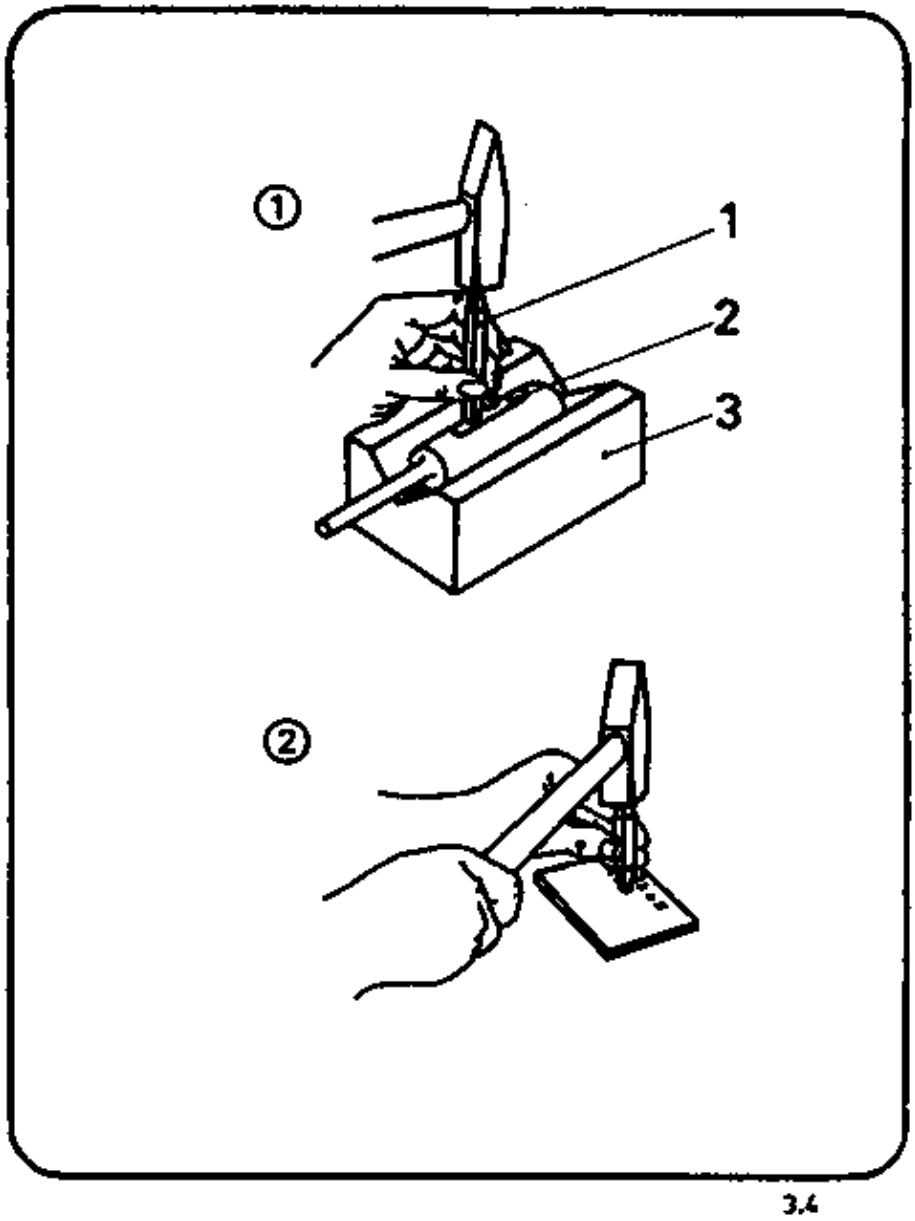
space between the lines	height of figures or letters
3	2.5
5	4
8	6
10	8
12	10

A small piece of sheet metal may serve to demonstrate the working technique of scribing using a marking gauge. The following hints should be included in the instruction on marking punches:

- The head of the punch must be burr–free.
- The engraving of a figure or letter must be perfect.
- The marking punch must not be crooked.

The trainees have to learn that marking operations require a high degree of concentration. This makes it necessary for the order of figures and letters during the marking operation to be permanently monitored.

Transparency No. 3.4. can be used to further illustrate this fact.



3.2. Exercises

If it was not possible to include demonstrations in the instruction, this must be done prior to the start of the exercises. If the trainees avail of only little practical skills, they should perform preliminary exercises on any small–size workpieces:

- minor exercises in lengthening sheet metal strips
- curving of a simple arch
- marking a combination of figures.

However, it is also possible to begin with the first exercise specified in the "Instruction Examples for Practical Training", at once.

However, it will be necessary, to prepare each exercise by a brief "job–related instruction", in which the trainees are shown a finished workpiece in order to make the purpose and intention of the exercises quite clear.

> The instructor must have finished such a workpiece by himself, so that he knows the problems involved in producing such a workpiece.

This makes it possible to identify the main points in evaluating the trainees' work and to inform them about difficult areas on the workpiece. During this special instruction, the sequences of operations and working drawings should be on the desks so that the trainees can make notes therein. All the trainees can carry out

the exercises simultaneously, if the appropriate number of working tools is available. If this is not possible, the trainees will be divided into groups according to the various categories of work and number of the tools available.

Trainees who cannot start with hammering and marking operations should perform some other activities in the workshop: selection and preparation of initial materials, checking and minor repair work on working tools under the supervision of the instructor. It is also possible to carry out exercises which consolidate the skills and knowledge of previously learned working techniques.

3.3. Examples for recapitulation and tests

This section comprises questions which should help to consolidate and test the 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 hammering?
(Working of sheet and sectional metal by carefully directed blows of a hammer for forming, straightening, strengthening or hardening the workpieces.)

2. What is the purpose of marking?
(Punching of figures and letters into the surfaces of workpieces in order to distinguish them from each other or to indicate the order of assembling or to mark necessary manufacturing data in a long–lasting manner.)

3. How do the design types of locksmith's hammer and hammers for sheet metal working differ?
"A" (Locksmith's hammers differ from one another by their weight and size, but their heads show a uniform shape. Hammers for sheet metal working have, apart from differing weights, a differing form of faces and they have no panes.)

4. What are the required properties of hammering supports?
"A" (Rigid, inflexible, possibly hardened – smooth surface.)

5. Which hammering supports are meeting the general requirements of hammering?
"A" (Surface plate, blacksmith's anvil.)

6. Which hammering supports meet the special requirements of sheet metal working?
(Anvil tool, sledge, blacksmiths' hardy and bordering tool.)

7. What types of marking punches are generally used?
"A" (Letter punches and figure punches.)

8. What is the typical effect of hammering?
"A" (The impact of the hitting hammer head upsets the material which has to give way laterally. The hammering support prevents a displacement into the direction of the blow.)

9. What property must materials have that shall be hammered?
"A" (They must be ductile.)

10. What is the effect of many hammer blows on a single spot of a workpiece?
"A" (The material consolidates and gets hard and brittle.)

11. How can this effect be reduced or eliminated?
"A" (Annealing or cooling down.)

12. Which difference do we have to consider in working steel sheets and in working copper sheets with this technique?
(Steel sheets have to be cooled down slowly, copper sheets have to be cooled down fast.)

13. What makes the difference in lengthening and curving of a metal strip?
"A" (Lengthening will elongate the metal strip in a straight line or widen it at the same time; curving wilt lengthen the metal strip unilaterally and bend it arch–like on the plane.)

14. How must the blows be directed when lengthening and curving?
“A” (Short, successive blows from front to rear or from rear to front.)

15. Which variants of blows are possible in chasing sheet metal?

(Variant 1: The blows of the hammer will be performed spirally on a flat hammering support – beginning inside and ending outside.

Variant 2: The blows of the hammer will be performed spirally on a hollow hammering support – beginning outside and ending inside.)

16. What are the working steps of flanging borders of sheet metal?
“A” (Rough–flanging – bending down of the border of the metal sheet
finish–flanging – bulging–in of the wrinkles and smoothing of the border.)

17. Which hammering supports should be used when flanging lids or covering caps of containers?
(The container to be covered should serve as a hammering support.)

18. How must we scribe the lines necessary for marking combinations of figures or letters?
(With pencil or brass scriber – the spacing must slightly exceed the height of the figures or letters.)

19. What must be done first, if the marking has to be performed on rough or curved surfaces?
(The sections of the surfaces to be marked have to be smoothed or levelled first.)

4. Application of the working techniques of “Hammering and Marking”

The sequence of exercises can focus on one topic each according to the variant mentioned in section 3 or it may be divided into several stages.

The “Instruction Examples for Practical Vocational Training –Hammering and Marking” provide 7 exercises whose degree of difficulty increases gradually.

These “Instruction Examples...” comprise a list of required materials (initial material, hand tools, measuring and testing tools, accessories), as well as the sequence of operations for producing the workpiece. An illustrative working drawing is also contained in these “Instruction Examples...”.

Thus, the trainees avail of the required information to do their exercises in an objective–related way.

If the progress of work during the exercises shows that the achieved quality standards of the workpieces is not sufficient, the trainees must carry out comprehensive preliminary exercises. In this case it is possible to use any appropriate waste components. If the skill has been practised sufficiently, the workpiece mentioned in the “Instruction Examples...” can be manufactured. Please, take the following hint into consideration:

> From the very beginning (i. e. cutting to size) until finishing the workpiece, the trainee has to do all the associated work by himself. This is the only way to guarantee a just evaluation of his achievement.

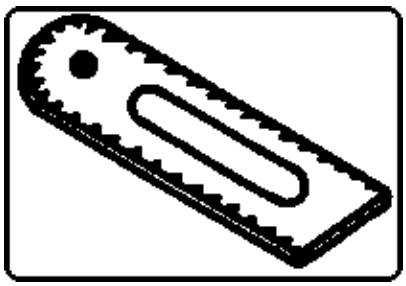
If the “Instruction Examples...” offered in this material should not be used for exercise purposes, it will be possible to work on other workpieces. However, you have to see to it that all the previous working techniques will be practised with that exercise.

4.1. Instruction Examples

To give a survey of the workpieces on which the previous knowledge shall be practised, the individual instruction examples are described in brief here:

Instruction Example 3.1.
Nameplate

A narrow strip of sheet steel is lengthened with the pane of a hammer so that it becomes 10 mm longer.

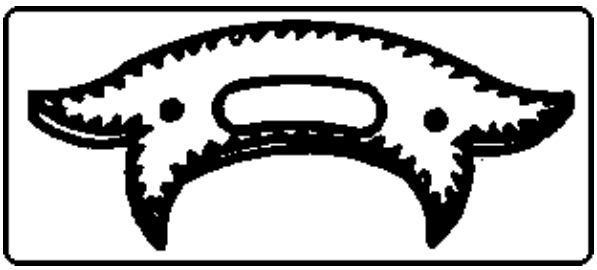


The section of the surface is smoothed with a hammer and sledge and then the trainee's name is marked on it.

This plate may be fixed to the finished workpieces so that it is easier to identify them.

Instruction Example 3.2.
Number Plate for Locker

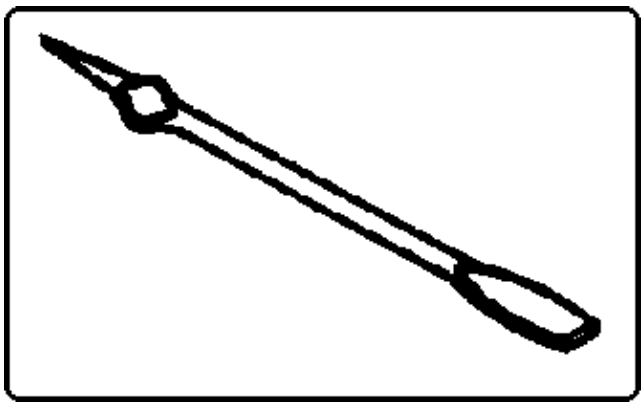
A narrow strip of sheet steel is curved with the pane of a hammer according to specified dimensions.



After smoothing a section of the surface and marking it with a figure it can be used as a numberplate for tool cabinets and wardrobes.

Instruction Example 3.3.
Screw driver

The face of a hammer is used to flatten round bar steel so that a screw driver blade and a handle extension will be produced. This workpiece can be finished by filing or grinding it according to Instruction Example 12.3.



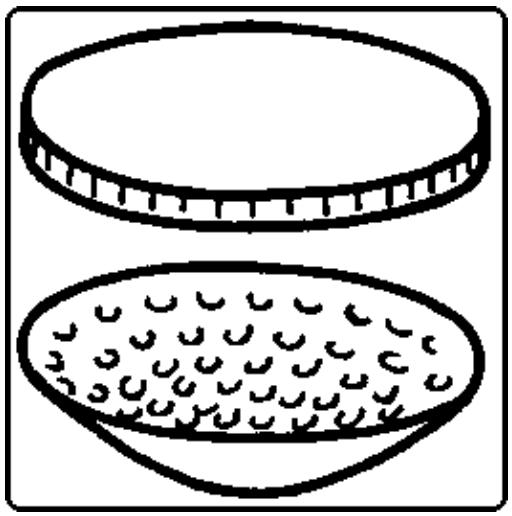
Instruction Example 3.4.
Copper Bit of a Soldering Iron

Round bar copper material is flattened with the face of the hammer and then work–hardened.

After its completion this workpiece can be used in the workshop.

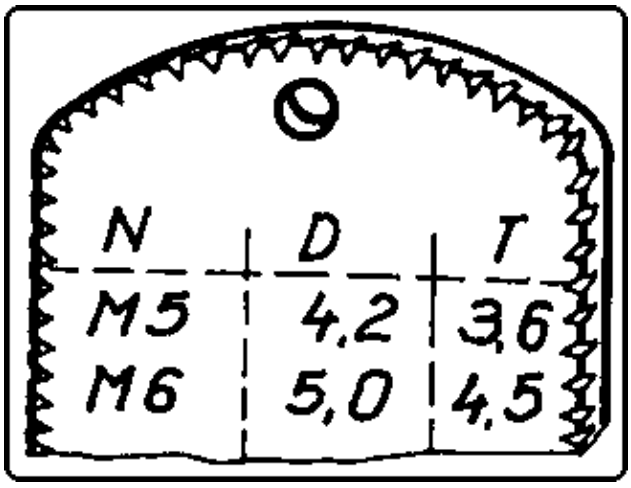
Instruction Example 3.5.
Bowl with Cover

Placed upon a hollow hammering support (steel tube), thin copper sheets are chased to form a bowl; a second sheet will be flanged so that it forms a cover matching the bowl.



Instruction Example 3.6.
Table to Determine Tapping Drill
Holes and Bore Depths

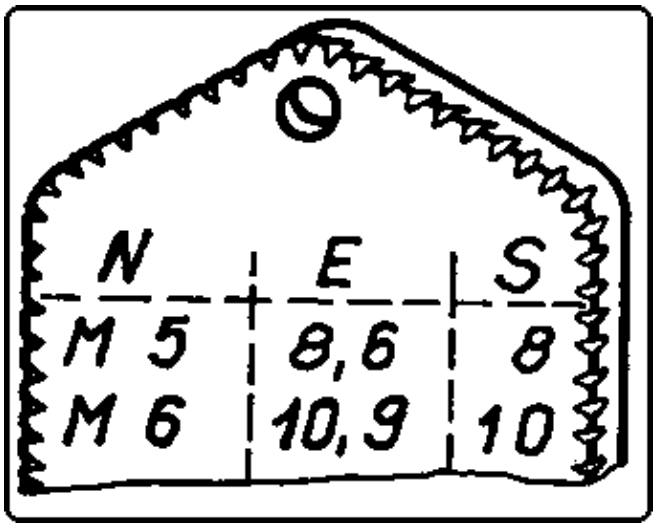
A table is punch–marked into a small–size steel sheet. When applying the working technique of “Thread Cutting” it will serve as a means to determine the required values.



Such a table is very handy and can be added to the personal tools of the trainee.

Instruction Example 3.7.
Table to Determine Widths across
Flats and Widths across Corners of
Hexagon–Head Screws and Nuts

A table will be punch–marked into a small–size steel sheet. In the assembly of screwed connections these values are required. They serve to select the proper open–ended spanners for the hexagon–head screws and nuts. This table is handy and can be added to the personal tools of the trainee.



4.2. Criteria for Practical Training

It is recommended to determine some major points of observation and evaluation when the work is being carried out. The following criteria may serve as a guideline:

Lengthening

Is the sequence of blows of the hammer uniform and narrowly spaced from one side to the other or does the trainee strike here and there at random?

Does the metal sheet stay straight during lengthening or does it curve?

Curving

Is the curvature of the sheet even or are there waves?

Chasing

Do the blows of the hammer comply with the respective variant (according to the hammering support)?

Does the trainee take cold–hardening into consideration and are there the proper intervals for cooling down the sheet?

Are there any cracks resulting from chasing?

Is it an even curvature or are there any buckles?

Flanging

Does the trainee observe the two working stages of rough–flanging and finish–flanging?

Does the trainee employ the appropriate types of hammers?

Is it an even flanging or are there any waves and irregularities?

Marking

Are the lines scribed with proper spacings?

Is the position of figures or letters even and upright?

Is there an even depth of punching?

Can the figures or letters be clearly identified or are there any double punchings?

5. Captions and legends of the "Hammering and Marking" transparency series

Transparency No. 3.1. Selected Tools for Hammering and Marking

(1) Locksmith's hammer

1 wooden handle
2 pane
3 face
4 wedge

(2) chasing hammer
(3) curving hammer
(4) bordering tool (flanging tool)
(5) blacksmiths' hardy
(6) marking punch

Transparency No. 3.2. Flattening (widening) and Lengthening
with Locksmith's Hammers

(1) Effect of hammer face
(2) effect of hammer pane
(3) flattening and lengthening with hammer face
(4) lengthening with hammer pane

Transparency No. 3.3. Curving, Chasing, Flanging

(1) curving with pane of locksmith's hammer
(2) chasing of a bowl with chasing hammer
(3) flanging of metal sheet border with blacksmiths' hardy and wooden hammer
(4) bulging–in of wrinkles with locksmith's hammer

Transparency No. 3.4. Marking with marking punches

(1) marking on curved surfaces

1 marking punch
2 filed area
3 vee support

(2) marking of combinations of figures –at right angles to the line of sight.