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

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

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Methodische Anleitung fur den Lehrenden
“Sägen von Hand”

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1. Objectives and contents of practical vocational training in the working technique of “Manual Sawing”

By concluding their training the trainees shall have a good command of the working technique of “Manual Sawing”. Therefore, the following objectives are to be achieved:

Objectives

- Knowledge of the purpose and application of manual sawing.

- Mastery in handling the saw and capability of carrying out true–to–size sawing cuts of any kind.

- Capability of selecting the proper tools and accessories and their proper use.

- Capability of evaluating the quality of their own work.

The following contents have to be imparted to the trainees:

Contents

- Purpose of sawing
- Tools and accessories
- Effects of sawing and handling of saws

2. Organizational preparation

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

The following steps have to be taken:

2.1. Preparation of instructions on labour safety

Prior to the exercises a brief instruction on the proper use of tools and materials has to be given. This comprises hints for accident–free work.

The main emphasis is to be laid on:

– Hand hacksaws with crackless handles must be used only I
– Fixing components must not protrude at the side of the clamp dog!
– The guide hand must not work in the range above the vice I

Familiarity with these hints is to be confirmed by the trainee's signature in a control book.

2.2. Provision of teaching aids

For demonstration purposes during instruction, a vice has to be installed at the place.

The "Trainees' Handbook of Lessons – Manual Sawing" is to be handed out to the trainees.

When using the transparencies series of "Manual Sawing", check whether they are complete (transparencies nos. 4.1. – 4.3.) 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 sawing purposes) should be kept ready for demonstration.

2.3. Provision of working tools and materials

The "Instruction Examples for Practical Vocational Training –Manual Sawing" 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 have to be laid out and prepared in sufficient numbers of copies according to the specifications mentioned in the "Instruction Examples...".

Each trainee is to be provided with a workbench with a stationary vice (check the proper working height of the vice).

The trainees' workbenches have to be fully equipped with tools and accessories according to the exercises planned. Do not forget to check this!

Recommended basic equipment:

– steel rule, try square, protractor
– steel scriber, prick–punch, dividers
– locksmith's hammer
– hand hacksaw with various types of saw blades
– bastard and smooth files – 200 mm and 250 mm (flat and half round)
– vee clamps.

2.4. Time schedule

Time planning is recommended for the following training stages:

– introduction to the working technique in the form of instructions
– necessary demonstrations
– job–related instructions in performing the exercises
– performing 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 vocational training in the working technique of "Manual Sawing"

The following paragraphs comprise proposals on conducting trainee instruction, the demonstration of the working techniques as well as exercises and tests. We recommend the following way of conducting the course:

Introductory instruction with demonstrations from the "Trainees' Handbook of Lessons".

Exercises in sawing from "Instruction Examples 4.1. – 4.6." and subsequent evaluation.

Final test of theory knowledge based on the contents of the "Examples for Recapitulation and Tests".

The exercise associated with "Instruction Example 4.7." can follow later as a complex work, because it is necessary to acquire other working techniques first.

Practical skills should be tested immediately after handing over the finished workpiece. Knowledge of theory should be constantly checked. However, it is recommended that a final test paper should be written after the conclusion of the exercises.

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 can be carried out on the basis of the main points contained in the "Trainees' Handbook of Lessons". The main subjects of "Purpose of Sawing" and "Tools and Accessories for Sawing" are to be taught with the employment of all the teaching aids available.

Purpose of sawing

This subject should be illustrated by presenting workpieces which were cut by sawing or which show kerfs. The trainees should recognize the single–piece nature of this work.

Tools and accessories

Transparencies nos. 4.1. and 4.2. can support the demonstration of original tools and accessories. The design of a hand hacksaw and the fixing of the saw blade is to be explained.

Vice

Most important clamping device for any locksmith work. It consists of a fixed part screwed onto the work bench and a movable part.

By means of a handle the movable part (clamping Jaw) is screwed towards the fixed clamping jaw (both jaws are hardened). The clamping jaws may be of flat or vee type.

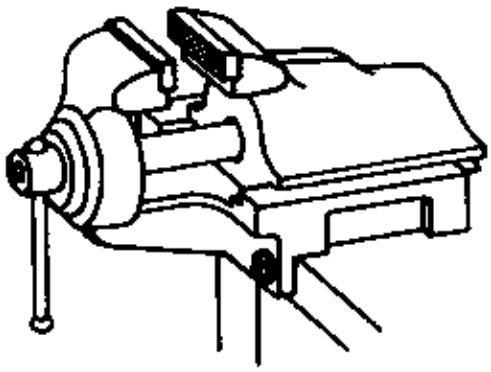


Figure 7 Vice

Vee clamps

Vee–shaped attachments for the vice permitting horizontal clamping of cylindrical workpieces.

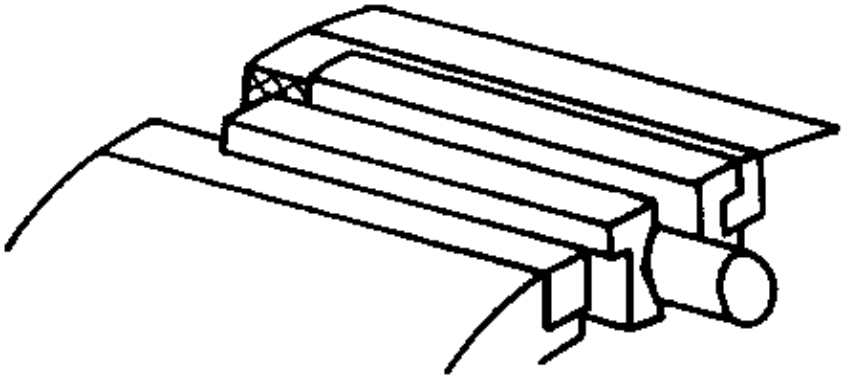


Figure 8 Vee clamp

Angle clamps

Simple angles to be vertically attached to the vice permitting long metal sheets to be firmly clamped.

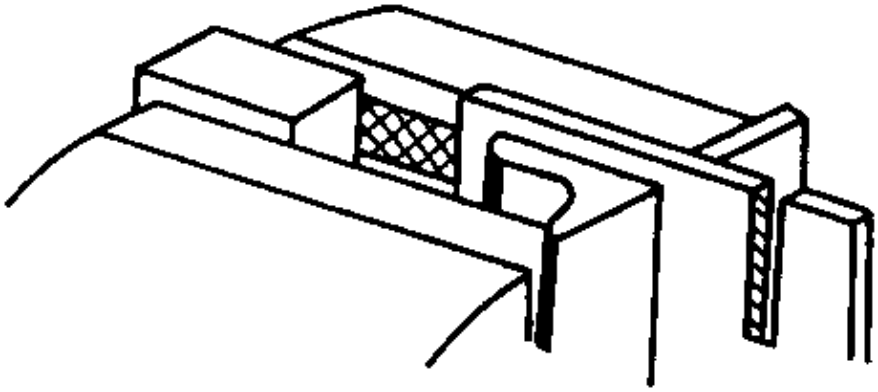


Figure 9 Angle clamp

Protective jaws

Soft–metal attachments for the vice to protect coated or sensitive surfaces of workpieces from damage when being clamped.

Saw blades for different cross sections of workpieces and degrees of material hardness

Type of saw blade	**cross section of workpiece**	**material hardness**	**tooth pitch (number of teeth on 25 mm)**
coarse	– solid sections (round, square and hexagonal steels)	soft steel, non–ferrous metals	14
normal	– normal sections (angles, sectional steel) – thick sheet metal	steel of normal hardness, harder light metals	22
fine	– light–steel sections – thin sheet metal	harder steel, cast iron	32

The instructor has to stress the importance of the free cutting action of saw blades.

For the purpose of demonstration one trainee is to be given the task to perform a sawing cut on any workpiece using a saw blade with free cutting action first, and then a saw blade without (or with poor) free cutting action. The trainees have to register the required times for sawing and to draw the necessary conclusions.

They will recognize that more time and energy is necessary for the use of saw blades without or with poor free cutting action due to the frequent jamming.

Subsequently, the trainees have to answer the questions contained the "Trainees' Handbook of Lessons".

The following order is recommended when introducing the accessories:

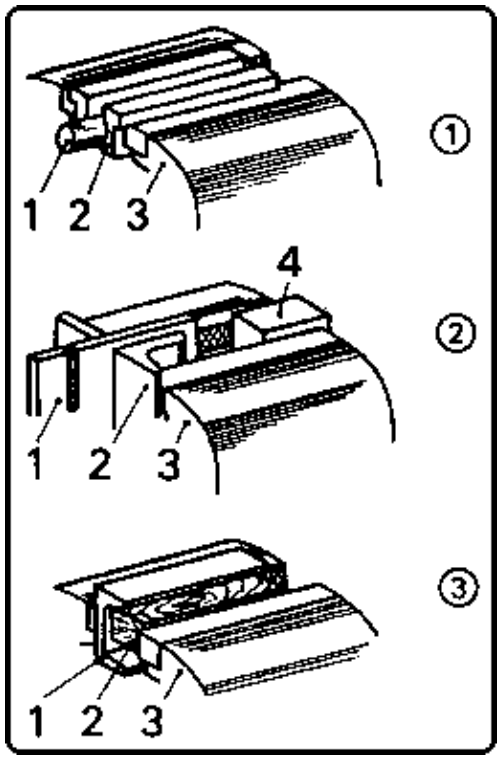
- vice
- vee clamps
- angle clamps
- protective jaws.

It must be stated quite clearly why these accessories have to be used – this should be supplemented by employing transparency no. 4.3.

If some of these tools and accessories should not be available as originals, the respective illustrations in the "Trainees' Handbook of Lessons" could supplement the instruction.

Effects of sawing, posture and
saw guidance

Demonstrations should show these effects when cutting a broad and a narrow workpiece each. The trainees will see that the saw will cut better when many teeth are cutting at the same time. This requires a different handling of saws.



In this context the trainees should be shown the proper posture and guidance of the saw.

The "Trainees' Handbook of Lessons" contains specific hints for this subject which must be taken into account.

How to handle the saw

The trainees have to be shown the close connection between a vertical guidance of the cut and the proper clamping of the workpieces. The following examples need particular explanation:

- Clamping of flat workpieces for sawing on their broad side.
- Clamping of sheet metal and sawing with upward pushing direction.

– Clamping and repeated re–clamping when sawing tubes.
– Fixing of angle sections and sawing on the broad side only.
– Sawing of deep cuts with the saw frame swivelled by 90°.

These facts should be further illustrated when working in the workshop.

3.2. Exercises

If it was not possible to include the individual demonstrations into the instructions, they should be performed right now before the exercises.

If the trainees avail of only little practical skills, they should do some preliminary exercises on any small workpieces:

– simple cutting of flat and square steel
– cutting of tubes and angle sections
– sawing of straight and angular recesses.

But it is also possible to begin with the first exercises contained in the "Instruction Examples for Practical Vocational Training" at once.

However, it is necessary to prepare any individual exercise by a brief "job–related instruction". Within this context the trainees are shown a finished workpiece in order to make them familiar with the aim and purpose of this exercise.

The instructor must have completed such a workpiece by himself so as to know the problems involved in manufacturing it.

This makes it possible to determine the main points in evaluating the trainees' performance and to advise the trainees on problems involved.

During these lessons of special instruction the trainees have to place the sequences of operations and working drawings of the training examples on their desks so that they can make notes therein.

All the trainees can carry out these exercises simultaneously, if the required number of working tools is available. If this is not the case, the trainees will be divided into groups based on the respective tasks and the number of the working tools available.

Those trainees who cannot start their practice of sawing immediately should do some other jobs in the workshop first:

– selection and preparation of the initial materials.

– checking and minor repair work on working tools under supervision of an instructor; other exercises can reinforce the skills of working techniques acquired earlier.

3.3. Examples for recapitulation and tests

This section comprises questions for consolidating and testing 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 sawing?
(Cutting of workpieces in a narrow saw kerf in order to divide them or to provide them with slots or cuts.)

2. How do the various types of saw blades differ?
"A" (Design of angles at the saw tooth, number of teeth on a length of 25 mm.)

3. What saw blade do we use when sawing steel of normal hardness?
(Saw blade with medium tooth pitch and cutting–type chip formation.)

4. Why is the free cutting action necessary for saw blades?
“A” (This is to prevent them from jamming in the kerf.)

5. Which are the common design–based ways of achieving the free cutting action?
(Raker–setting of saw teeth, wave–setting of teeth.)

6. What is to be taken into consideration when clamping a workpiece for sawing purposes?
“A” (The workpiece is to be clamped in a way that allows a vertical sawing cut and prevents the workpiece from springing and slipping.)

7. Which is the most important clamping device for workpieces?
“A” (Vice.)

8. Which types of workpieces have to be clamped in vices by means of protective jaws?
(Workpieces with coated or sensitive surfaces.)

9. Why must we guide the saw in such a way that as many teeth as possible are cutting at the same time?
“A” (If only a few teeth are cutting, there will be the danger of hooking in and breaking out of teeth.)

10. What is to be taken into consideration when sawing off workpieces?
“A” (Immediately before the workpiece is sawn off, the pressure on the saw must be reduced so that the saw blade will not be damaged by a torn off workpiece.)

11. How is the saw to be handled when sawing thin metal sheets?
"A" (Saw must be held slightly upwards in the pushing direction.)

12. How is the saw to be handled when sawing tubes and sectional steel?
“A” (Tubes and steel sections must not be sawn off in one pass, but they have to be reclamped during sawing so that as many teeth as possible will be cutting at the same time.)

4. Application of the working technique of “Manual Sawing”

The sequence of exercises can follow the order of the 7 (or 6)

Workpieces mentioned in the “Instruction Examples for practical vocational training – Manual Sawing”.

These “Instruction Examples...” comprise a list of materials (initial materials, hand tools, measuring and testing tools, accessories) as well as the sequence of operations for manufacturing these workpieces. Thus, the trainees avail of the necessary information to begin their exercise–related work.

Should the quality of the manufactured workpieces be considered insufficient, the trainee has to carry out comprehensive preliminary exercises. To do so, any waste components will do.

If the skill has been practised sufficiently, the envisaged workpiece can be manufactured.

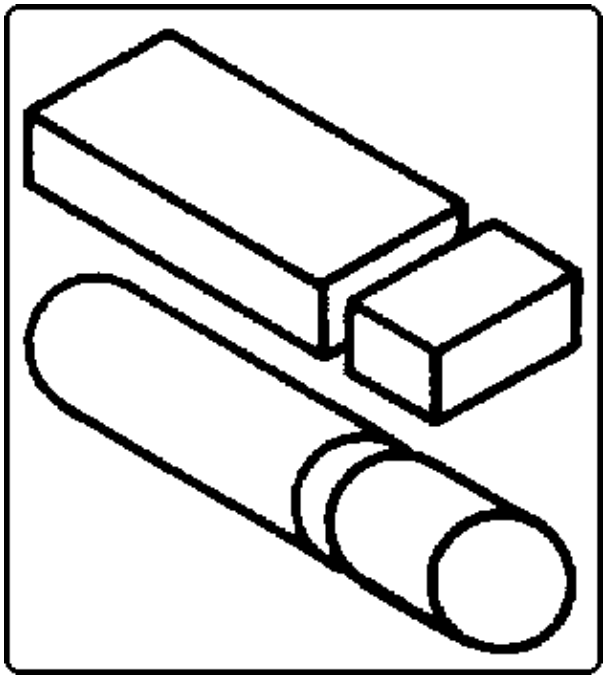
> The following hint should be taken into consideration:
> The trainee has to do all the work alone – from the very beginning (cutting of initial material) till the completion of the workpiece.

This is the only way to guarantee a just evaluation of the achievements. Should the offered “Instruction Examples...” not be used in the exercises, then it is also possible to select other workpieces. In this case all the working techniques acquired earlier should also be practised with these workpieces.

4.1. Instruction examples

What follows is a brief description of the individual training examples in order to give a survey of those workpieces on which the previous knowledge is to be verified:

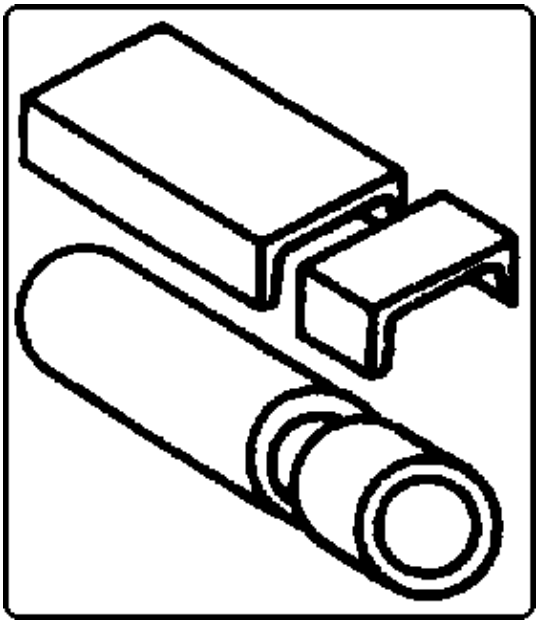
Instruction Example 4.1.
Spacers and Pin Drifts



Flat steel and aluminium sheets as well as round material of copper and brass are used to practise simple, straight saw cuts. The finished parts can be employed as necessary accessories in workshops: spacers for clamping, pin drifts for loosening pin connections.

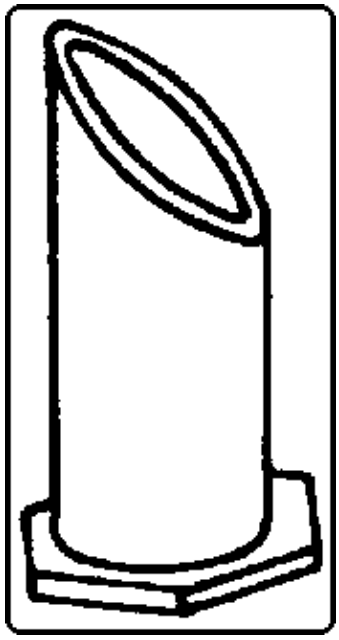
Instruction Example 4.2.
Stands and Supports

Channel sections and steel tubes serve to practise the specific skill of cutt–off sawing. Repeated re–clamping of the workpiece is a must.



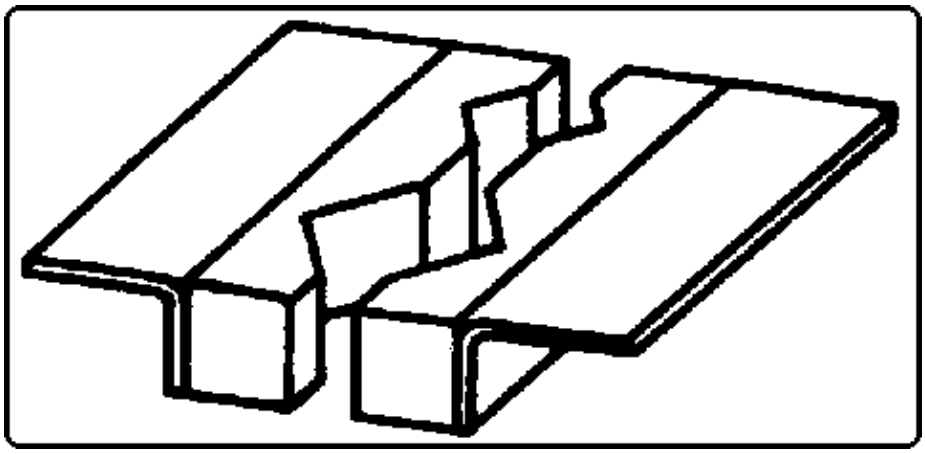
Channel can be further worked in order to manufacture drill stands etc. The instruction examples 2.3. and 7.4. give a description of continuing this work. The tubes can be prepared in such a way that they can serve as supports for instruction example 4.6.

Instruction Example 4.3.
Container



Light metal or steel sheets or tubes will be sawn to given dimensions to practise mitre cuts. After glueing, soldering or welding, these components can serve as containers for pins or scribers.

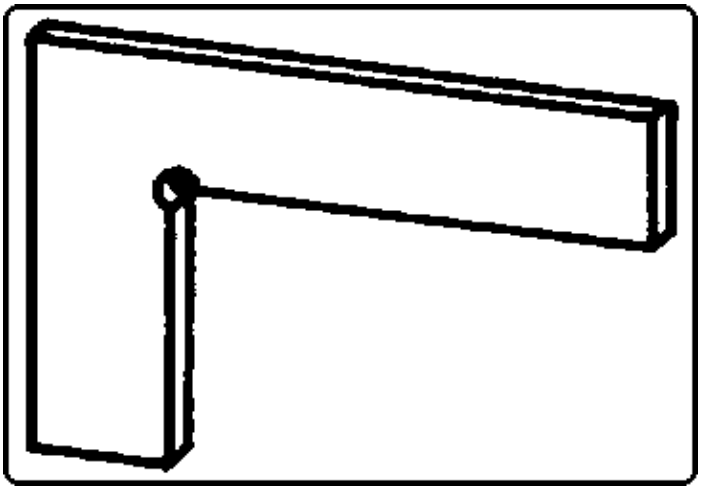
Instruction Example 4.4.
Vee−shaped−Attachment



Steel sheet will be cut to size by long and straight sawing cuts; solid square steel will be sawn by mitre cuts (the required angle will be given by the instructor).

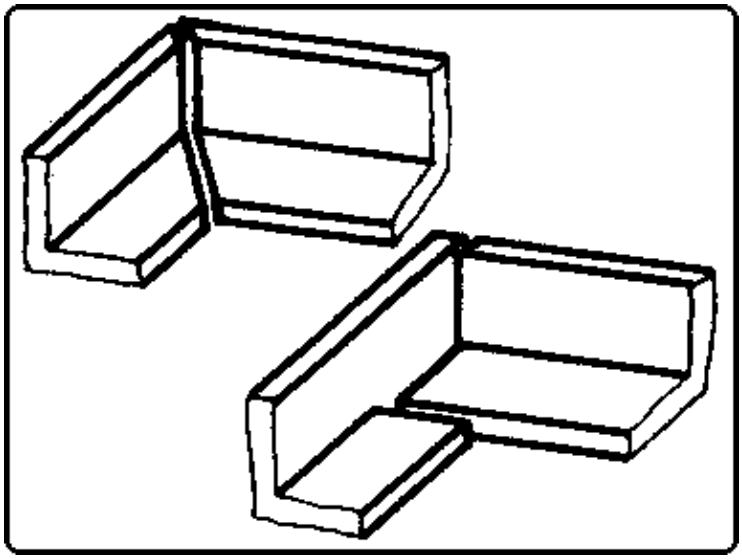
After−having connected these components by bolts or rivets this workpiece can be used as accessory for clamping cylindrical workpieces.

Instruction Example 4.5.
Steel Square



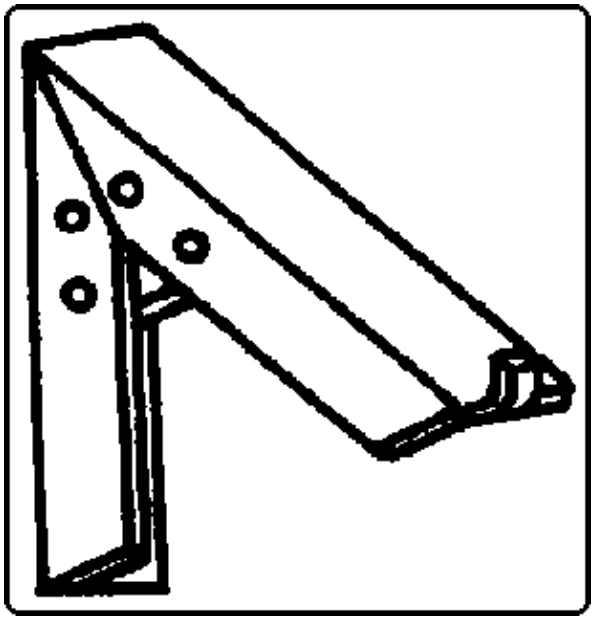
Long and straight sawing cuts of high precision are practised on steel sheets. Once completed, the workpiece can be used in the workshop.

Instruction Example 4.6.
Angle–Steel Frame Table



Straight and mitre cuts serve to practise the technique of joining angle steel to form a frame. Emphasis is to be laid on the peculiarities of straight and mitre cuts. Welded with the supports mentioned in instruction example 4.2., a frame for a table is produced which can be provided with an insert (of steel or wood) so as to form a table for putting down tools etc. in the workshop.

Instruction Example 4.7.
Wall–Shelf–Bracket



Angle steel is used to practise mitre cuts and cut–outs.

When combined with other working techniques, a set of brackets for wall shelves can be produced.

These brackets can be bolted into the wall and provided with a board of any length – and this results in a useful and solid place for laying down workshop accessories.

4.2. Criteria for practical training

It is recommended to determine some major points of observation and evaluation of the work performed.

The following criteria may serve as a guideline:

Does the trainee select the appropriate saw blade?

Does he fix the saw blade in the proper way (in the pushing direction)?

Is the workpiece clamped as required?

Does the trainee use available accessories?

Does the trainee employ cutting oil for sawing?

Does the trainee pay attention to vertical guidance of the saw?

Does the trainee re–clamp sections during sawing or does he saw off in one pass?

Does the trainee pay attention to the fact that there must be as many teeth as possible cutting at the same time even when sawing thin workpieces?

Does the trainee's tool comply with the labour safety requirements?

5. Captions and legends of the "Manual Sawing" transparencies series

Transparency No. 4.1.: Design and operation of a hand hacksaw

(1) Hand hacksaw

1 – handle
2 – fixed clamping dog

3 – retaining pin
4 – saw blade
5 – saw frame
6 – adjustable clamping dog with wing

(2) saw teeth in action

Transparency No. 4.2.: Fixing and free cutting action of saw blade

(1) Fixing of saw blade

1 – clamp dog
2 – rivet or pin
3 – saw blade

(2) action of saw blade with raker–set teeth

(3) action of saw blade with wave–set teeth

4 – free cutting action

Transparency No. 4.3.: How to clamp a workpiece for sawing

(1) Clamping a round workpiece with vee clamp as attachment

1 – workpiece
2 – vee clamp
3 – vice

(2) clamping a metal sheet with angle clamp as attachment

4 – spacer

(3) clamping a channel section with hardwood attachment