Integrating Companies in a Sustainable Apprenticeship System

Project 2017-1-DE02-KA202-004174

Intellectual Output 3

Train-the-Trainer Manual

Cutting

Authors: ISC Germany and ICSAS-Team

Version: Final

Erasmus+

This project has been funded with support from the European Commission.

Contents

1. Introduction

1.1. Aims of the ICSAS Project

The aims of the Erasmus+ project «Integrating Companies in a Sustainable Apprenticeship System» are to

- show ways how the existing Vocational Education and Training (VET) systems to train skilled workers for footwear manufacturing in Romania and Portugal can evolve towards work-based learning (WBL), and improve the sector-specific tutor training in Spain and Germany
- develop a sector qualification framework and the referencing of national qualifications of Germany, Portugal, Romania, and Spain.

1.2. Eleven Manuals to Guide In-Company Tutors

In dual training schemes, the work-place specific know-how is imparted by skilled workers from the respective departments. As outlined in the ICSAS project application, the project consortium has committed to issuing eleven manuals, the purpose of which is to prepare designated in-company tutors in WBL for their role and provide support for the work-based learning phases of the apprenticeship. The tasks of a tutor are to

- demonstrate the operations which the apprentices are expected to learn to perform
- introduce the apprentices to each new task and supervise them during their first approaches
- accompany them as their skills are becoming more and more advanced
- guide them towards an independent performance of the task

Furthermore, each company enrolled in work-based learning shall appoint a Head of Training who is responsible for

- drawing up an individual training schedule for each apprentice (how long each apprentice will be trained at each learning station and in which order an apprentice will run through the departments – not all apprentices can start, for example, in cutting)
- assessing and documenting the learning progress of each student at each learning station

The manuals are not meant to replace a textbook. They are meant to provide support to the trainers to plan the work-based learning activities with the trainees. The workplace trainers are invited to gather more information from other sources.

1.3. Take Your Apprentices on a Guided Tour

Before you start the hands-on training in a specific department, please make sure that the apprentice has been given a tour of the entire company including all departments.

For example, the apprentices should be introduced to the types of products the company manufactures and their intended use, the different customer segments, the distribution

channels etc. They should be allowed insight into the product creation and manufacturing processes, i.e. product design, pattern making, purchasing department, production planning, and all production departments to warehouse and logistics.

Point out the details of a typical shoe model which the company produces (see Fig. 1). Your trainees will better understand the complexity of the product “shoe”.

Fig. 1: Views of shoe parts like on this photo can be very helpful for the trainee to understand the complexity of a shoe

1.4. Cutting: Start in the Leather Warehouse

In the leather/materials warehouse the apprentices can be made familiar with the various types of leather as well as with all other upper materials that can be processed in the cutting department. Focus on the characteristics of each material.

Explain the different leathers, synthetics, and textile materials which your company uses to make uppers, soles or other shoe components, explaining their specific properties, origins, production process (tanning and leather finishing methods), quality management procedures to detect leather blemishes etc.

This document does not focus on leather production as the VET school will extensively cover this very important learning field. If you would like to revise the basics of leather production again, please feel free to familiarise with the textbooks that the VET school which your apprentices are attending uses.

2. Cutting of Shoe Materials

First thing when introducing an apprentice to the cutting department: Please remember to (re-)explain the safety rules and the dangers that the different cutting methods, machines and tools represent.

Cutting shoe parts from a leather hide does not just mean cutting parts of the correct geometry from any part of the hide. Leather cannot be cut in multiple layers by machines. Cutting leather requires specialised and experienced workforce. There are many factors to be respected in order to deliver quality work. Know-how and expertise of the workers in the cutting department are decisive for the quality of the shoes produced. Firstly, because their skills and knowledge have an impact on the number of reworks and rejects, and secondly, because leather is expensive. An experienced cutter can save his/her company lots of money: If the cutting waste can be reduced to a minimum by choosing the ideal cutting layout of the shoe parts on the hide or skin, this results in considerable savings for the company.

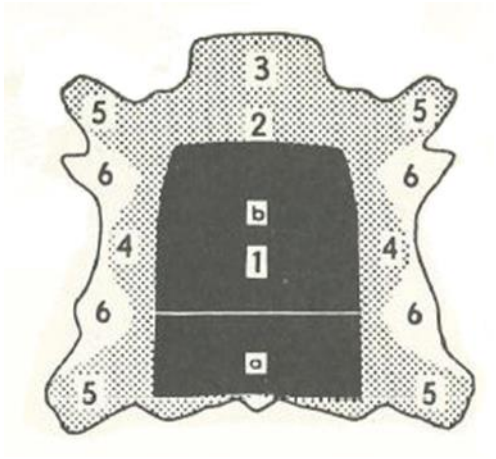
Leather is a natural product and is produced by tanning animal hides (which are usually a by-product of meat production). We speak about “hides” and “skins”. The term “hides” designates leather from rather big, grown-up animals. “Skin” designates leather from young or rather small animals. Therefore, we talk about bovine (cow or buffalo) hides but calf, goat, sheep, pig or even fish skins.

Each hide or skin is different in terms of size, homogeneity of thickness or dye, quality zones, and in terms of defects. Certain leather types are considered to be somewhat easier to cut than others (such as patent leather or black bovine leather), and there are leather types which require a higher degree of expertise (such as coloured glaze kid or reptile leathers).

2.1. Cutting Rules for Leather

Although there are basic cutting rules to be respected, there is no strict cutting scheme which can be applied and repeated for each hide. It is the key task of a cutter to understand the individual characteristics of each hide and utilise the material in the best possible way by finding the ideal placement and interlocking, the so-called “nesting” of the shoe parts to be cut. It is quite an art to arrange the cutting layout in a way to minimise waste and to conceal small blemishes in areas of shoe parts where they are less or not at all visible.

Quality Zones



1= = Butt
a = Bend
b = Back
2 bis 5 = Not part of the butt
2 = Shoulder
3 = Neck / Head
4 = Belly
5 = Legs
6 = Leg pits

Fig. 2: Parts of a hide or skin

Fig. 2 visualises the quality zones of a calf hide. The butt represents the best quality. In this zone the leather is firm and its fibre structure very dense. The next best zone is the shoulder, followed by the neck. Belly, legs and leg pits are of rather inferior quality. Other important quality factors apart from the zone of the hide / skin are the homogeneity of grain and dye as well as the absence of defects such as holes, scars, cuts, loose grain etc.

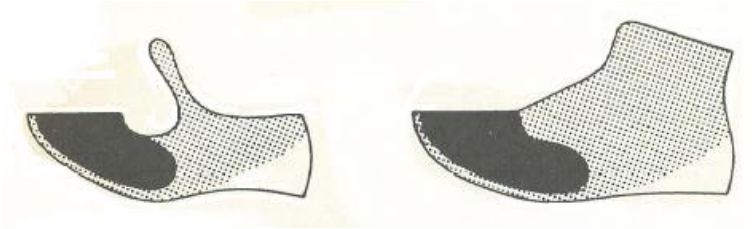


Fig. 3: Upper parts which should be cut from the butt

Fig. 3 relates to Fig. 2 and explains which parts of the shoe upper should be cut from the butt. The vamp represents the part of the shoe which is exposed to high mechanical stress (during production: elongation at lasting; during wear: mechanical impacts, walking creases). At the same time, the vamp is the “face” of the shoe. Therefore, it should be cut from the best hide part, the butt. The rear parts of the upper (such as quarters) are less exposed to stress. In addition, the quarters will be reinforced by the heel counter. Therefore, they can be cut from hide zones of inferior quality. When cutting quarters from a leather hide or skin, the front upper part of each quarter should always point towards the butt and the lasting allowance should point towards the edge of the hide / skin.

Fat creases of the neck should always be placed in the longitudinal direction of a quarter in order to be able to pull them out during lasting.

Fig. 4 shows how to place slight leather blemishes on upper and lining parts to reduce leather waste.

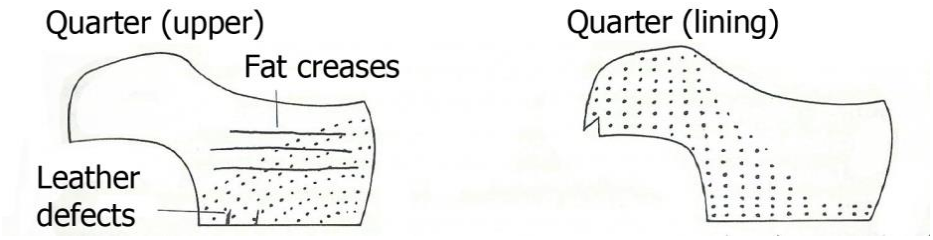


Fig. 4: The dotted zones on are less exposed to mechanical stress

Stretch Direction

One of the characteristics of leather is that it has a stretch direction. In order to ensure that shoe parts will "work" correctly on the final product, it is important to respect the stretch direction of the material to be cut.

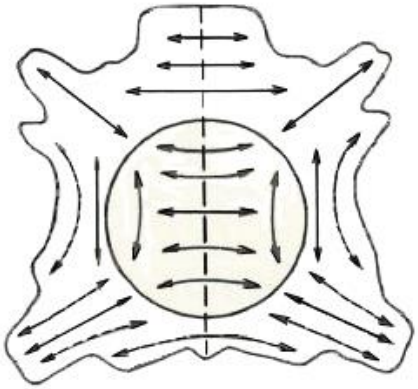


Fig. 5: The arrows indicate the direction of the least stretch

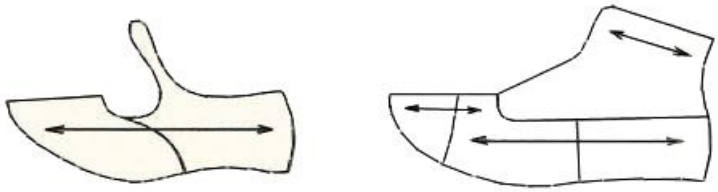


Fig. 6: Upper parts must not stretch in longitudinal direction

Fig. 5 shows a calf hide. The arrows indicate the direction of least stretch. The arrows on the shoe uppers (Fig. 6) indicate how to place the direction of least stretch.

- An upper must not stretch in longitudinal direction
- Stretch is necessary in the transverse (=cross) direction of the vamp and in the waist area in order to be able to pull the upper tightly to the last
- Heel covers must not stretch in transversal direction
- Tongues and boot shafts must not stretch in longitudinal direction

Nesting of Shoe Parts on Leather: Always Think in Pairs

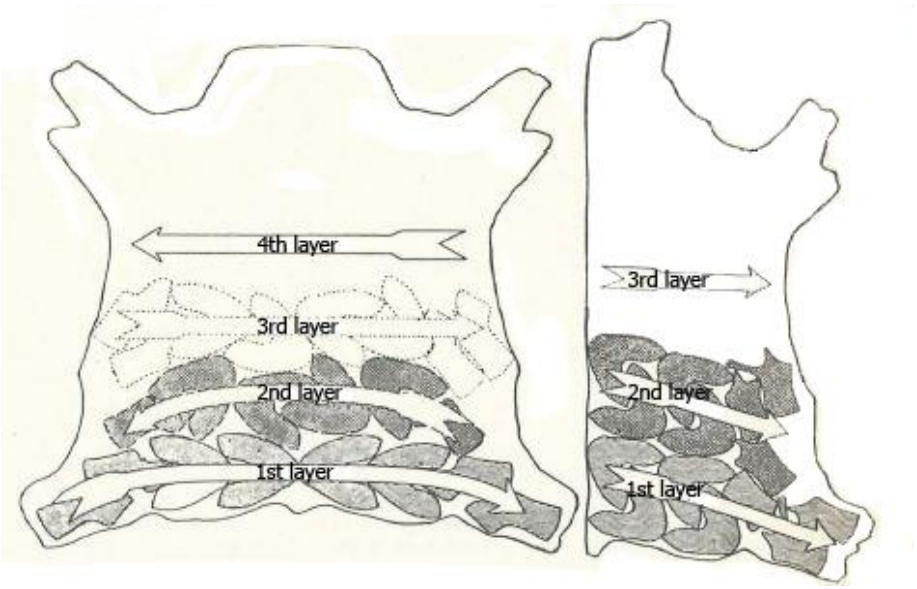


Fig. 7: Always place upper parts for left and right shoes in pairs

Fig. 7 shows how vamps and quarters are placed respecting stretch and quality rules.

The third important rule is that all parts of a pair must be of homogenous thickness, colour, and structure (for nubuck an suede leather, the fibres should smoothen with the grain from shoe tip to heel). In consequence, the two vamps of a shoe pair, for example, should be cut from the same area. The cutter always needs to think in pairs, as Fig. 8 to 10 show. The images also visualise that a cutter always tries to place cutting waste in the less valuable zones of a hide. Experienced cutters are able to place leather blemishes in lasting allowances lap seam areas.

Fig. 8 to 10 show examples of cutting layouts of a basic men's shoe model, a men's boot, and of different ladies' models.

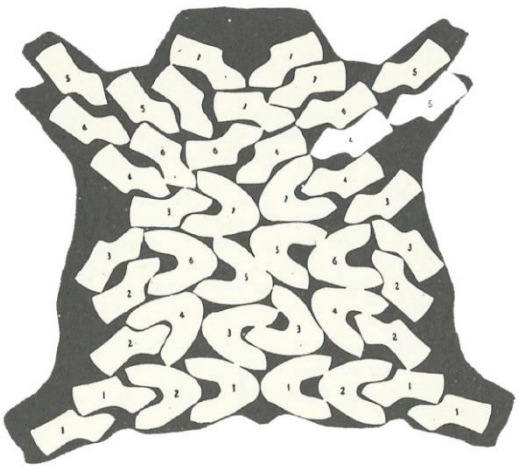


Fig. 8: Basic men's shoe model

Fig. 9: Men's boot

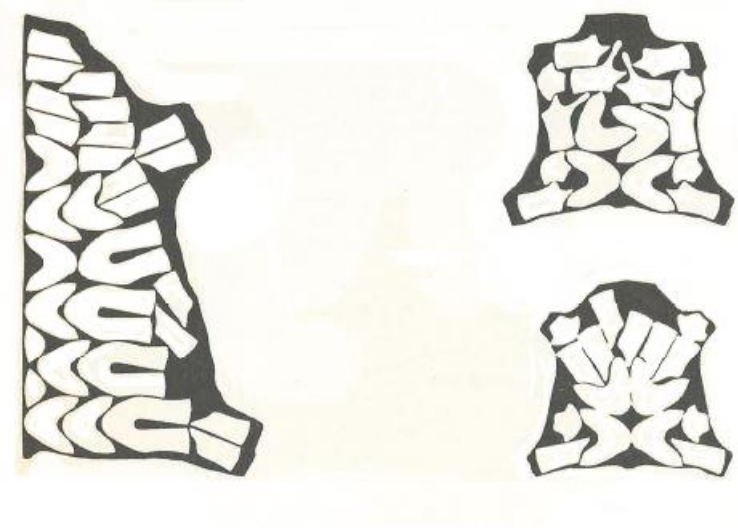


Fig. 10: Half patent leather hide (left) with a mix of two different shoe models and two goat skins (right) each with a different shoe model (the bottom one is a suede skin)

Leather Lining

Cutting lining leather is different from cutting upper leather: The best leather must be placed in the rear of the shoe because this is where it has to be the most wear resistant. When cutting lining quarters, their rear should always point towards the butt. Vamp linings should not be cut from the butt.

2.2. Cutting of Textile Materials

In textile cutting, the stretch direction is equally important as in leather cutting: Just as for upper leather, a textile shoe part must be cut in a way that there is the least possible longitudinal stretch (Fig. 11), i.e. in the direction of the warp thread. If this rule is not respected, the textile upper risks breakage during lasting.

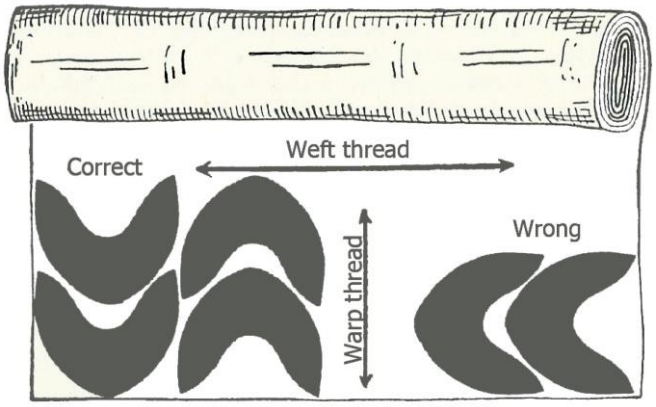


Fig. 11: How to place upper parts on textile materials

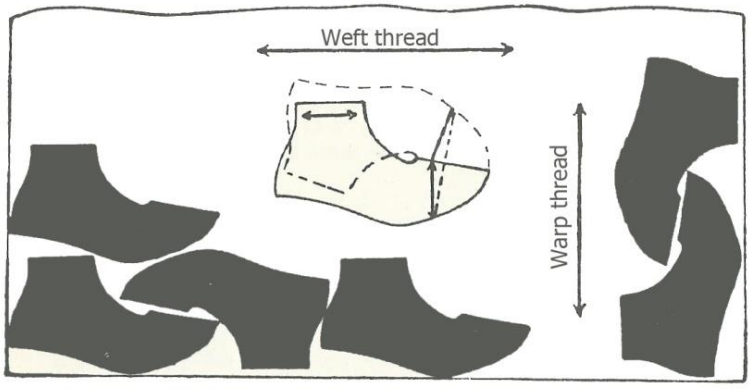


Fig. 12: How to place lining parts on textile materials

Fig. 12 shows a very common way of placing lining parts on textile material: The four parts in the bottom left corner are cut in a double layer. When unfolding the lining part after cutting (see dotted line), you will see that the middle line of the lining part is not parallel to the weft thread direction but in an obtuse angle which is important enough to ensure that the part will not tear during lasting.

2.3. Cutting of Synthetic Leather

Synthetic leather with a textile base is cut in the same way as textile materials. Leather trims (leather toe or heel caps) or toe puff materials are placed diagonally on the material (Fig. 13).

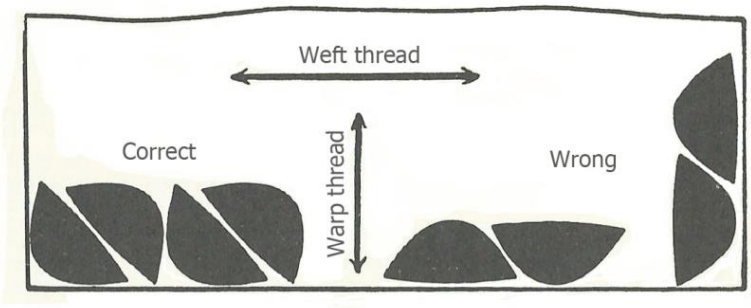


Fig. 13: How to place toe caps or toe puffs on synthetic materials

2.4. Cutting of Leather Bottom Materials (Soles, Insoles, Heel Lifts, Counters etc.)

Fig. 14 and 15 visualise how to place shoe bottom parts on a hide.

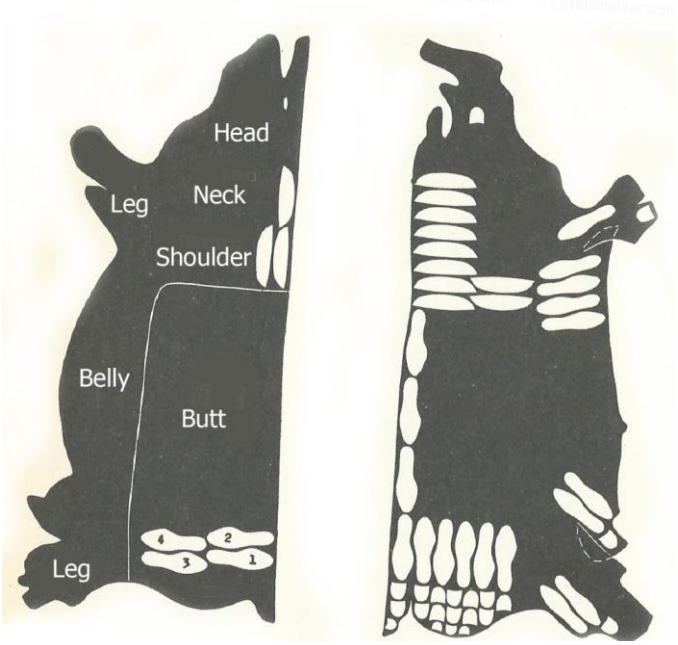


Fig. 14: How to place bottoming parts on a hide

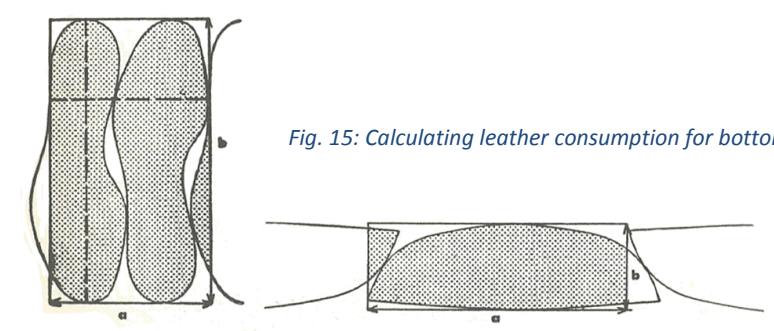


Fig. 15: Calculating leather consumption for bottoming parts

3. Cutting Machines and Tools

3.1. Cutting Knives

Specific knives are used for hand cutting of leather (Fig. 16).

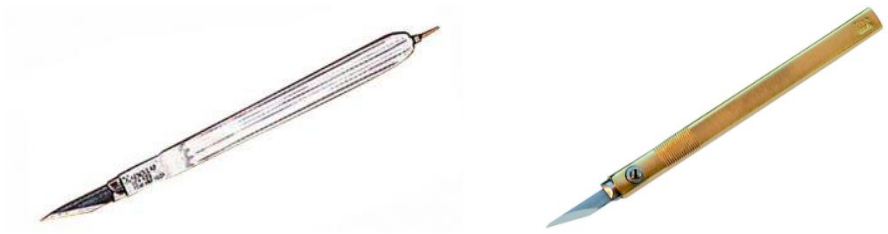


Fig. 16: Knives for manual cutting

3.2. Cutting Machines with Clicking Dies

Several types of cutting / clicking machines require cutting dies. The first clicking presses were mechanical versions which used the force of a flywheel. These machines are not in use anymore because it is not possible to guaranty the safety of the operating personnel.

Modern cutting presses are powered by hydraulic pump systems. There are two basic builds: Beam presses, which are mainly used for cutting non-leather sheet materials, and swing arm types as they are commonly used for leathers. There are many variants of these two basic types.

Fig. 17: Swing arm clicking press

Fig. 18: Beam cutting press

Cutting Dies and Cutting Boards

Cutting Dies

Cutting dies must have the correct profile and correct dimensions, which both primarily depend on the shoe model and the material to be cut. Also to be considered are: pattern size, degree of complexity, number of cutting cycles, expected cutting pressure, and whether the material will be cut in single or multiple layers. It is important to discuss the material to be cut and the intended cutting process with the die maker.

A large variety of different RDS profiles exists, from versatile types to very specific ones:

- BE = single layer cutting (leather)
- BD = single layer cutting, double edge for cutting left and right parts with one single die
- AE = symmetric profile for splitting knives
- AD = symmetric double edge steel
- TE-g = cutting of multiple layers (textile, fleece, lining, leatherette)
- SE-g = rigid material cutting (insole)
- ATE = cutting heavy textile materials in several layers
- BEN = back clearing dies (outsole)

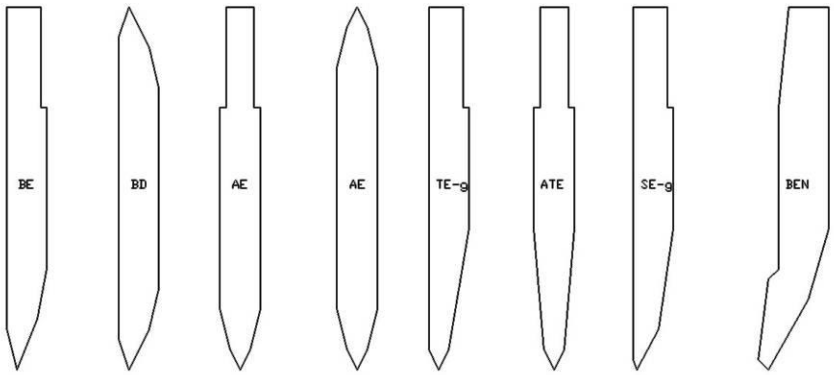


Fig. 19: Different blade shapes

The production of cutting dies requires greatest care. Upper and bottom edge must be parallel even without minimum load. They must be properly stored. The blades must not touch other blades nor other metal or other hard material (Fig. 20).

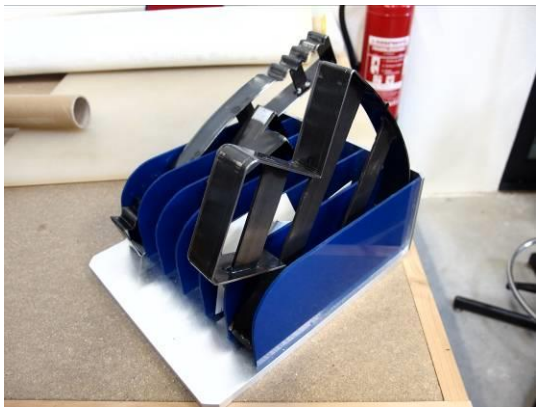


Fig. 20: Correct storage of cutting dies is important

Cutting dies can carry punchers, pickers or markers.

Fig. 21: Cutting dies can be equipped with punchers, pickers or markers, which can make subsequent work steps redundant

Cutting Boards

The prevalent plastic material for cutting boards is polyamide (PA) blended with other thermoplastics. The crucial properties of cutting boards are:

- hardness (expressed in Shore / °Sh)
- thickness
- size

The most important property of a cutting board is its hardness. Depending on the supplier, there are different approaches to choose the appropriate cutting board for each specific cutting press and each specific material to be cut.

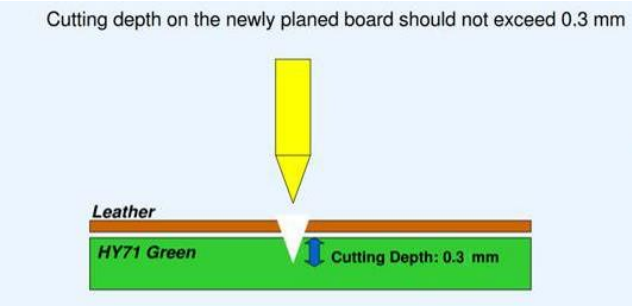


Fig. 22: How to properly adjust a hydraulic cutting press

Cutting boards should be regularly flipped and turned. Correct storage is also key.

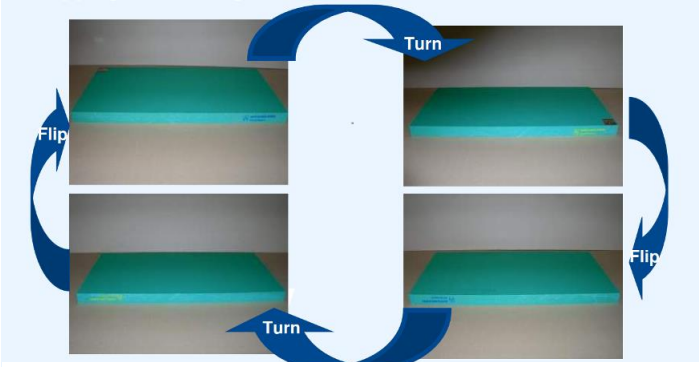


Fig. 23: How to flip and turn a cutting board

Fig. 24: Correct (horizontal) and wrong storage (vertical) of cutting boards

Fig. 23: Some companies still use cutting boards made of end-grain wood

3.3. Dieless Cutting Tables – CAM

Today, dieless cutting is state-of-the-art even in cheap-labour countries. Of course, it must be carefully considered whether the investment and maintenance costs of a CAD/CAM system are worthwhile and whether its advantages (flexibility, speed, no costs for cutting dies and no waiting time for their production) outweigh those of the conventional cutting with cutting dies. CAM machines are mainly used for sample production because they offer great speed and flexibility. They are also a good solution for companies which are unable to find qualified skilled workers for traditional cutting.

The important feature of CAD/CAM cutting tables is that the positioning of the parts to be cut can be altered several times until the final cutting layout is approved. Cutting only starts when the operator is satisfied with the nesting of all parts on the hide. This is not possible with traditional cutting.

Most CAM systems allow for simultaneous marking, numbering and punching of the parts. When comparing the return on investment of a traditional cutting machine and a CAM machine, the possibility of grouping the above mentioned operations and the optimised utilisation of material to be cut should also be taken into regard.

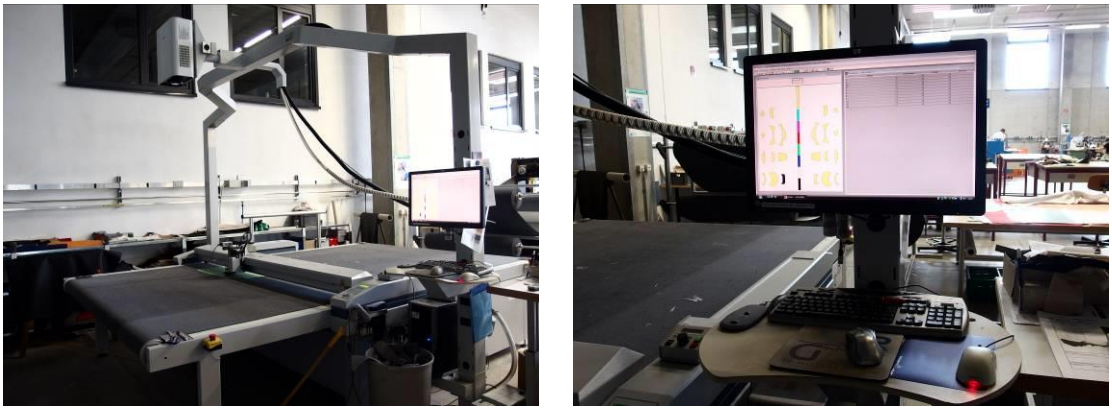


Fig. 26: Dieless CAD/CAM cutting table (oscillating knife)

The CAD system communicates the geometrical data of the parts to be cut to the CAM cutting table. The material (leather hide) is placed on the working area of the cutting table and the geometry of the parts to be cut are projected onto the material. The parts are placed using desktop and mouse. The number of finished parts and the number of parts left to be cut is automatically displayed.

4. Example: Cutting Department at Gabor / Rosenheim

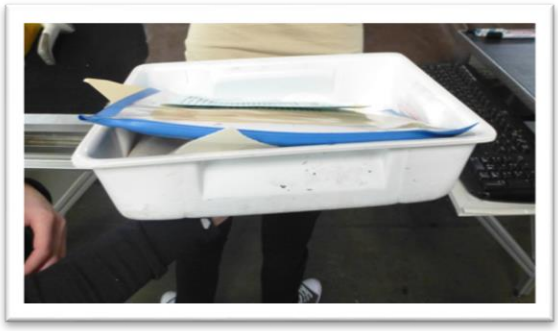


Fig. 27: The box arrives in the cutting department.

Fig. 28: It contains the work ticket, ...

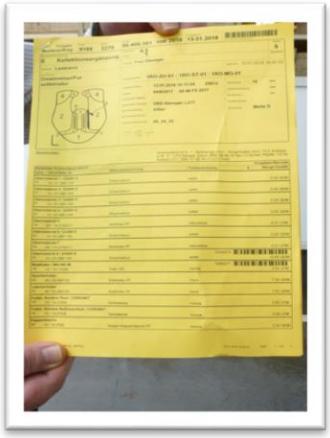


Fig. 29: ... the material specification list ...

Fig. 30: ... and the pattern stencils.

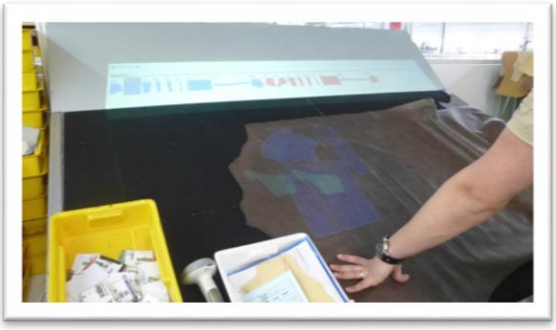


Fig. 31: The cutting layout is created.

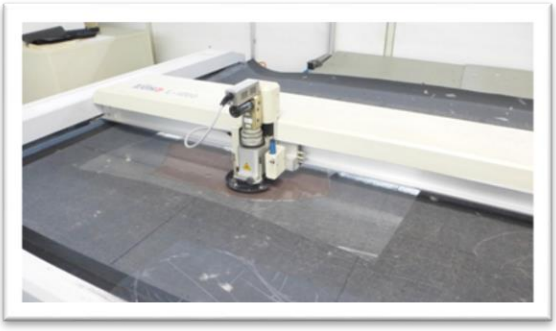


Fig. 32: The upper parts are being cut.

Fig. 33: Cut upper parts.

Fig. 34: The parts are split to attain homogenous thickness.

Fig. 35: Thickness gauge to check the splitting result.

Fig. 36: The parts are stamped (size, batch number etc.).

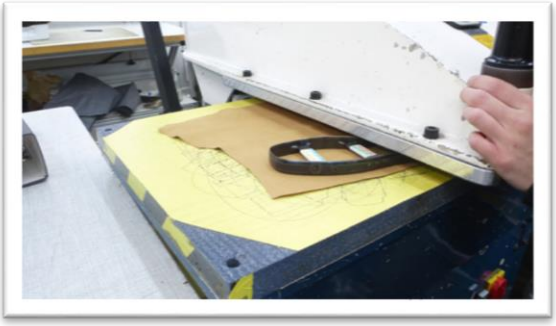


Fig. 37: The sock liners are cut with cutting dies on a swing-arm clicking press.

Fig. 38: Finally, the foam paddings for the sock liners are cut (different cutting die; clicking press)

5. Assessment / Feedback Template

5.1. Introduction to Feedback Sheet

Unlike learning in formal environments as in classrooms or workshops, learning outcomes (LO) from work-based learning (WBL) in a learning station (LS) depend strongly on the actual equipment of the production line and the models and makes, which a shoe factory manufactures. If the shoe models produced do not require certain work tasks of a whole sphere (in stitching or assembly, for example), then it is simply not possible to acquire skills in this production line related to this method.

A systematic and transparent communication on concrete LOs acquired via WBL by a learner/apprentice between tutors, supporting the learner in the various departments, and the head of training, being responsible for the entire training programme, is of great importance in WBL.

With the intend to provide a concise and handy communication tool, we recommend using the matrices as shown below: They allow tracking the achievements of each trainee in each department in a quick and easy way. The matrices do not refer to any formal assessment; they simply state the degree of autonomy each trainee was able to reach within the given timeframe in each Sphere of Activity.

The matrices list the main work tasks (in bold) and the performance that can be acquired in each department. The work tasks refer to the acquired skills; to indicate that they include key competencies and knowledge the underlying elements for some of the work task are listed.

How to use the matrices: In order to give feedback on the learning progress of each trainee, please tick off the level of autonomy the learner has reached for each work task (choosing between needs assistance / needs instruction / needs supervision / completely independent).

If the work task in the matrix was not part of the training, you can leave it out or erase the work task; if additional work tasks were trained, please feel free to continue the list of work tasks according to your training goals.

In the end, the matrices will document what each learner has been able to acquire and which level of autonomy she/he has reached. And again, although this has already been said: Please bear in mind that you may have to adapt the matrices according to the processes and to the operations in your department.

Sphere of Activity: Cutting

Work task:	Cutting by hand, including

Reading & understanding work ticket;
Providing & preparing the material [...];
Performing the task applying safety measures and asking for support if needed;
Controlling own work and identifying possible defects;
Preparing products for next task;
Knowledge about materials;
Cooperation with colleagues;
[Please continue the list if you wish to add criteria].

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Work task:	Clicking with cutting dies

[Please set up the criteria in this section in line with your evaluation needs according to the example given above]

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Work task:	Cutting with CAD-CAM machines

[Please set up the criteria in this section in line with your evaluation needs according to the example given above]

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Work task:	Splitting

[Please set up the criteria in this section in line with your evaluation needs according to the example given above]

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Work task:	Stamping

[Please set up the criteria in this section in line with your assessment needs according to the example given above]

Evaluation

Needs assistance	Needs instruction	Needs supervision	Completely independent
☐	☐	☐	☐

Place, Date Signature

Final evaluation (in this department)
Cutting; including all work tasks above
Evaluation

Needs further training	Can perform all work tasks (almost) independently
☐	☐
Place, Date Signature	

6. List of Figures

Credit:

Figures 1, 16 to 21 and 23 to 26: ISC

Figures 2 to 15: Alexander Besching, Handbuch für die Schuhindustrie (reworked ISC)

Figure 22: Röchling Hydroma GmbH

Figures 27 to 38: Gabor / ISC