



Integrating Companies in a Sustainable Apprenticeship System

Project 2017-1-DE02-KA202-004174

Intellectual Output 3

Train-the-Trainer Manual

Stitching

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1. Introduction

1.1. Aims of the ICSAS Project

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

- induce the existing Vocational Education and Training (VET) systems to train skilled workers for footwear manufacturing in Romania and Portugal to develop 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

Within this project, the project consortium has committed to editing eleven manuals which are intended to prepare in-company tutors and provide support for the work-based learning phases of the apprenticeship.

The work-place specific know-how (for example in the cutting department) will be imparted by skilled workers from this department. They will take on the role of in-house workplace instructors/trainers.

- demonstrating the operations which the apprentices are supposed to learn to perform
- guiding and supervising the apprentices during their first approaches as their skills are becoming more and more advanced
- leading them towards an independent performance of the task

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

- planning of the order of the overall training of each apprentice (how long each apprentice will be trained at each learning station and in which order)
- assessing and documenting the learning progress of each student at each learning station

The chapters of this document 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, you could start with presenting the types of products your company manufactures and their intended use, the different customer segments, the distribution channels etc. Allow the apprentices 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.

Present some shoe models your company produces (as in 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

2. Stitching

Stitching is a complex process that allows to join two layers of material by passing through a needle and thread. The seam joining of two or more pieces is accomplished by means of a flexible element (thread, cord, string) that passes through the holes made by a working device (the sewing needle in the case of sewing machines for uppers). The seam maintains the integrity of the joined pieces at various stresses both in the manufacturing process and during the use of the product.

The priority in stitching is to get a durable seam. In addition to strength, the aesthetic of the seam, influenced by fashion and trends, is becoming more and more important. Changing the aspect of the stitch is possible by selecting the needle type (with different shape of the needle blade) in correlation with the thread characteristics.

2.1. Sewing rules

Types of stitches and seams

The stitch is a loop of thread or yarn resulting from a single pass or movement of the needle in sewing. A seam is defined as a line over which two or more materials/pieces are placed over each other. Depending on how the threads are interlacing and move over and between the materials, joining them, the mechanical stitches are classified according to ISO 4915-1991.

In the footwear manufacturing, the most usual stitches, classified according with ISO 4915-1991, are:

- locked stitch - class 300
- single thread chain stitch- class 100
- double thread chain stitch- class 400

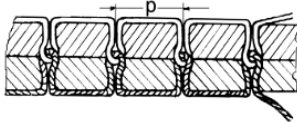

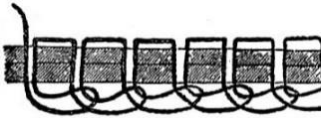

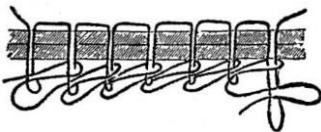

Type of stitches	Representation	Position on the material or pieces
<p><i>Locked stitch</i></p> <p>This stitch is made up of two threads.</p>	 <p>Source: Wikipedia</p>	 <p>Source: www.minerva-boskovice.com/887-160020</p>
<p><i>Single thread chain stitch</i></p> <p>This stitch has only one thread which forms a chain on the underside of the material.</p>	 <p>Source: Wikipedia</p>	 <p>Source: https://milohshop.com/products/waxwing-leather-noce-classic-bifold-with-chain-stitch-135</p>
<p><i>Double thread chain stitch</i></p> <p>This stitch has two threads. The chain is formed on the underside of the material.</p>	 <p>Source: Wikipedia</p>	 <p>Source: http://englishsourcing.com/M2fPTOcCuWQ.video</p>

Table 1: Types of stitches

The above figure shows how the upper thread and the bobbin thread are interlocked in case of an lapped stitch. The needle penetrates the material and moves down to its lowest point. The bobbin hook catches the upper thread, and carries it around the bobbin and bobbin thread. The thread is then pulled up into the material, completing the stitch.

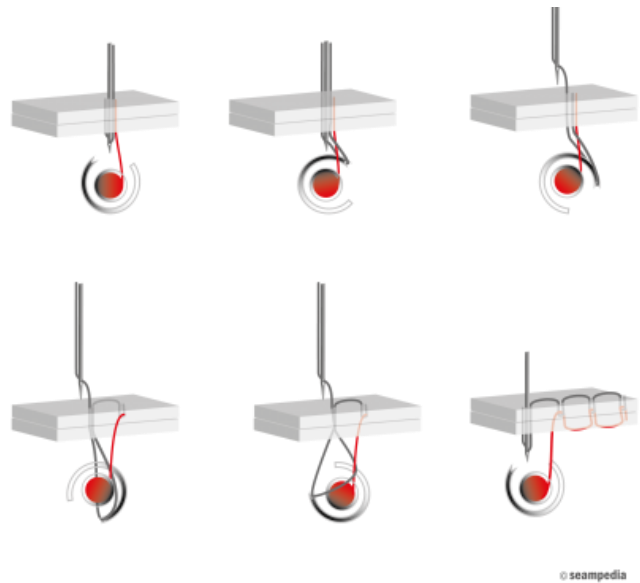


Fig. 2: How the stitch is done
 Source: www.seampedia.com/en/by-the-sewing-stitch-begins-the-sewing/

The basic seams that are used for closing the shoes uppers are (Table 2):

- Lapped seam;
- Closed seam (180°);
- Brooklyn seam;
- Butted seam.

These types of seams require appropriate technological allowances, depending on the materials, their thickness, the number of stitches and the presence or absence of decorative elements/perforations.

Type of seams	Representation	Examples of application
<p><i>Lapped seam</i></p>		<ul style="list-style-type: none"> • joining quarter and counter, quarter and vamp, linings <p><i>Credit photo: ISC</i></p>

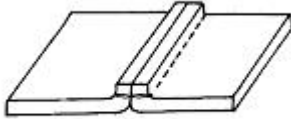

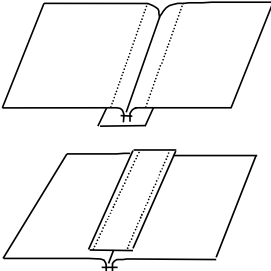

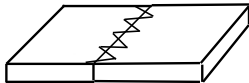

<p><i>Closed seam (180°)</i></p>		<ul style="list-style-type: none"> • closing the quarters or counters on the back contour  <p><i>Credit photo: ISC</i></p>
<p><i>Brooklyn seam (based on closed seam)</i></p>		<ul style="list-style-type: none"> • closing the quarters or the counters on the back contour  <p><i>Credit photo: ISC</i></p>
<p><i>Butted seam</i></p>		<ul style="list-style-type: none"> • joining two pieces of the counter using the cross (zig-zag) stitch; joining pieces of lining; seam for closing an edge  <p><i>Source: www.duerkopp-adler.com/export/sites/duerkoppadler/commons/download/technology_praxis/Technologie_Praxis_shoes.pdf</i></p>

Table 2: Type of seams

Top seam refers to the stitching the topline of the shoe. This stitch has two roles:

- It fixes the lining
- It fixes the binding or folding allowance

In this case, the sewing machine may have a knife mechanism to trim away the lining allowance, namely also trimming allowance.



Fig. 3: Post bed machines with integrated direct drive for inserting lining and undertrimming;
Source: www.minerva-boskovice.com/888-356020

Needles and threads

The needle is designed to perforate the leather and to transport the thread from one side of the materials to the other. The parts of a classic needle are shown in Figure 4. The main reasons why the correct selection of the needle is so important are:

- To produce a strong seam
- To obtain a good qualitative appearance of the seam.

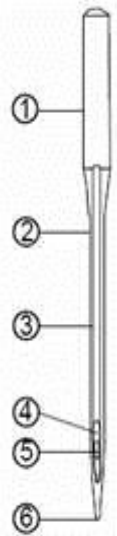


Fig. 4: Needle

1-Shank (with cone/shoulder) - is the thickest part which is inserted into the needle bar of the machine.

2- Blade – is the part that passes through material. It has two grooves (3- Long groove and 4- Short groove)

The point of the needle includes the eye (5) and the tip (6). The point penetrates the material, forming a hole for the thread to pass through.

The point of the needle has different shapes, allowing it to be used in various materials and applications (Table 3).

Type of needle (code)	Stitch appearance, perforation aspect	Needle point	Applications	Type of needle (code)	Stitch appearance, perforation aspect	Needle point	Applications
LR			Shoes and leather goods	LL			Bags, shoes, car upholstery
VR			Decorative stitches on thick and medium thickness leathers	DH			Belts, briefcases, heavy shoes, plastics, upholstery
SD			Footwear, fine leather goods, embroidery	P			Decorative stitches, footwear, handbags, bags, belts and upholstery
PCR			Shoes, upholstery and bags	PCL			The seam appears like the one made with P-type needles
S			Footwear, handbags, belts and accessories	R			Soft leather sewing, leather embroidery, sports shoes, clothing, car upholstery

Table 3: Needle type, needle point, and recommended applications (source: Groz-Beckert)

The quality and strength of the stitching is determined by the physical and mechanical properties of the **sewing thread** that can be twisted in S or Z. The thread quality is measured by the following parameters:

- nature of thread
- thickness
- strength
- elasticity

- resistance to abrasion
- uniformity
- contraction degree
- appearance, colour.

All the above parameters give to the thread good sewability characteristics, which may influence the sewing performance. The requirements that define the superior sewability of thread are:

- No breakages in high-speed sewing
- Smoothness and a high level of abrasion resistance to pass easily through the machine guides
- Consistent stitch formation to avoid skipped stitches
- No changes in tension during sewing

Table 4 presents the needle (thickness) and thread (fineness, composition) characteristics for different assortments of leathers.

Type of leather	Needle size		Thread size, measured in TEX*		
	mm	Symbol	Cotton	Silk	Synthetic
<i>Goat leather, velour</i>	0.60	60	85/3	80/3	120/3
<i>Pressed or patent leather</i>	0,70	70	60/3	80/3	100/3
<i>Swine leather</i>	0,75	75	60/3	80/3	70/3
<i>Leathers with thickness less than 1 mm</i>	0,80	80	60/3	80/3	70/3
<i>Leathers with thickness more than 1 mm</i>	0,9	90	40/3	60/3	50/3
<i>Heavy leather</i>	1,15	115	54/3x3	-	30/3

Table 4: Characteristics of needle and thread according to material

* Note: Tex is the most used measuring method. Tex is the weight (in grams) of 1,000 meters of thread. The higher value the Tex has, the thicker the thread is.

Parameters of stitch

The parameters of stitch and quality requirements are shown in the Table 5.

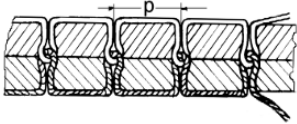
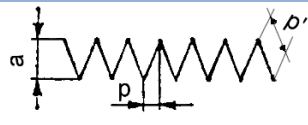
Stitch parameters	Meaning
<p><i>Step</i></p>	 <p>The distance between two successive holes in the direction of the stitch</p>
<p><i>Stitch density</i></p>	<p>The number of steps per one cm of the seam length</p>
<p><i>Amplitude of stitching (in the case of the zig-zag seam)</i></p>	 <p>The distance measured in the transverse direction to the stitch direction</p>
<p><i>Thread tension</i></p>	<p>The thread tension is a parameter that determines the correct binding loop of thread in the middle of the joined materials</p>
<p><i>Stitching speed</i></p>	<p>The speed affects the appearance of the seam and the position of interlacing nodes. Also, it could affect the stitch steps length.</p>
<p><i>Quality requirements:</i></p> <ul style="list-style-type: none"> • Uniformity of the stitch steps length • Parallelism of the seam lines to the edge of the parts; • Parallelism of stitch lines in case of multiple seams; • Proper selection of needle and thread, in correlation with the nature and properties of materials which combine. 	

Table 5: Stitch parameters and quality requirements

Calculating the seam allowances

Technological allowances are calculated according to the following parameters: the number of stitches, the distance from the edge of the piece to the first stitch, the distance between stitches, the diameter of the decorative perforations (if any). As example, the recommended calculation of norms for the overlapping allowance are shown in Table 6.

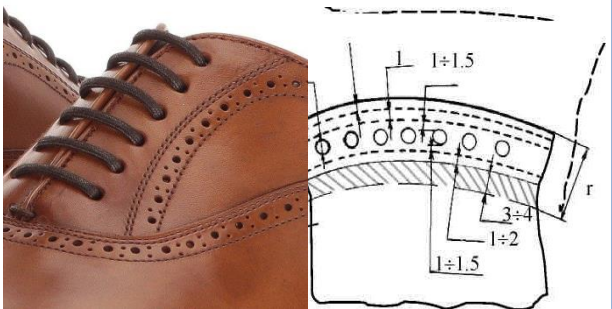

Parameter	Distance (mm)
<p>Distance from the edge of the piece to the first stitch</p> <ul style="list-style-type: none"> Leather - 0.8÷1.5 mm Non leather material - 1.5÷2 mm <p>Distance between 2 rows of stitches</p> <ul style="list-style-type: none"> Without holes - 1÷4 mm With holes of diameter - $d+(2÷3)$ mm 	
<p>Distance between the last row of stitch and the skived edge - 1÷2 mm</p>	 <p>Source: www.esquire.com/style/mens-fashion/a55401/made-in-england-shoes-british/</p>

Table 6: Example of calculation of allowances for the overlapping seam

2.2. Sewing machines for uppers

In the footwear sector three type of **sewing machines** are used:

- Flat bed machine - with a single needle, with 2 needles, with a single needle and trimming device, zig-zag;



Photo credit: Dürkopp Adler AG

- Post bed machine - with a single needle, with 2 needles, with a single needle and trimming device;



Photo credit: Dürkopp Adler AG

- Cylinder arm machine



Photo credit: Dürkopp Adler AG

- Automatic sewing machines develops specific operations in a complete cycle. An example of how a programmable machine operates is presented in the following video.

www.youtube.com/watch?v=EoWxsm2x4h0



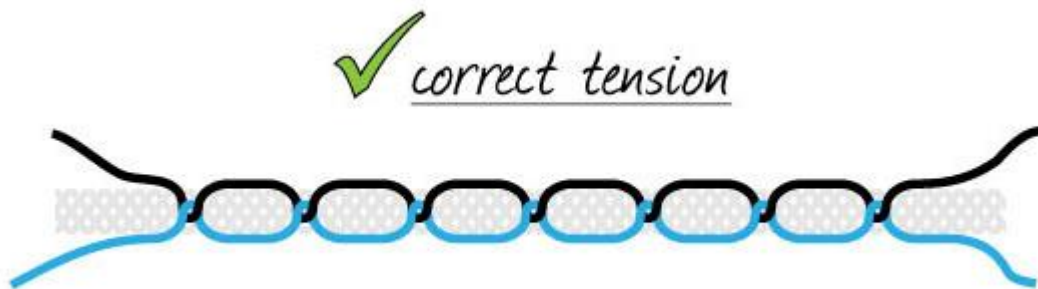
Photo credit: HighTex

Before performing any sewing operation, the machine has to be checked and properly prepared:

- Settings and adjustments to be made according to the instructions manual of the machine manufacturer.
- Threads are selected according to the technical specifications that accompanies the sample.
- Needles are checked and changed, if necessary.
- Stitch length and tension of the treads are set and tested against specifications.
- Testing operations are made each time when an adjustment, change or replacement of the machine parts are necessary.

The machine operator has to identify any stitching fault may occur due with the poor machine performance. Also, he/she has to check the sample (joined pieces) in order to ensure that the quality requirements are met.

2.3. Stitch and seam defects



For the normal stitch, the interlacing between upper tread and the hook tread should be positioned at the middle of the sewing joint. Table 7 presents several defects most commonly identified in stitching the uppers.



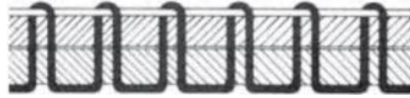



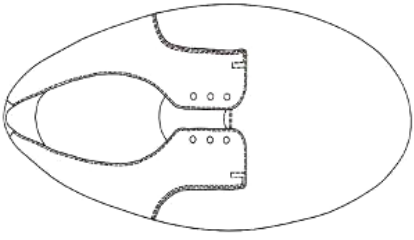
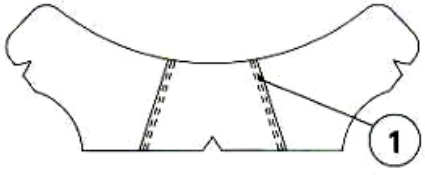
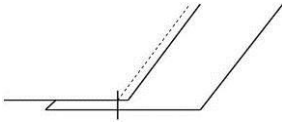
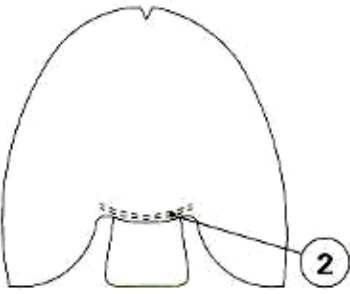
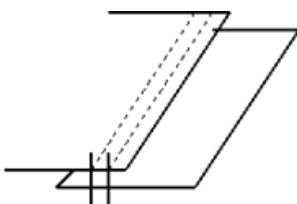
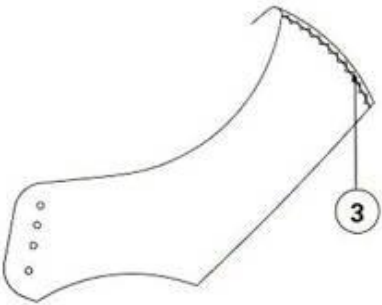
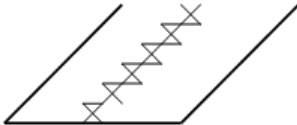
Defect		Causes and possible solutions
<p><i>Skipped and loose stitches</i></p>	 <p>Source: www.styleforum.net/threads/brogue-quality-allen-edmonds-strands.439502/ https://sewsweetness.com/2014/12/sew-faux-leather.html</p>	<p>Excessively tight tension of the hook thread.</p>  <p>Excessively tight tension of the upper thread.</p>  <p>Depending on what thread is tensioned, adjustments on feeding mechanisms of the upper or hook threads are necessary.</p>
<p><i>Uneven stitching</i></p>	 <p>Source: http://impactiva.com/uneven-stitching-case-016/</p>	<p>On the top or bottom side the irregular stitching density can be observed. This defect is caused by an improper rubbing and flattening of the material.</p>
<p><i>Wavy stitching</i></p>	 <p>Source: http://impactiva.com/wavy-stitching-case-576/</p>	<p>The line stitching could be wavy because the feeding roller used is too wide.</p>
<p><i>Visible stitching holes</i></p>	 <p>Source: http://impactiva.com/visible-stitching-holes-case-641/, http://impactiva.com/visible-needle-holes-case-224/</p>	<p>The stitching holes are visible when stretching the material for upper lasting. In this cases, a reinforcement of the area is necessary. Also, the proper correlation between tread, needle and material has to be checked.</p>

Table 7: Common stitching defects

2.4. Sequential process of stitching operations for a sample

Table 8 shows an example of the stitch operations process for the uppers parts of a Derby type shoe.

Derby Shoe		<p>Parts:</p> <p>Uppers: vamp, tongue, quarters, counter</p> <p>Linings: vamp lining, counter lining, quarters lining</p>
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Name of operation	Stitch position on the product	Seam type	
1. Joint lining parts by stitching together the counter lining and quarter lining		overlap seam, 1 stitch	
2. Stitch the vamp lining and tongue		overlap seam, 2 stitches	
3. Close the quarters on the back line		zig-zag stitch	

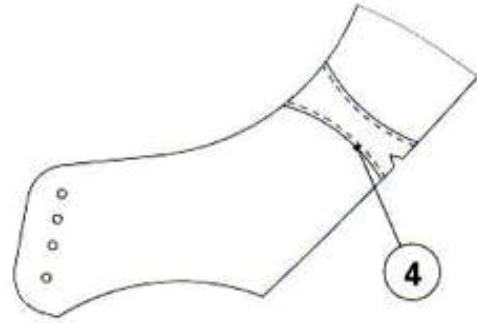
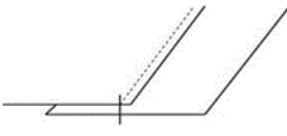
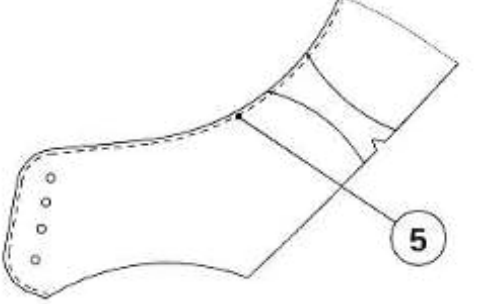
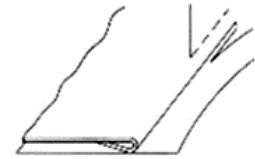
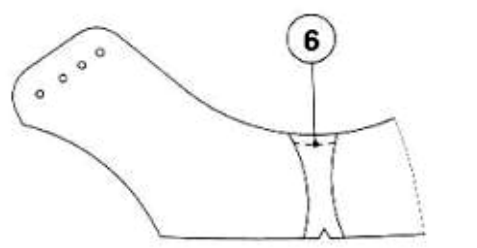
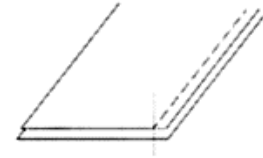
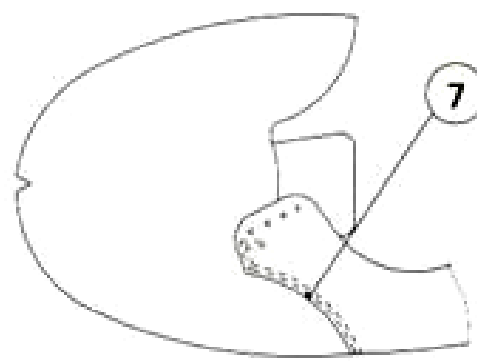
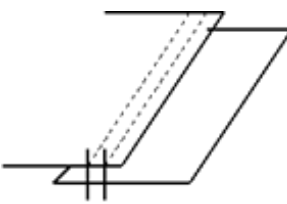
<p>4. Stitch the back strip/counter</p>		<p>overlap seam, 1 stitch</p>	
<p>5. Stitch the quarters and the lining on top line</p>		<p>overlap seam, followed by cutting the lining allowances</p>	
<p>6. Make the reinforcement stitch at the top of the counter/back strip</p>		<p>overlap seam, 1 stitch</p>	
<p>7. Close the vamp and quarters. Make the reinforcement stitch</p>		<p>overlap seam, 2 stitches</p>	

Table 8: Sequence of stitching operations for a Derby shoe

3. Assessment/ Feedback template

3.1. Introduction to feedback sheet

Differing from learning in formal environments as in classrooms or workshops, learning outcomes (LO) from work-based learning (WBL) depend sometimes strongly on the actual production line. If the shoe actually produced does not offer a certain stitching method, for example, then it is not possible to acquire skills related to this method.

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

We recommend the matrix that follows in the next chapter for this communication: Tracking the achievements in each department is neither time-consuming nor related to any formal assessment.

The matrix you will find in the following is an example; it is not a ready-to-use template. Please do not understand this matrix as an unchangeable checklist or as something that must be reached by each learner during WBL; it is just an example how to document what the learner has acquired or not and which level of autonomy she/he has reached. Please bear in mind that you will have to adapt this matrix according to the process and to the operations in your department.



Sphere of Activity: STITCHING ROOM (including pre-stitching operations)

Work step	Assessment				Place	Date	Signature
	Needsassis- tance	Needs instruction	Needs super- vision	Completely independent			
Reception of the materials and pieces for stitching							
Understand the data of the Production Plan / weekly chart of the activity. Identify priorities, models and materials.							
Reception of the materials and pieces delivered by the warehouse, according to the manufacturing orders							
Reception of the materials and pieces delivered by the previous departments (pre-stitching or cutting)							
Prepare the pieces for stitching							
Identify and check the pieces against the production sheets (such as: model, number of pairs, pieces, sizes, materials, technical information)							

<p>Perform assisting operations for sewing, such as:</p> <ul style="list-style-type: none"> • marking the stitches, • assembling the pieces by gluing, • application of reinforcement tape, • thread cutting, • eyeleting • lacing • trimming the linings • etc. 							
<p>Group, re-group and organize the pieces in work batches, work orders, boxes etc.</p>							
<p>Exercise stitching on the flat bed sewing machine</p>							
<p>Identify the constructive parts of the flat bed sewing machine. Maintenance rules.</p>							
<p>Treadle (pedal of the sewing machine) exercises to get a feeling for speed and needle movement.</p>							
<p>Sewing exercises on paper (with needle, without thread) with increasing difficulty: straight lines, curves, circles.</p>							
<p>Practise needle selecting/fixing, threading of upper and looper thread, adjustments on the sewing machine.</p>							
<p>Perform various stitches and seams on textile/synthetic and leather materials, with needle and thread.</p>							
<p>Control the stitches in order to identify possible defects, adjust the sewing machine accordingly.</p>							



Exercise stitching on the post bed/ cylinder arm sewing machine							
Identify the constructive parts of the post bed/ cylinder arm sewing machine. Maintenance rules.							
Treadle (pedal of the sewing machine) exercises to get a feeling for speed and needle movement.							
Sewing exercises on paper (with needle, without thread) with increasing difficulty: straight lines, curves, circles.							
Practise needle selecting/fixing, threading of upper and looper thread, adjustments on the sewing machine.							
Perform various stitches and seams on textile/synthetic and leather materials, with needle and thread.							
Perform stitching operations on post-bed machine equipped with trimming device (stitch the topline of the uppers and trim the linings)							
Control the stitches in order to identify possible defects, adjust the sewing machine accordingly.							

<p>Perform a complete closing process for the uppers of a Derby shoe.</p> <p><i>Notes:</i></p> <ul style="list-style-type: none"> • <i>The bellow manufacturing process is based on the sequence of stitching operations for a Derby shoe table (Table 8.).</i> • <i>The shoe model/type could be changed according to what the company produces when the training is done.</i> 							
<p>Preparation - Understand the work order; Select the needle and thread; Receive, control and prepare the pieces for stitching</p>							
<p>Step 1. Join lining parts by stitching together the counter lining and quarter lining</p>							
<p>Step 2. Stitch the vamp lining and tongue</p>							
<p>Step 3. Close the quarters on the back line</p>							
<p>Step 4. Stitch the back strip/counter</p>							
<p>Step 5. Stitch the quarters and the lining on top line</p>							
<p>Step 6. Make the reinforcement stitch at the top of the counter/back strip</p>							
<p>Step 7. Close the vamp and quarters. Make the reinforcement stitch</p>							



<p>Perform the final control in the stitching room against the following criteria:</p> <ul style="list-style-type: none"> • Leather defects • Straight seams? • Correct distances? • Correct leather colour? • Eyelets correctly set? • Correct lap seams? • Derby bars symmetric? • Correct closing seam? • Lateral / medial correct? • Lining correct and without creases? 							
<p>Final assessment (in this department)</p>	<p>Needs further training</p>	<p>Can perform all work steps (almost) independently</p>			<p>Place</p>	<p>Date</p>	<p>Signature</p>

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