Basic Footwear Production Operations

Level-I

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LG #14	LO#1- Describe Foot anatomy and foot abnormality

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Explaining the structure and main function of the foot
- Explaining foot abnormality
- Explaining various types of the abnormality
- Explaining the basic feature for the footwear abnormality

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Explain the structure and main function of the foot
- Explain foot abnormality
- Explain various types of the abnormality
- Explain the basic feature for the footwear abnormality

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 1- Explaining the structure and main function of the foot

1.1. Function of the foot

- **Balance and Standing**
- **Walking and Running**

Balance and Standing

The foot is used to support the weight of the body in standing or walking and keeping it properly balanced in an erect position. For these function the foot need stability.

Walking and Running

The foot is acted as a lever to raise the body, propel it into motion (it can be walking or running) and helps it to absorb socks. For these function the foot needs flexibility.

1.2. Structure of the foot (foot anatomy)

The human foot is a combined structure of base and lever, supporting and balancing the body's weight while standing, as well as raising and moving the body forward when in motion. Our feet works for us the whole day, whether we stand, play, run, or walk and in the process they become the most affected part of our anatomy the science, which studies the structure of the feet and the interrelations of its parts. The important structures of the foot can be divided into several categories. These include

- Bones and joints
- Muscles
- Ligaments and tendons

All of these components work together in union to provide the body with support, balance and mobility. A structural flaw and malfunction in any one part can result in the development of problems elsewhere in the body. Conversely, abnormalities in other parts of the ultimately can lead to problems in the feet.

- **Bones and Tarsus:** The tarsus is the group at the back of the foot and has irregularly shaped short bones
- **Metatarsus:** consists of five metatarsals (long bones). It is slender bones located in the front of the instep
- **Phalanges:** consisting of the fourteen long bones forming the toes

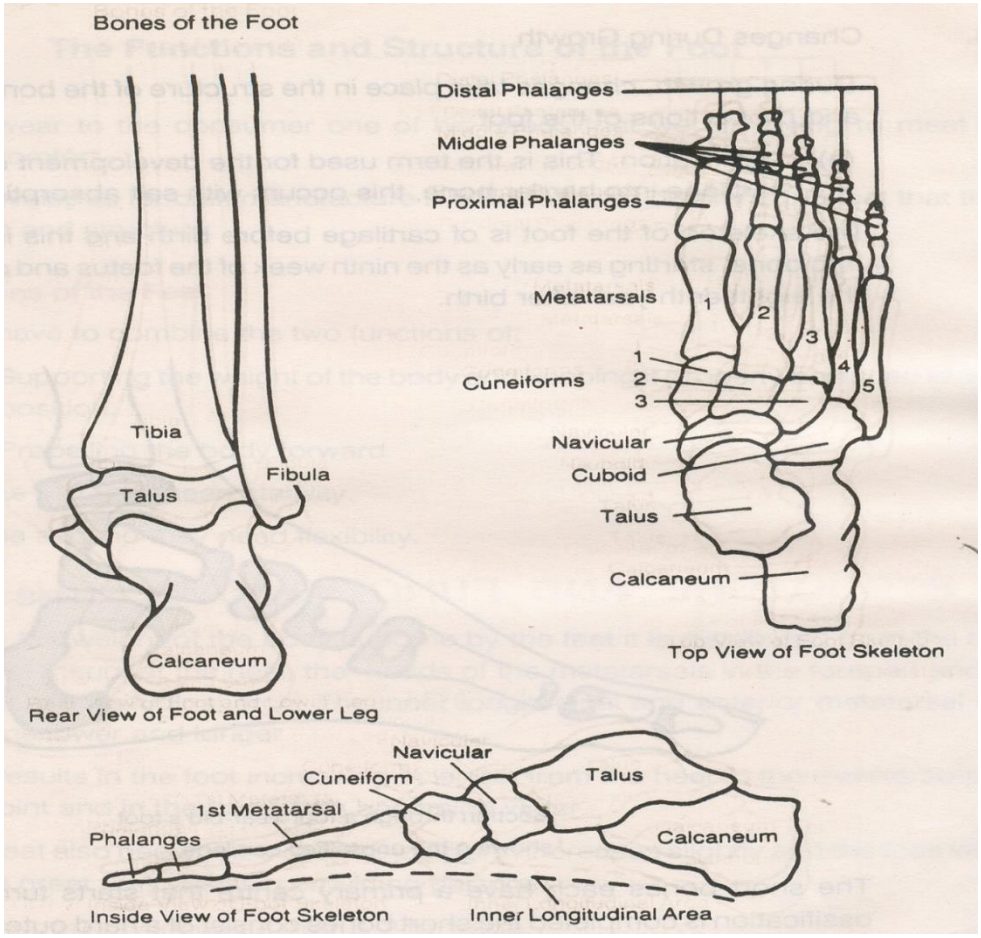


Figure 1 Different views of the foot bones

Structurally, the foot has three main parts; the **forefoot,** the **mid foot**, and the **hind foot**.

- **The forefoot:** - is composed of the five toes, collectively called Phalanges, and their connecting long bones, the metatarsals.

- **The mid foot**: - featuring five irregularly shaped tarsal bones (the navicular, cuboids, and three cuneiform). It forms the foot's characteristic arch and serves as a shock absorber.

- **The hind foot**: - The talus and the calcaneus make up the hind foot. The calcaneus is the largest tarsal bone, and forms the heel. The talus rests on top of it, and forms the pivot of the ankle.

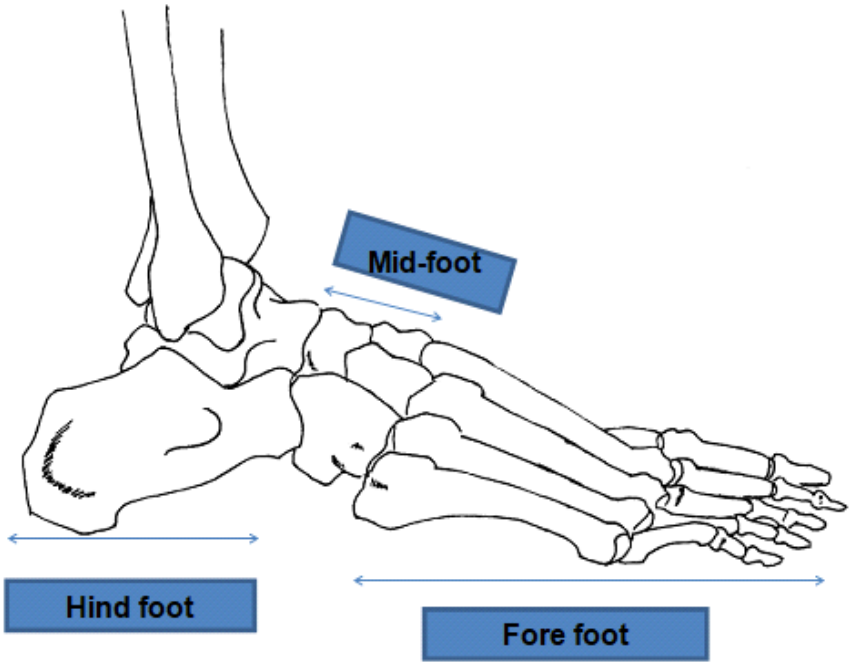


Figure 2 parts of the foot

Muscles and tendons

Muscles of the foot and leg balance the body and control the levers. The muscles in the leg provide power for the foot and those in the foot itself are used mainly for balance and direction.

Tendons are strong inelastic "ropes" which attach the muscles to the bones. They keep the dynamic balance and shape of the foot. Tendons are very similar to ligaments; the difference is that tendons attach muscles to bones, whereas ligaments attach bones to bones.

There are four groups of muscles in the leg that act on the foot.

1. **The front group:** Four muscles in front of and between the tibia and fibula whose tendons pass in front of the ankle joint. They raise the foot, turn the sole in and out and extend the toes up.

2. **The outside group:** Two muscles, which join the fibula. The tendons pass behind the ankle joint so they bend the foot down and turn the foot out.

3. **The surface back group** one muscle joined to the thighbone and the other to the tibia and fibula.

4. **The deep back group:** Four muscles under the calf whose tendons pass behind the ankle to flex the toe down and turn the foot.

Ligaments

Ligaments are the soft fibrous tissues that attach bones. They stabilize the joints. The longest of these, plantar fascia, forms the arch on the sole of the foot from the heel to the toes. By stretching and contracting, it allows the arch to curve or flatten, providing balance and giving the foot strength to push off and initiate the act of walking.

Joints

The main joints of the foot are:

- **Ankle Joint-Hinge:** The bases of the two bones together from a socket into which the talus fits-thus forming the ankle joint.
- **Sub Tales Joint-Gliding:** Talus glides on the calcaneum.
- **Mid Tarsal Joint-Gliding, ball, and socket:** Cuboid glides against the calcaneum.

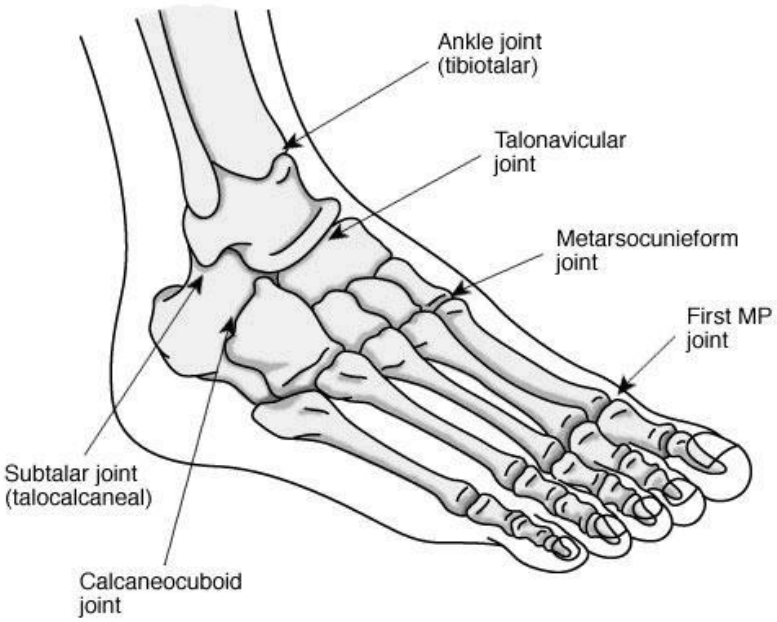


Figure 3 Joints of the foot

Flat Feet The foot is flat if they have no visible arch and your footprint is completely visible with no inward curve between the big toe and heel. (Footprint No 3)

Figure 4 Flat

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Fill in the blanks: (Total Marks: 7)

1. The foot has two vital functions. These are ------- and --------(3)
2. ---------- are the soft fibrous tissues that attach bones.(2)
3. ---------- of the foot and leg balance the body and control the levers.(2)

Short answer questions: (Total Marks: 10)

1. Explain the main function of the human being foot. (5 points)
2. What is the three main parts of the foot? (5 points)

Note: Satisfactory rating - 17 points **Unsatisfactory - below 17 point**

Information Sheet 2- Explaining foot abnormality

2.1. Foot abnormality

Foot abnormality is a disorder of the foot that can be acquired. Such deformities can include Hammer toe, Bunionettes, corns”

The human foot can be changed five ways from a normal functioning part of the body to an abnormal.

- Accidents- weights dropped, crushing bones: cuts which severe tendons, etc
- Ill-health- this could weaken the muscle tone, e.g. neurological abnormalities
- Hereditary tendency
- Congenital abnormality (exists at birth)

The first cause poorly fitted or ill-chosen shoes or stocking is an area in which you can be help in the relief of discomfort due to these causes. It is in your power to prevent any customer from losing the normal use of feet from poorly fitted or ill-chosen foot wear.

Figure 5 Foot abnormality

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Fill in the blanks: (Total points: 4)

1. A ---------- Is a disorder of the foot that can be congenital or acquired.

Short answer questions: (Total points: 6)

1 What is foot abnormality? (3 points)

2 Describe briefly how human foot can be changed from normal functioning to abnormal functioning. (3 points)

Note: **Satisfactory rating – 10 points** **Unsatisfactory - below 10 points**

Information Sheet 3- Explaining various types of the abnormality

3.1. Types of Foot Abnormality

- Blisters
- Corns
- Bunions
- Ingrown Toenails
- Hammer toe

Blisters

Blister is a soft fluid sacks that form between top layers of skin or a double on the skin filled with fluid. Although usually painful, its chief danger lies in the possibility of infection

The causes of blister are:

- Friction due to loose-fitted shoes.
- Friction produced by rough seams in shoes or socks.
- Lumps in the sole or inside of a shoe.
- A shoe that is too loose and which clips around on the foot.
- Too, loose stockings or heavy seams in stocks or stockings.

Corns

These types of abnormalities are caused by misalignment, which causes friction on top of the toes. It is a hard thickening of the skin, plus a central core or nucleus at a point where pressure is more. They may be a symptom of hammertoes. Excessive pressure of friction in the area, short or tight fitting shoes and misalignment of the foot structure.

Figure 6 Corns

Bunions

An inflammation and swelling on the side of the joint formed over the metatarsal head of the big toe.

Most bunions are behind the point of the large toe on the large metatarsal bone. "Bunionettes" are behind the little toe (the outside of the foot). Misaligned arches are usually the cause of bunions, pronation or supination. This abnormality also caused by prolonged compression of the toes in a short shoe so that the joint of the big toe is pushed outward often secondary to uncorrected metatarsus virus of childhood.

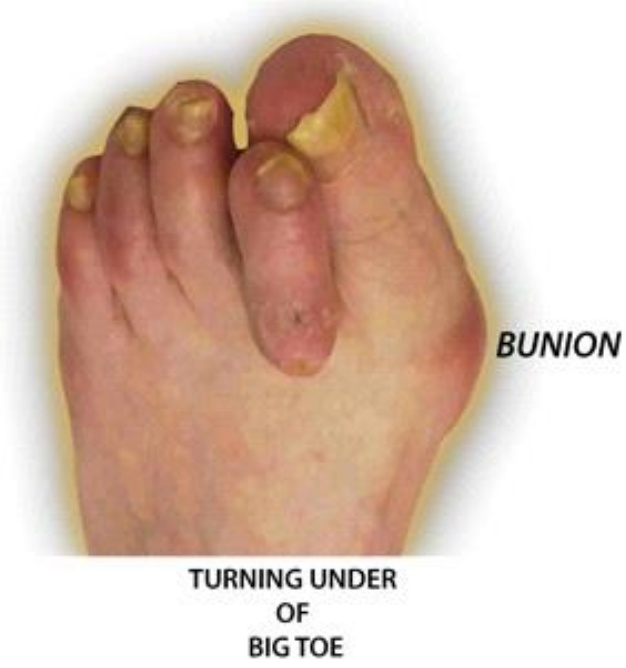


Figure 7 Bunion

Ingrown Toenails

The toenails grow into the skin and flesh of the toe. It is extremely painful and since the outer section of the skin is broken, infection can take place. The cause of this abnormality is pressure on the nails from undue crowing of the toes, or from too short shoe or hosiery, poor hygiene, Incorrect cutting of nail and Tight shoes.

"Deformity of the toenail" means an abnormality resulting from injury to the nail or nail bed, from chronic infection (for example, tinea), or from a congenital malformation.

Hammer toe

Hammer toe most frequently results from wearing poorly fitting shoes that can force the toe into a bent position, such as excessively high heels or shoes that are too short or narrow for the foot/narrow pointed shoe. Having the toes bent for long periods of time can cause the muscles in them to shorten, resulting in the hammer toe deformity. This is often found in conjunction with bunions or other foot problems. It can also be caused by muscle, nerve, or joint damage resulting from conditions such as osteoarthritis, rheumatoid arthritis, stroke, Charcot-Marie-Tooth disease or diabetes.

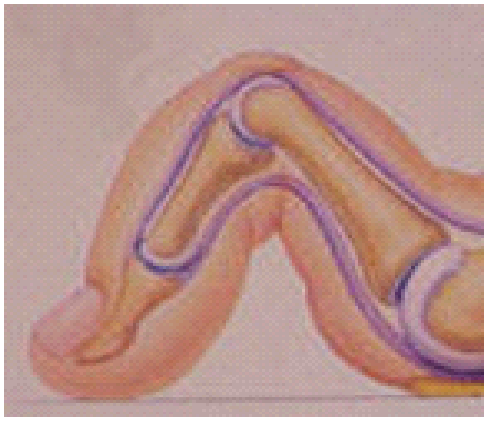


Figure 8 Hammertoe

High arch

The process by which some one shift his weight to the outside of his foot. His arches can be so high that he only walking on his bone structure, heel, ball and toes; all pressure areas.

Symptoms may reappear and the orthotic will press up into the bone structure in the middle of the foot, taking it out of the metatarsal arch of the foot.

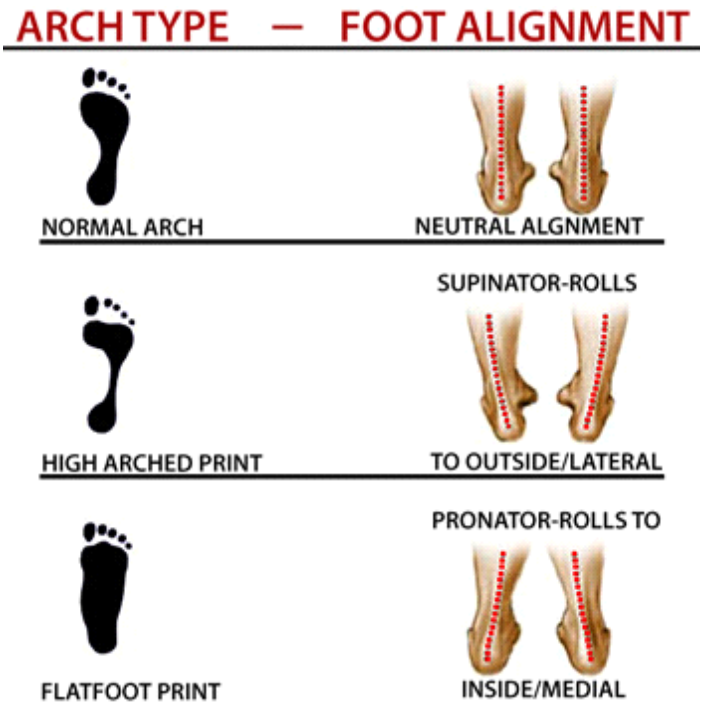


Figure 9 Arch type and Foot Alignment

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Match the following words: (Total points: 5)

A	B
1. Blisters	A. Blister is a soft fluid sacks that form between top layers of skin or a double on the skin filled with fluid.
2. Corns	
3.Bunions	B. These types of abnormalities are caused by misalignment, which causes friction on top of the toes.
4. Ingrown toenails	
5. Hammer toe	C. The cause of this abnormality is pressure on the nails from undue crowing of the toes, or from too short shoe or hosiery
	D. An inflammation and swelling on the side of the joint formed over the metatarsal head of the big toe.
	E. It is a condition in which the first joint of the toe is permanently bent downward.

Short answer questions: (Total points: 5)

1. At least mention four types of foot abnormalities and briefly describe them. (3 points)
2. Describe briefly the main causes of abnormalities you listed in question number one. (2 points)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

Information Sheet 4- Explaining basic feature for the footwear abnormality

4.1 Feature for the footwear abnormality

The uniqueness of the human foot may be described as:

Morphological: the visible form and structure of the foot;

Biomechanical: the function of the foot

The normal foot has a normal sized arch and leaves an imprint that has a flare but shows the forefoot and heel connected by a wide band. The normal foot lands on the outside of the heel, then rolls inward slightly to absorb shock.

The human foot has its own uniqueness and in some cases, under specific circumstances, can be placed back to a particular shoe. It is important to remember that how a person walks and steps is not only controlled by the feet, but by the rest of the human body. Each part of the body contributes significantly to the activities of the feet and their process.

.

Self-Check4	Written Test

Name: _____ Date: _____

Directions: True or false (5marks)

1. There are three basic foot types of biomechanical needs of the foot.(3)
2. .Feet are controlled by the rest of the unique human body(2)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

LG #15	LO #2- Describe processes to produce footwear

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics • Introducing about history of footwear • Identifying basic Processes used to produce footwear features • Describing footwear features • Identifying instances of specialized footwear for abnormalities This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Introduce about history of footwear • Identify basic Processes used to produce footwear features • Describe footwear features Identify instances of specialized footwear for abnormalities
Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the information Sheets 4. Accomplish the Self-checks

Information Sheet 1-Introducing about history of footwear

1.1. Introduction

Shoemaking is the process of making footwear since ancient time. Originally, shoes were made one at a time, by hand. Traditional handicraft shoemaking has now been largely superseded in volume of shoes produced by industrial production but, not necessarily in terms of quality, attention to detail, or craftsmanship.

Shoemakers or cord wieners (cobblers being those who repair shoes) may produce a range of footwear items, including shoes, boots, sandals, clogs and moccasins. Such items are generally made of leather, wood, rubber, plastic, jute or other plant material, and often consist of multiple parts for better durability of the sole, stitched to leather upper.

Figure 10 Traditional footwear making Europe

Shoes have come a long way over the past thousands of years. Shoes have been around for so long it is hard to pin point when they were first utilized. There are cave paintings that show the use of a foot covering/shoes. These coverings were very primitive made mostly of plants woven together just for protection and warmth. Some paintings found

that date back, and show foot coverings that resembled fur boots. The earliest evidence of European shoes was found on the Ice Man who was discovered in the Alps. He was wearing shoes made of rawhide bearskin woven together by plant fibers and stuffed with straw for insulation; obviously, it did not help him with the being frozen in ice part.

Figure 11 Ancient type of shoes

Flip Flops

The flip-flop has always been a popular style dating back to the Ancient Egyptians. The first shoes made were said to be sandals which makes sense because they are simple and practical especially in the Egyptian climate. Basic sandals were made by making an imprint in the wet sand then braided papyrus was molded into the sole, and then held to the foot by palm fibers using the thong style.

Over time sandals became more detailed and made of hides and leathers, also different designs for different ranks of people. The Pharaoh's shoes had a pointy tip, only he and his sons wear to wear that style. Color was also different depending on who you are. Gold for royals and people of court, Red and yellows for the middle class, and lower class and slaves wore no shoes.

Figure 12 Egyptian shoes

Greek and Roman

The Greeks and Romans were known for their sandals. Greeks were master shoe makers by 400 BC sandal making was sophisticated. Social “rules” were set into place for shoes such as: shoes are only to be worn outdoors, once inside you must take off your shoes. The type of shoe you wore also depended on your occupation.

The Romans cared more about the conquest than the fashion aspect of shoes. They made their shoes for a specific purpose, durable and sturdy, especially for their soldiers. The Romans also used colors and styles for rank identification. Red was only allowed to be worn be the Emperor, black and white were for senators and pale colors for the wealthy. Once again the slaves and the poor wore nothing or the plainest of sandals.

Figure 13 Greek and Roman

Middle Ages

When the middles ages rolled around it seemed all the sophistication of the Greeks and Romans became lost. People were separated from one another, very little communication and travel; basically people didn't have a clue. There were a lot of fads when it came to shoes in the middle ages ranging from exaggerated point toed shoes to "duck bill" shoes made of silk. These styles were turned shoes, shoes that are stitched then flipped inside out.

Heels made their appearance around this time, but not for fashion. Thong style shoe on a wooden heeled platform were used to muck out stables and farm. Over the next couple centuries shoes evolved and devolved. From slippers to heeled slippers, poofy and pointy, the shoe scene was all over the place men being just as flamboyant as women. In the 1800's shoes started to be more conservative and plain, and men swayed away from the heel scene.

Figure 14 middle Ages shoes

Modern

Around the 1900s, shoes start to resemble styles we have today such as stilettos and oxford shoes. From basic rawhide and plant made shoes to shoes made of plastics and polyurethane, shoes really have come a long way.

Figure 15 Modern shoes

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

True or false: (Total points: 3)

1. The earliest evidence of European shoe was found on the ice-man.(1)

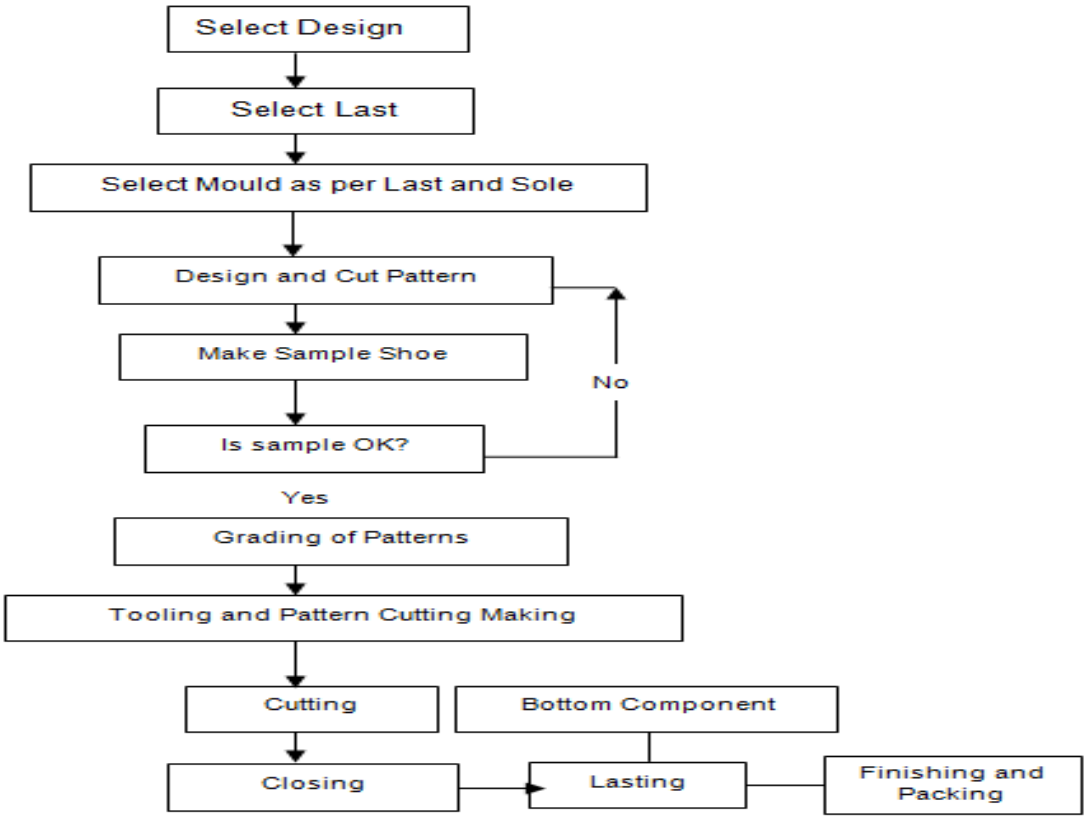
2 .Around the 1900s, shoes start to resemble style such as stilettos (2).

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**

Information Sheet 2- Identifying basic Processes used to produce footwear features

2.1 Processes to produce footwear

There are many ways to attach the sole to the upper but commercially only a few methods are preferred. Shoes were traditionally made by molding leather to a wooden last. Modern technology has introduced many new materials and mechanized much of the manufacture. Remarkable as it may seem the manufacture of shoes remains fairly labor intensive. Shoe making activity passes through different operation. The flowchart below shows the basic steps in construction of shoe in the order in which they are carried out in the shoe factory.



The following diagram shows the details of sequences of flow of activities in each department in construction of shoe

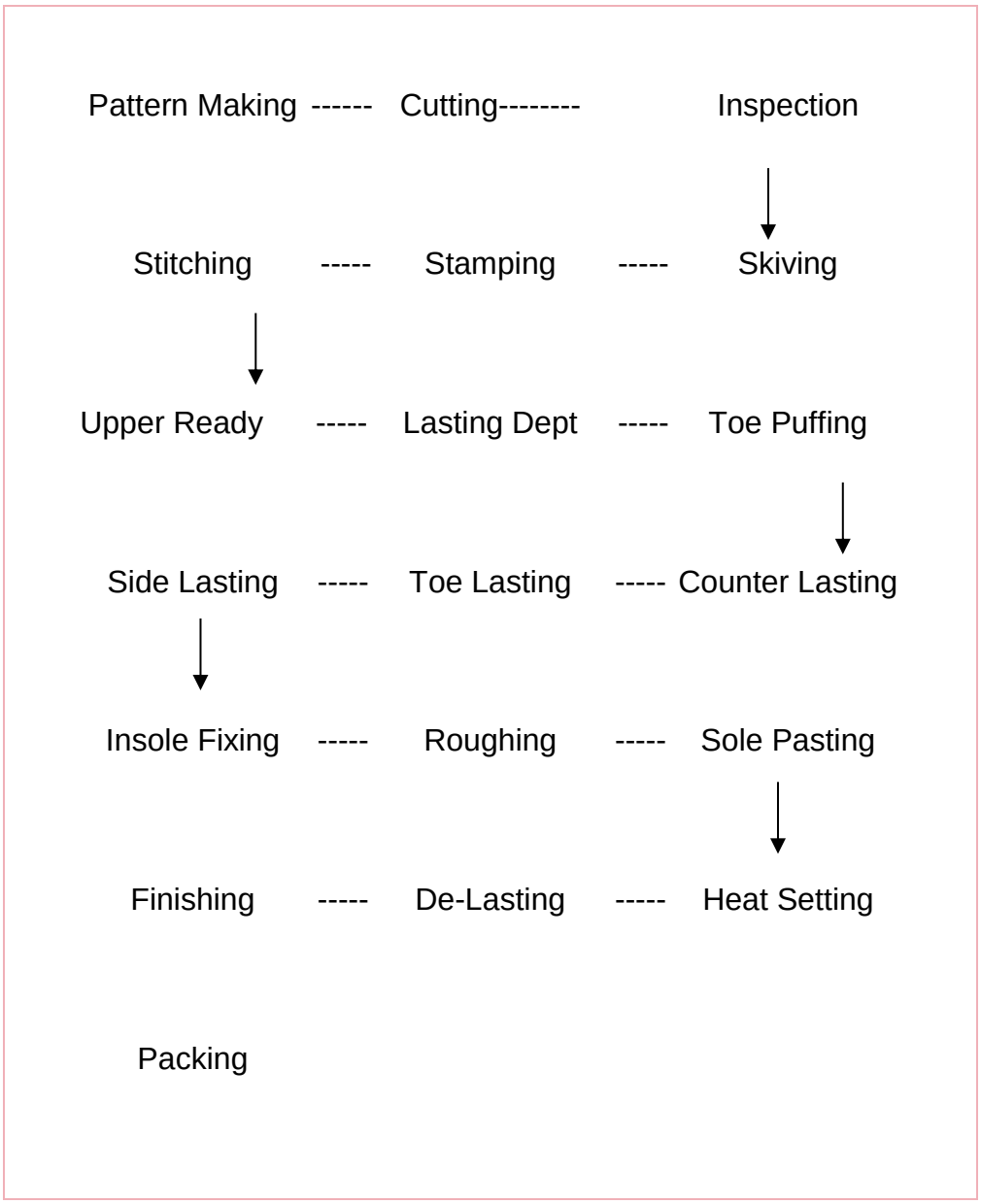


Figure 16 Sequences of flow of activities in construction

2.2. Selection of Last

Last is selected as per the style.

Designing and Pattern Cutting

Designing takes place in three steps:

- Marking of Last: The last is marked with marking tape to make mean form from which standard is to be made.
- Standard Making: Standard pattern is then made from the mean form.
- Pattern Cutting: Pattern is cut from the standard.

Cutting

The cutting is also called clicking. The cutting of uppers and linings is the first step in shoe construction and is done in the cutting room of the factory. These parts are cut to a pattern and are later fitted together in much the same way as parts of a suit or dress are cut and then sewn or assembled to provide the finished garment. Most of the cutting today is done by machine. There is still some hand cutting being done in factories. However, this method is used where economy is the factor.

Closing

As the construction, cost, design, function, material and style of the shoe vary, so too does its upper fitting. The number of different steps included in this group may range from more than 60 to as few as 15. In addition to the progressive assembly of the various upper parts by stitching, other operations may include such things as gimping and perforating the upper for decorative purposes; skiving which reduces the thickness of edges of leather parts that are to be assembled; seam rubbing and taping to remove the bulk of the material to ensure foot comfort, and so forth.

While the upper is being fitted and assembled, other parts of the shoe are being prepared in the stock cutting department. These parts include insoles and outsoles; welting; counter stiffener – which are moulded to the shape of the last and which reinforce the shoe, preserve its shape and serve as protection for the foot; heels, toe puffs, both hard and soft – preserve the shape of the toe of the shoe during wear. Steel toes are used in the production of work shoes and boots.

Lasting

Lasting is a series of operations in which the shoe upper and lining are drawn tightly to the last over which the shoe is made, and then fastened to the insole of the shoe. Lasting is one of the most important parts of the shoemaking process. It is here that shape is built in for the life of the shoe.

Flat lasting/ cement lasting

In recent years there have been many developments in machinery used for lasting in the cemented construction. The result has been that cemented lasting has been considerably simplified. Many firms now completely last the shoe in three stages. There are many systems available, this being of great advantage to the footwear manufacturer as he can select a system which is suitable for his particular product. Factors such as heel height, waist curvature, whether it is lasting for men's, women's or children's work will all have a considerable effect on the manufacturer's choice of system.

Finishing

Finishing is a series of operations, which include attaching soles, heels, trimming sole edges, staining, setting and burnishing the edges of heel and sole. Finishing includes the preparation of outsoles for a final wax, gum or buffed finish; removal of the last, nailing of heels from inside when necessary; inserting sock lining and heel pads and branding the manufacturer's or retailer's name

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Fill in the blanks: (Total points: 5)

1. Shoes were traditionally made by molding leather to a ----------.
2. When injection moulding of PVC was introduced it was quickly recognized that the process and the product had a number of advantages over ----------.
3. The cutting is also called ----------.
4. Roughing is as critical for vulcanizing as for ----------.
5. ---------- a construction type where the soles are attached to the welt or runner or any other intermediate component which are these already being attached to the lasted upper.

Short answer questions: (Total points: 5)

1. Describe briefly the basic processes to produce footwear. (2 points)
2. Discuss different activities through which shoe making operation passes and show the sequences of the flow process. (2 points)
3. Discuss the activities carried out in each footwear production departments. (2 points)
4. What is cutting, sewing, lasting and finishing? Briefly explain each of them. (2 points)

Note: **Satisfactory rating – 10 points** **Unsatisfactory-below 10 points**

Information Sheet 3-Describing footwear features

3.1. Footwear feature are depends on its sole, size, shapes and lace

Soles

The sole is the layer of material which covers the bottom of the shoe and is the walking surface of that shoe. The sole may be made of a diversity of material, i.e. leather, pure rubber, resin rubber compound, plastic etc.

Figure 17 Sole

Laces

Shoelaces, which are also called shoe-strings, or boot laces, are a system commonly used to secure shoes, boots and other footwear. They typically consist of a pair of strings or cords, one for each shoe, finished off at both ends with stiff sections, known as aglets. Each shoelace typically passes through a series of holes, eyelets, loops or hooks on either side of the shoe. Loosening the lacing allows the shoe to open wide enough for the foot to be inserted or removed. Tightening the lacing and tying off the ends secures the foot within the shoe.

How to keep your shoelaces tied is a question asked many times. It is a chronic problem everyone has that wears shoes with shoelaces.

One reason shoelaces come untied is caused by worn and stretched shoelaces. With normal use, the location of the shoelaces knot (bow) wears and stretches the fibers of the shoelace. These worn and stretched shoelaces will come untied more easily than shoelaces that are not worn and stretched. The main reason of shoelaces come untied is because they are not properly tied.

Figure 18 Lace Size

A shoe size is a numerical indication of the fitting size of a shoe for a person. Shoe size is represented by length and ball girth. The size and shape a shoe is determined by the shoe last on which it is manufactured. Foot size is used to determine the shoe size, and foot shape provides information on how to design the last shape. The size of the left and right foot is often slightly different for many people. In order to choose a shoe size, both feet should be measured and then the shoe size should be chosen based on the larger foot.

Figure 19 Size

Shape

The shoe last on which it is manufactured and foot shape provides information on how to design the last shape determines the shape of a shoe.

Figure 20 Different shapes

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

True or False: (Total pints: 3)

1. The shape of a shoe is determined by the shoe last on which it is manufactured
2. Foot shape provides information on how to design the last shape.
3. Shoe size is represented by length and ball girth.

.**Short answer questions: (Total points: 4)**

1. Discuss briefly the main features of footwear as per their use. (2 points)
2. Describe briefly the features the footwear must have in relation with the function of the foot and in relation with the structure of the foot. (2 points)

Note: **Satisfactory rating – 7 points** **Unsatisfactory - below 7 points**

Information Sheet 4- Identifying instances of specialized footwear for abnormalities

4.1 Foot Orthoses

Orthosis is any device added to the body to stabilize or immobilize a body part, prevent deformity, protect against injury, or assist with function Protection against physical insult weight bearing forces

- Axial loading of the orthosis & therefore relief of distal
- Assistance or resistance to joint motion
- Maintenance or correction of body segment alignment

Lower Extremity Orthoses:

- Hip orthosis
- Hip knee ankle foot orthosis
- knee ankle foot orthosis
- knee orthosis
- Ankle foot orthosis
- Foot orthosis

Benefit from orthotics

- People with foot problems
- People who must walk or stand excessively on the job.
- People who are active in sports
- Overweight individuals
- People with diabetes
- Older adultsIt is important for patients to follow the doctors' instructions on when to wear them to obtain the greatest benefit.
- Relieve areas of plantar pressures

- Reduce shock
- Reduce shear
- Accommodate deformities
- Stabilize and support deformities
- Limit motion of joints

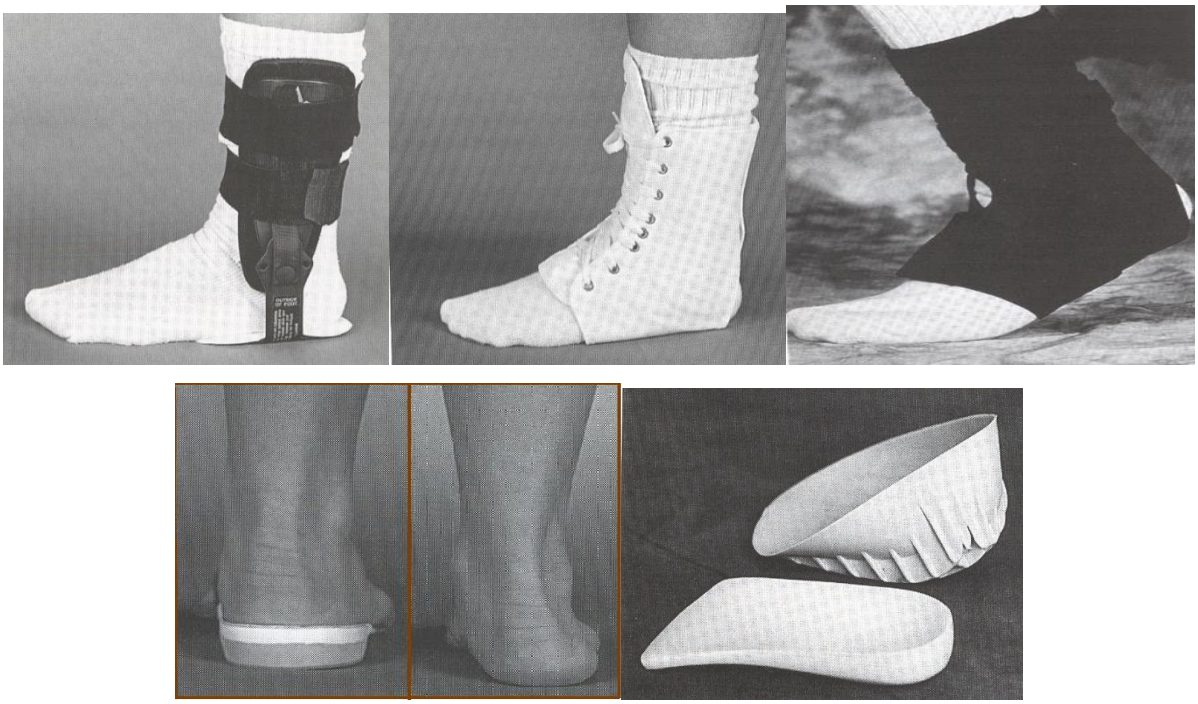


Figure 21 Orthoses

Soft / flexible orthoses

- Used to provide cushioning.
- Improves shock absorption, decreases shear forces, redistributes plantar pressure
- These orthoses may be used in combination with other materials for control of mild biomechanical imbalances
- They have a limited life span

Semi rigid orthoses

- Provide some measure of flexibility and shock absorption
- used for to control or to balance the misaligned foot
- More commonly to control abnormal supination or pronation with some degree of shock absorption and pressure redistribution

Rigid orthoses

- Similar to semi rigid devices
- Used to control abnormal motion

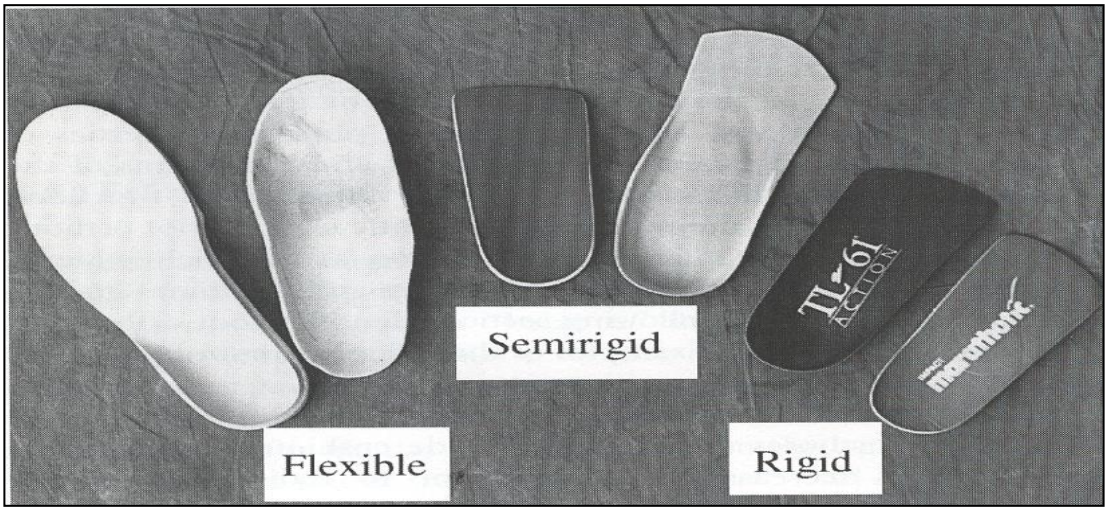


Figure 22 Flexible, Rigid and Semi rigid

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Type 1: Short Answer Questions

1. Define orthosis (2)
2. Write some basic purposes of orthoses(3)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

LG #16	LO #3- Determine the sizing system

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Explaining the sizing systems and their purposes
- Identifying types of the size measuring tools
- Explaining the procedures of foot measurement
- Explaining the basic principles of fittings
- Explaining the types of lasts

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Explain the sizing systems and their purposes
- Identify types of the size measuring tools
- Explain the procedures of foot measurement
- Explain the basic principles of fittings
- Explain the types of lasts

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 1- Explaining the sizing systems and their purposes

1.1 Sizing systems and their purposes

Sizing system is a numerical indication of the fitting size of a shoe for a person. A shoe size is represented by length and ball girth.

characteristic lengths that a shoe-size system can refer to:

- The average length of foot for which a shoe is suitable. For customers, this measure has the advantage of being directly related to their feet. It applies equally to any type,form or material of shoe. However, this measure is less popular with manufacturers, as it requires them to test carefully for each new shoe model, for which range of foot sizes it is recommendable.

- The length of the inner cavity of the shoe. This measure has the advantage that it can be measured easily on the finished product. However, it will vary with manufacturing tolerances and provides the customer only very crude information about the range of foot sizes for which the shoe is suitable.

  The length of the last, the foot-shaped template over which the shoe is manufactured. This measure is the easiest one for the manufacturer to use, as it identifies only the tool used to produce the shoe. It makes no promise about manufacturing tolerances or for what size of foot the shoe is actually suitable.

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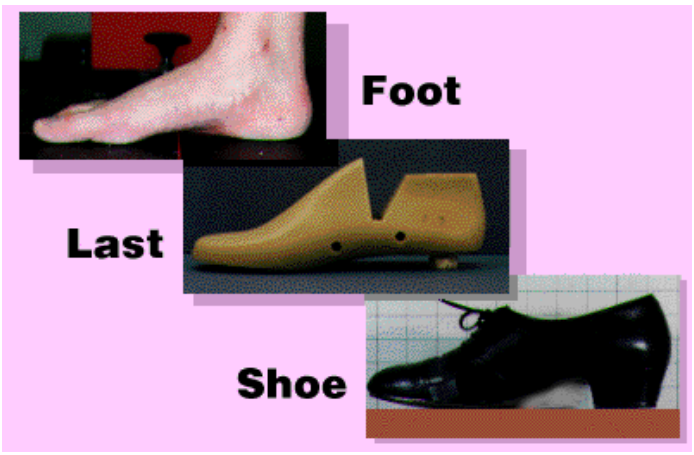

Figure 23 Foot, last and shoe

Common sizing systems used worldwide is listed below:

- English sizing system
- French sizing system
- American sizing system
- Mondo point sizing system

The UK, USA and Continental are basic scales.

English (UK) sizing system

The length scale for English sizes commences or starts with size 0 which is 4 inches long, and progresses 3 full sizes or 6 half sizes per inch until size 13 1/2 is reached. Here the numbering recommences after size 13 1/2 is reached and the next size being 1 and continuing to include the largest sizes. The smaller size scale is size 0 to 13 1/2 and measures from 4 inches to 8 3/6 inches and the larger scale size is size 1 to 12 and measures from 8 2/3 inches to 12 1/3 inches

The English size scale:

The English size stick begins with zero size at 4 inches.

Inches	(Foot sizes) English size stick
1	
2	0
3	
4	
	1
5	2
	3
	4
6	5
	6
	7
7	8
	9
	10
	11
8	12

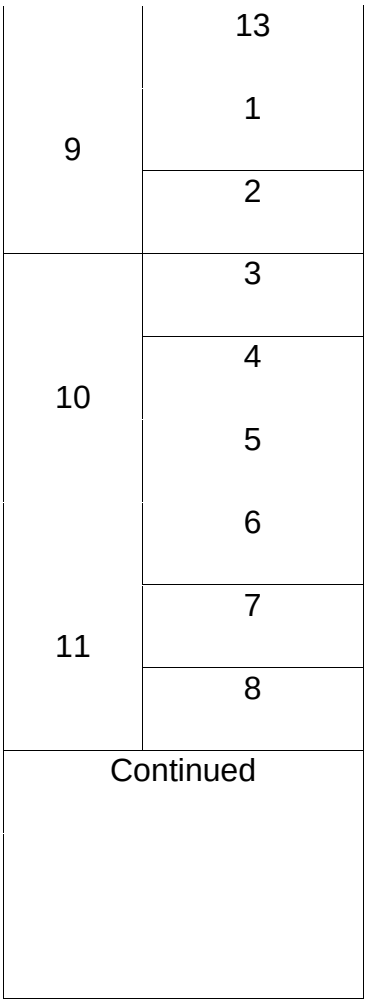

Figure 24 English size stick

- It advances by one-third inch per size
- Half sizes are one sixth of an inch.
- Children's sizes run from 0 to 13 ½.
- Adult sizes recommended at 1.

Examples:

- A child's size 9 is 7 inches.
- A boy's size 2 is 9 inches.
- A man's or women's size 5 is 10 inches.

French sizing system (Paris points) or continental system

The French Size Scale (Paris Points):

- The French size scale (Paris Points) is related to the C.G.S. (Centimeter Gram Second) Metric measurement system.
- French sizes are calculated on a scale of 3 sizes to 2 centimeters. There are no half sizes.
- The first size begins with the first centimeter and progresses consecutively down the scale.
- By referring to the English size scale and the French size scale, a comparison can be made.

French(Paris points)	Centimeter
1	2
2	
3	4
4	
5	
6	
7	6
8	
9	
10	
11	8

12 13	10
14	
15	
16 18 20	12
Continued	

Figure 25 French size scale/stick

Approximate equivalent French and English sizes are:

English child's 10 = French 28

English girl's 1 = French 33

English woman's 5 = French 38

English man's 8 = French

Table 1 Length and girth increment in UK and French sizing system for kids, women and men shoes.

Description	Length increment (mm)	Total girth increment (mm)	upper outer /inner girth increment	lower girth increment	Total upper girth increment
French (kids)	6.67	4.0	1.3	1.3	2.6
UK (kids)	8.46	5.0	1.7	1.7	3.4
French (men)	6.67	4.5	1.5	1.5	3.0
UK (ladies)	8.46	5.5	1.8	1.8	3.6
UK (men)	8.46	6.3	2.1	2.1	4.2

American(USA) sizing system

American size scale is identical to the UK scale except that it starts at 3 11/12 inches instead of 4 inches. In USA Size Scale:

Marking

USA sizes on ladies shoes are often shown multiplied by 10.

E.g. 6-1/2 = 65.

English = 5

American = 6-1/2 (65)

French (continental) = 38

Width Marking

It is common practice to indicate the width of a shoe by a letter or a number.

The exact notation is decided upon by the individual manufacturer.

Inches	USA sizes
1 11/12 2 11/12	0
3 11/12	
4 11/12	1 2 3
5 11/12	4
	5
	6
6 11/12	7 8 9
7 11/12	10
	11 12 13
8 11/12	1 2

9 11/12	3 4
	5
Continued	

Figure 26 American size scale/stick

Mondopoint system

The Mondopoint system is the same as measuring the foot (not the shoe) in millimeters (mm). However, some companies treat Mondopoint as centimeters (cm). For example: a shoe may be labeled either 240 (mm) or 24 (cm) if it is designed for a foot that is 240 millimeters long (including some wiggle room for socks). Some times Mondopoint sizes with two numbers separated by a slash is used (e.g. 240/95, the second number is the width of the foot in millimeters.

Sizing system conversion

The above basic sizing system can be converted from one sizing system to another sizing system. The following formula can be used for converting English to Paris point or vice versa.

For Shoe Sizes up to Size 13:

Paris Points = 1.27 (12 + English shoe size)

Or

English Shoe size = Paris points /1.27 (12)

For Shoe Sizes 1 and Above:

Paris points = 1.27 (25 + English Shoe size)

Or

English Shoe size = Paris points /1.27 (25)

Girth Measurement and Grade

Joint Girth: The Joint Girth Grade is the amount by which the last circumference grows from one size to another around the joint portion.

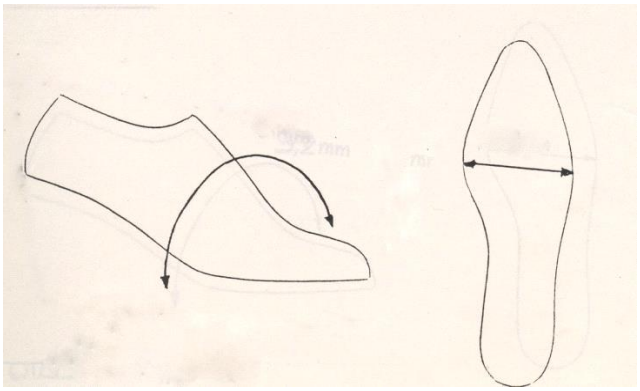

Figure 27 Joint girth

The amount of the grade will vary and depend on a variety of requirements, i.e. type of features to be made on the last.

As a rule, there are two main girth grades

Children's Range – Sizes 0 – 10-1/2 = 3/16 (4.76 mm)

= 3/16 Girth Grade.

For this range, the amount between fittings is 3/16 (4.76 mm)

Adult's Range – Size 11 – onwards = ¼ (6.35 mm)

= ¼ Girth Grade.

For this range, the amount between fittings is ¼ (6.35 m)

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Fill in the blanks: (Total points: 5)

1. ----------is a numerical indication of the fitting size of a shoe for a person.

2. Shoe size is represented by length and ----------.

3. American size scale is identical to the UK scale except that it starts at 3 11/12 inches instead of ----------inches.

Short answer questions: (Total points: 10)

List the common shoe sizing systems and briefly describe each of them. (5 points)

Discuss what is meant by shoe size. (5 points)

Note: Satisfactory rating – 15 points **Unsatisfactory - below 15 points**

Information Sheet 2-Identifying types of the size measuring tools

2.1 size-measuring tools

- Brannock Devices
- Foot measuring tape

Brannock Device

The Brannock device measures the length of the heel and the widest point of the foot. For that purpose, the device has another, shorter scale at the side of the foot. If this scale indicates a larger size, it is taken in place of the foot's length.

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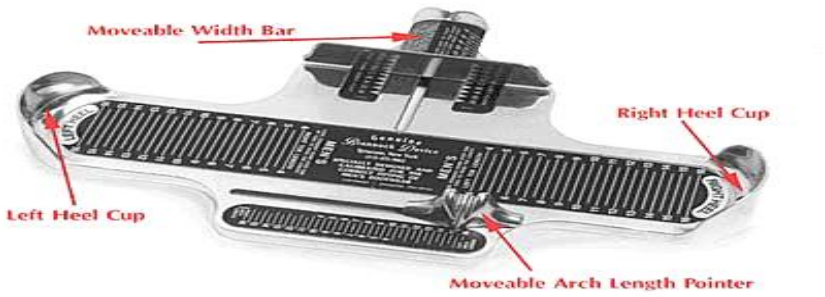


Figure 28 Brannock Devices

The Brannock device also measures the length of the distance of the heel and the widest point of the foot (heel to ball).

Foot Measuring Tapes

Measuring tapes are only one of many devices use for taken measurements but it is the most widely used in one form or another.

Measuring with tape:

- The tape can be used to measure length, but it is used mainly to take girth measurements, or distance around the foot.

- Care must be taken to use tape which will not stretch in use.

Figure 29 Foot measuring tape

Self-Check 2	**Written Test**

Name: _____ Date:_____

True or False: (Total point4)

1 .Brannock Device is a foot size measuring instrument invented by Charles F. Brannock in (2)

2 .The tape cannot be used to measure length, but it is used mainly to take girth measurements, or distance around the foot.(2)

Short answer questions: (Total points: 6)

1 What are the devices used to measure the foot sizes? (2points)

2 Describe briefly the uses of the devices mentioned in question 1. (2 points)

3 What is Brannock device? Define briefly. (2 points)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

Information Sheet 3 Explaining the procedures of foot measurement

3.1 Introduction

Foot measurement system calls for lasts for feet with short toes and feet with long toes, putting the ball of the foot in its proper place and leaving enough toe-space to ensure that the toes are not cramped or twisted.

Three measurements towards a correct fit. The light aluminium Brannock Device which are adults, women's, growing girls and junior models, is designed to provide the three vital measurements toe-to-heel, ball to heel and width in relation to each other and at the same time

3.2 Procedure of Foot Measurement Using Brannock Device

- Prepare the Device. Position the Foot
- Measure Lengths.
- Find the Correct Shoe Size.
- Measure the Width
- Measure the Other Foot Remember the Fitting Process
- Remember the Fitting Process

Procedure of Foot Measurement Using Brannock Device

1. Prepare the Device

Prepare the Brannock Foot-Measuring Device as shown in the photo below. The width bar should be set to its widest position and the arch length indicator should be slid back, so the foot can be positioned easily on the device.

2. Position the Foot

Have the customer remove their footwear and stand, placing their right heel into the right heel cup. The customer should stand with equal weight on both feet to ensure that the foot being measured has elongated and spread to it's maximum size. Be sure the heel is properly located against the back of the heel cup, by grasping the customer's ankle and device together, as illustrated in photo.

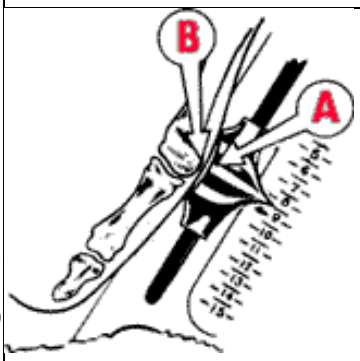
3. Measure Lengths

Heel-to-Toe Length

Press the toes flat against the base of the device and look straight down over the longest toe (not necessarily the first toe) to read toe length. Make sure the customer's socks are snug against the toes (without drawing the toes back) to yield an accurate measurement.

Arch Length (Heel-to-Ball)

Place your thumb on the ball joint of the foot (as shown in the photo to the right). Slide the pointer (A on diagram) forward so the inside curve of the pointer fits the ball joint of the foot and the two high ribs come in contact with your thumb. When the pointer is properly located, the lower middle rib will be against the ball joint on the side of the foot (B on diagram). This yields the arch measurement. The arch length represented in the diagram is 8 1/2.



4. Find the Correct Shoe Size

Compare the arch length to the heel-to-toe length. Generally, you will use the larger of the two measurements as the correct shoe size. If the arch length and heel-to-toe length are the same, this will be the shoe size. If the heel-to-toe length is larger than the arch length, then fit to the heel-to-toe size. If arch length is larger than heel-to-toe, then fit to arch length. Example**:**

It is important that both measurements be taken and compared to find the proper shoe size. Simply using the heel-to-toe length may result in an improper

5. Measure the Width

Slide the width bar firmly to the edge of the foot. Locate the shoe size (as determined in step four) on the movable width bar and view the width measurement indicated by the properly determined shoe size. If the shoe size falls between widths, choose a wider width for a thick foot, a narrower width for a thin foot.

Cleaning the Device

Clean the Brannock Device with a damp cloth. Use liquid dishwashing detergent if necessary. Do not use spray cleaners or disinfecting solutions as they may adversely affect the measuring areas of the device.

6. Measure the Other Foot

Reverse the device end-for-end and measure the other foot following the steps described above. Be sure to measure both feet, and then fit the larger foot. It is common to have feet of different sizes.

7. Remember the Fitting Process

When used properly, the Genuine Brannock Foot-Measuring Device is designed to indicate the correct shoe size. This is the first step in the fitting process. It may be necessary to make compensation in sizing to achieve a proper fit for each individual customer. The fitting process often involves trial fittings to ensure that the proper size was selected.

	**Junior Model** The Genuine Brannock Junior Model, shown here, is designed exclusively for children. Children's feet are constantly growing. With this in mind, the Junior Model device ensures that the shoe will fit, while allowing approximately one size for growth. The method of measurement is the same as the adult model with the exception of finding the width. Instead of utilizing a width t-bar, the Junior device uses a slide to measure the width. Position the slide so the arrows point to the size determined from toe or arch length. Then, find the width line, which aligns to the widest part of the foot.

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Short answer questions: (Total points: 4)

1. Describe briefly the procedure to be followed when measuring the foot by using Brannock devices. (2 points)
2. What are the three measurements helps to get correct fit a shoe. (2 points)

Note: Satisfactory rating – 5 points **Unsatisfactory - below 5 points**

Information Sheet 4- Explaining the basic principles of fittings

4.1 principles of fittings

Fitting is done on a two dimensional scale: overall length and ball width. Yet the foot and shoe are three-dimensional objects. Thus, what we have is a shoe of one size, shape, and sectional proportions attempting to fit a foot of many or varying sizes, shapes, and proportions

Size

Probable cause of this fault is just guessed size, and not measure feet or not know what measure on a Brannock fitting device. The other cause this fault is did not follow the fitting guides. The solution for this fault is that measure both feet on a Brannock fitting device while standing and then follow that styles fitting guide to get the right size.

Wrinkles on upper

This fault is caused due to poor or improper lasting operation by operator can be corrected by taking the following action.

a. Operator must take care while lasting

b. Operator must be given good training procedure.

Sole opening

Sole opening or gaping is caused by the following factors:

a. Sole or shoe bottom is not fully covered with adhesive

b. Sole not prepared as per the procedure

c. Not enough activation is carried out

d. Cycle time on press too short

e. Insufficient pressure on sole press

f. Wrong adhesive used

Broken toe-puff

Broken toe puff fault occur when the operator applies too much force during toe lasting operation or when using low quality toe puff. This fault can be reduced by using appropriate force and quality toe puff during lasting operation.

Loose top line

Loose top line fault is caused when a reinforcement material is not used or the reinforcement used is of low quality. This fault can be avoided by using reinforcement materials.

Alignment of upper

This fault is caused by the following factors:

a. Poor upper putting by the operator.

b. Operator not trained correctly.

Alignment of sole

Sole layed too far forward:

This fault is caused by the following factors:

a. Poor sole spotting by the operator.

b. Operator not trained correctly.

Sole layed too far back:

This fault is caused by the following factors:

a. Poor sole putting by the operator.

b. Operator not trained correctly

Sole layed to one side:

This fault is caused by the following factors:

a. Poor sole putting by the operator.

b. Operator not trained correctly.

Length Fit

Figure 30 Length fit

The first step upon standing is to check the overall length of the shoe in relation to the foot inside. There is no scientific space between end of toe and end of shoe, but the rule of thumb is between 3/8" and 5/8." We take into consideration foot expansion upon weight bearing.

Heel to Ball Fit

The next fit check is from heel to the ball of the foot. The big toe joint needs to be at the widest part of the shoe. This is important because the shoe has been designed to bend at this point and this is where the foot also bends. If these two don't match up, then excessive pressures will be placed on both the foot and the shoe. In addition to this, if the ball of the foot does not line up, the arch of the foot will not be properly supported by the support in the shoe.

Figure 31 Heel to Ball Fit

As we check both overall length and heel to ball, we must take into consideration that the foot may be longer in the toes or shorter in the toes in relation to the heel to ball fit. If heel to ball is longer, meaning short toes, try to fit heel to ball or a little shorter if possible. If necessary, fit heel to ball and pad with layered cork to keep toe from toeing up. Try to fit in a short toe last. If overall length is longer, then we must fit the heel to toe. Try to fit in a long toe last to get the best fit.

Ball Width Fit

Quite often people either fit or are fitted with the width too tight. The idea is that the upper will stretch. However, this does not always happen. When fit this way, not only can the shoe wear out faster due to excessive forces on the upper, but also the pressure on the foot can cause a variety of problems, such as corns, metatarsal pain, as well as foot dysfunction.

Figure 32 Ball Width Fit

The ball width fit is challenging in another sense because the foot has three different widths at the ball: foot at rest, foot on weight bearing, and foot under conditions of heat, humidity, and moisture. The shoe, fitted with one width, must provide proper width fit under these conditions. Here again, it is a matter of experience and judgment in selecting the width.

When checking for the width fit, we look for the foot to fit flat in the shoe and to able to spread out naturally inside. We should be able to pull the upper with a slight pinch. There should not be any excess on the little or big toe. Should there be a bunion on the big toe or little toe, going wider quite often will cause the heel to be loose. In this case, we would normally spot stretch these areas in order to take the pressure off the toes and still give us a snug heel fit.

Top line Fit

Figure 33 Top line fit

The top rim of the shoe should fit snugly against the foot. There should be very little or no gapping at the side. The exception to this rule applies to dress flats or heels which will gap on the sides when the foot and shoe flexes at the ball. As we slide our hand down the sides, we also check for the top line rubbing under the ankle. If this occurs, we either look for a shoe with a lower heel counter or put a small heel lift in the shoe to take the pressure off the ankle.

Arch Fit

In good-fitting shoes, the arch area hugs closely to the foot. But sometimes stress or torsion wrinkles will be seen in the upper, on the inner under side of the arch. This could be due to fit of the shoe or due to the foot over pronating. In the event of a dysfunctional foot, one might consider an arch support added to the shoe.

Heel Fit

Figure 34 Heel fit

This is the fit of the heel of the foot into the heel space of the shoe. The fit should be snug in order to stabilize the foot at heel strike when walking. We also need to check the top to make sure that it doesn't bite into the Achilles tendon, causing a "pump bump." Slippage under certain conditions, such as tight calves, can occur even when the heel appears to be snug.

Throat Fit

Figure 35 Throat Fit

The shoes' throat and throat line are the entry point for the foot into the vamp or forepart area. There must be throat room for the waist and instep to move forward during the weight bearing and step action. If the throat is too tight, then heel irritations can occur by

being shoved back into the heel. As the foot expands in size throughout the day, the throat line pressure increases. If severe or prolonged enough it can cut off blood circulation to the toes and cause uncomfortable sensations of numbness or tingling in the toes, plus swelling around the waist and instep.

Volume Fit

Shoe fitters traditionally think of fit in terms of linear measurement, overall length, heel to ball, and ball width. The fitter should know beforehand that volume fit is every bit as important as traditional size fit. After all, the fitter is constantly dealing with a wide range of foot types- fleshy, fat, bony, stocky, muscular, spready, etc. Each presents its own challenge to volume fit. And unless the volume or inter-space fit is as accurate as the conventional fitting sites (length, width), we not only don't have a proper fit, but also often cannot expect fully efficient shoe performance and comfort satisfaction.

Figure 36 Volume Fit

Walk Test

Finally, after all aspects of the shoe fit have been checked, you should walk around and tell the fitter of any uncomfortable feelings. This will help the fitter to determine if a different size should be tried, adjustment should be made, or whether to bring a pedorthist into the fitting to determine if a dysfunction of the foot is occurring causing the shoe to be uncomfortable.

Foot Orthosis Fit

Figure 37 Foot Orthosis Fit

For the most part, the fitting of a shoe with a foot Orthosis is the same as just fitting the shoe to the foot. All the same parameters must be assessed. Some styles and shapes of shoes may work better than others. This is best determined by those professional shoe fitters with training and experience.

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Fill in the blanks: (Total points: 6)

1 Foot gauge are only ----------. They measure only two dimensions, and indicate which size and fitting is likely to fit correctly.

2 Both feet must be ----------.

3 The larger should be ----------.

Short answer questions: (Total points: 6)

4 What rules should be applied when fitting foot? (2points)

5 How do you know what shoe fits best? (2points)

6 When checking for fit what are the things you are going to carry out? (2 points)

Note: Satisfactory rating – 12 points **Unsatisfactory - below 12 points**

Information Sheet 5- Explaining the types of lasts

5.1 Lasts

The **last** is template or model upon which the shoe is built. The last is a solid 3D plastic or wooden model. The Shape of the shoes is determined entirely by the last upon which it is made. A last is measured at several points including:

- Heel to toe
- Heel to ball
- Circumferential measurement at the ball
- Waist
- Instep & Heel

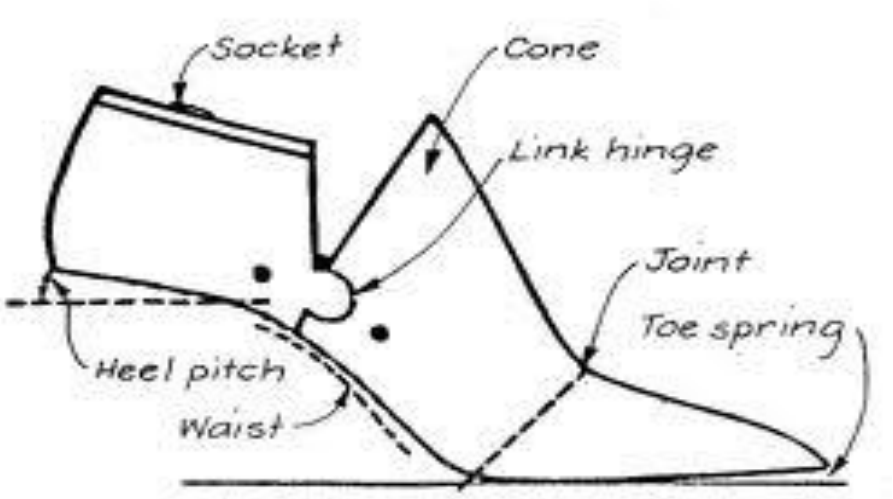


Figure 38 Last

Part of the Last

- **Cone**: a solid shape, become narrower at the top.
- **Feather edge**: the boundary line around the upper where it joins the welt or the sole or the corresponding line around an insole or last.

- **Forepart**: the front part of the last from the waist forward.
- **Heel pitch**: an angle between heel and baseline
- **Joint:** the main line of flexing of the foot.
- **Toe spring**: angle of the sole forepart and baseline.
- **Waist**: area anterior to the seat.

Different types of lasts

The fit of a shoe depends on the design shape and volume of the Shoe Last. The shoe last must represent the anatomical information of the foot, at the same time giving the finished shoe a pleasing and fashionable appearance.

Solid Last

These kinds of shoe lasts are the simplest and are used for low-heel shoes and sandals.

Figure 39 Solid last

Hinge Last

These lasts are used for all kind of shoe production. The lasts have a fore part and a back part and are connected by a spring. When slipping, the last is bent to shorten at the V-cut. Then the last is removed from the shoe without damaging or deforming the back part of the shoe.

V-hinge Last

Figure 40 V- hinge last

Scoop last

These lasts are used for the manual shoe production. The shoe-lasts have a wedge on the top and can be detached from the main body. The lasts can be easily taken out of the lasted shape by removing the wedge.

Figure 41 Scoop last

Self-Check 5	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Short answer questions: (Total points: 10)

1. What is last? (2points)
2. Explain briefly the points at which the last is measured. (2points)
3. What is the use of last? (2points)
4. List the different types of lasts used in footwear industries. (2 points)
5. Describe briefly the use of any two types of lasts you mentioned in question/ (2 points)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

LG #17	LO #4- Identify parts of shoes

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics • Describing upper parts of a shoe • Describing lining and interlining parts of a shoe • Describing bottom parts of a shoe This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Describe upper parts of a shoe • Describe lining and interlining parts of a shoe • Describe bottom parts of a shoe
Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the information Sheets 4. Accomplish the Self-checks

Information Sheet 1 Describing upper parts of a shoe

4.1 Upper parts of a shoe

The parts of shoe can be grouped broadly into those which make up the upper and those which constitute the sole and heel at bottom. The aim of this section is to identify the basic parts which go to make up uppers and bottoms.

Figure 42 Parts of shoe

Upper consists of three basic parts

- The vamp, which covers the toes and forepart or front of the shoe.
- The quarters, which covers the middle of the foot.
- The counter, which covers the back of the foot.

Positions /Areas in shoes

The top of the shoe which surrounds the opening for the foot is called the **top line**. The lower extremity where the upper meets the sole or insole is called the **feather edge**. When the patterns are cut, an additional margin is added to the feather edge which allows the upper to be attached to the rest of the shoe. This is called the **lasting allowance.**

Various areas of a shoe have names like toe, ball, heel and back seam or the shoe can be sectioned as forepart [the front area of the shoe], middle part [the waist area of the shoe] and back part [the heel area of the shoe].

Example of Shoe and its Parts:

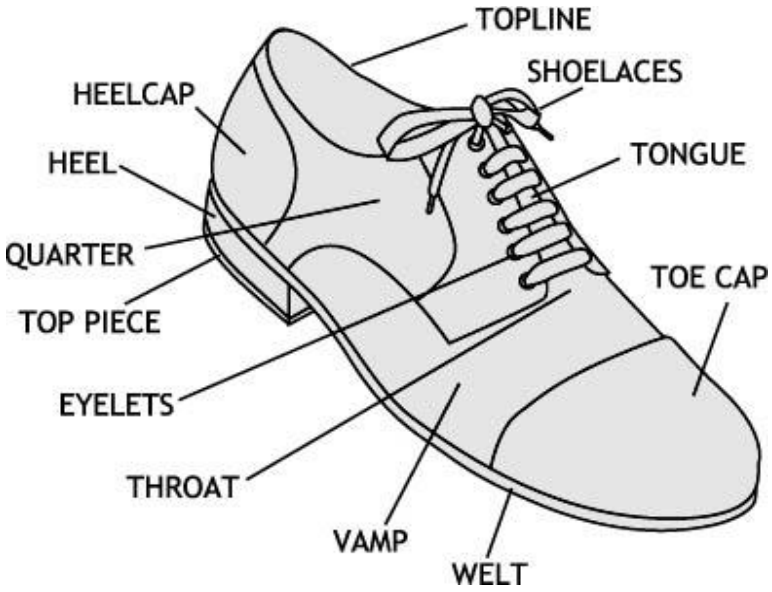


Figure 43 Parts of shoe

Vamp

This is the part of the upper covering the front part or portion of the shoe from the toe as far as the quarters. It covers the toes and a portion of the instep.

It may consist 1 piece, or more than one separate pieces stitched together to make a whole. Such as: Toecaps wing, caps Aprons and Vamp Wings

Toecaps and wing caps

A conventional toecap is set squarely across the shoe. A wing cap is angled back to give a streamlined effect. This may cover the toes in an intricate flowing curve or may lie simply round the wall edge of the last. In both cases.

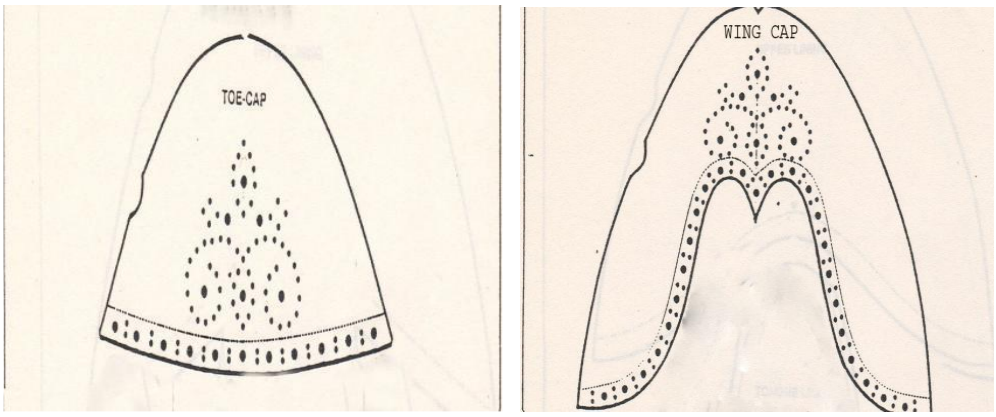


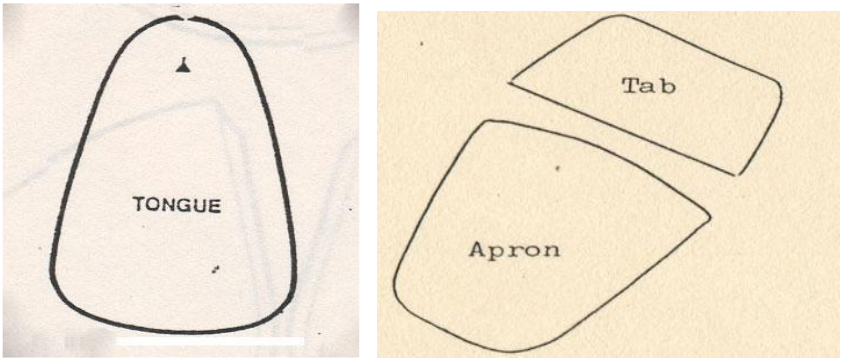
Figure 44 Toecap and wing cap

Aprons and Vamp Wings

Alternatively, the vamp may be divided into an apron covering part of the top of the foot, and wings enclosing the sidewall of the foot. Although the relative positions of vamp and apron can vary, the seam joining them will follow more or less and wall edge of the last where it changes from the horizontal to the vertical plane. It will be noted that the wings alone extend to the lasting edge.

Tongues and Tabs

A vamp may have a separate tongue or the vamp and tongue may be cut all in one piece. An apron may have a separate tab to cover the instep or the apron and tab may all be cut in one piece.



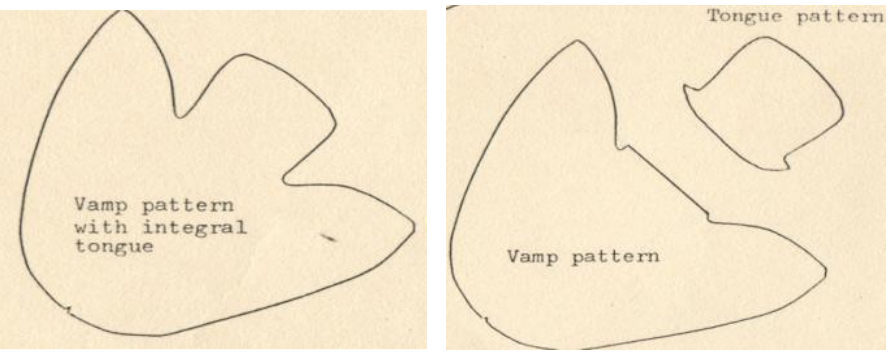


Figure 45 Tongues and tabs

Quarters

- Sections which form the back, outside part of the upper and lay over the instep to close the facings. The portion of a shoe or boot that meets the vamp to form a majority of the uppers.
- Most shoes have 2 quarters known as inside and outside

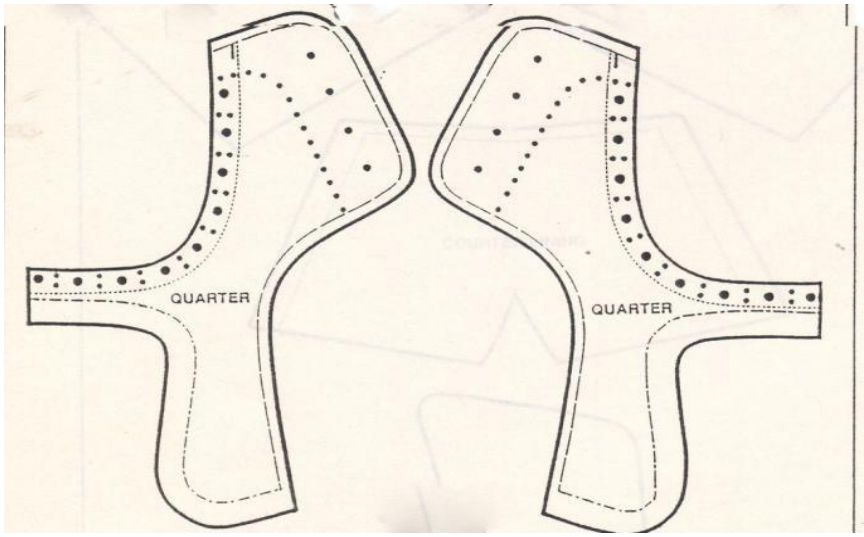


Figure 46 Quarters

Counters

It has been stated earlier that an elementary shoe is made up of two quarters, which are joined at the back. It is sometimes desirable to eliminate this heel seam so that the back of the shoe is cut as one piece. This one piece is called a **counter.**

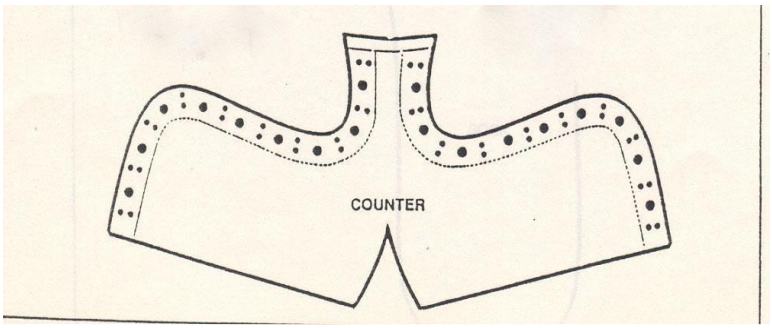


Figure 47 Counter

It will be noticed that even with a one piece counter, it is necessary to have a small back seam to maintain the shape of the counter to the last shape at the back. However, shoes are now being produced which have this seam eliminated completely. The back is moulded to the shape of the last by a combination of heat and pressure.

Appliqués

The essential fact about the different parts of a shoe described so far is that they are all separate pieces joined together to make a whole vamp or quarter. Different styles common appliqués of shoes include:

- Saddles and Bars
- Back Straps
- Small butter flies on children shoes

Saddles and Bars

The vamp may have a saddle or bar across it from joint to joint. This may serve two purposes:

- To reinforce the shoe especially at the throat where it bears the continued strain of flexing.
- To cover a seam or gusset. This could be the vamp/quarter seam or could be the seam joining an apron to a tab or tongue.

Figure 48 Saddles and bars

Back Straps

The heel seam is subject to considerable strain both in lasting and wear. It is common to reinforce it either with a counter or with a blackstrap.

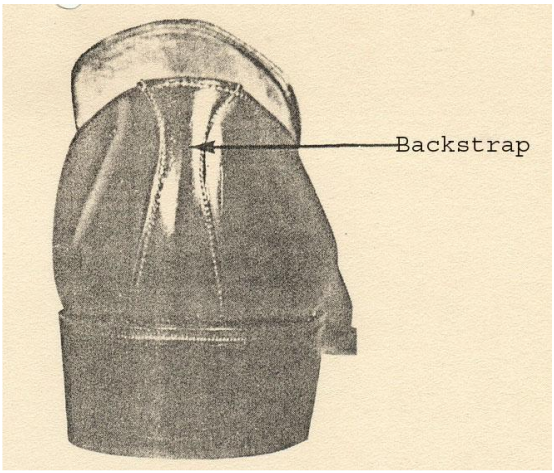
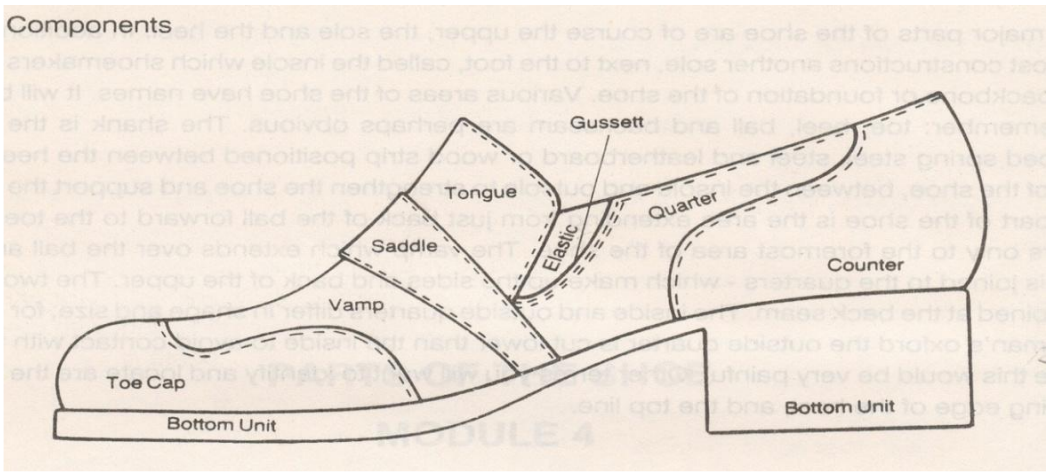
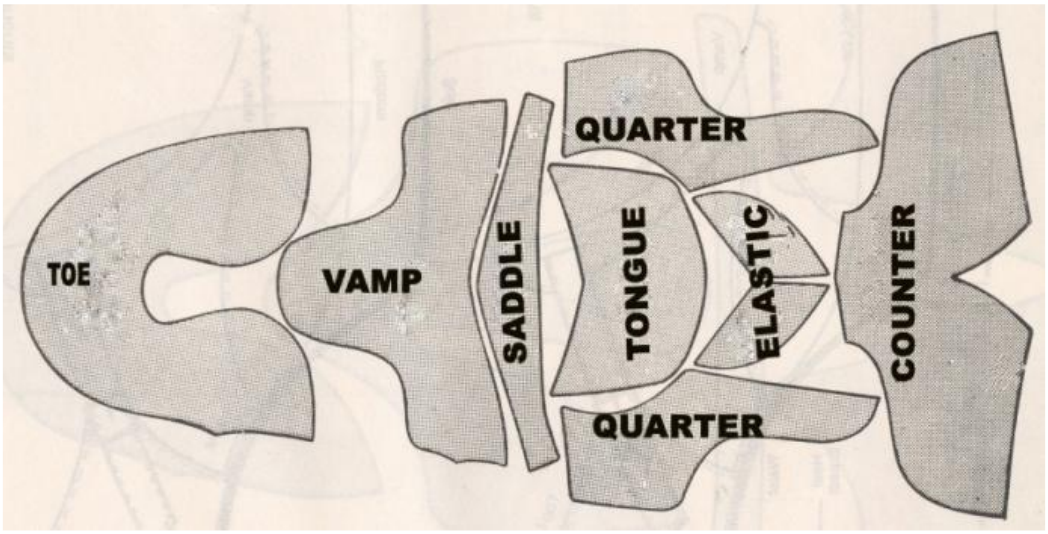


Figure 49 Back strap

While these various appliqués do serve a subsidiary purpose they are not essential to the composition of the shoe. In addition, appliqués can be added which serve no purpose at all except to enhance the appearance of the shoe.





Self-Check 1	Written Test

Figure 50 Different upper parts of shoe

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

Total Marks: 15

Type 1: Short Answer Questions

1. List the basic parts a simple upper. (5)

2. What is applique? (5)

3. Write some examples of appliques (5)

Note: Satisfactory rating – 15 points **Unsatisfactory - below 15 points**

.

Information Sheet 2- Lining and Interlining

2.1 Lining

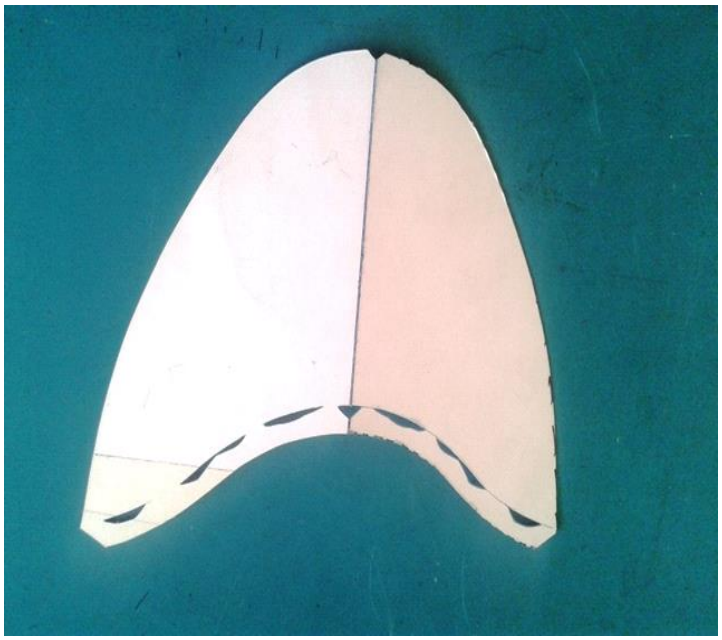


Figure 51 Vamp lining pattern

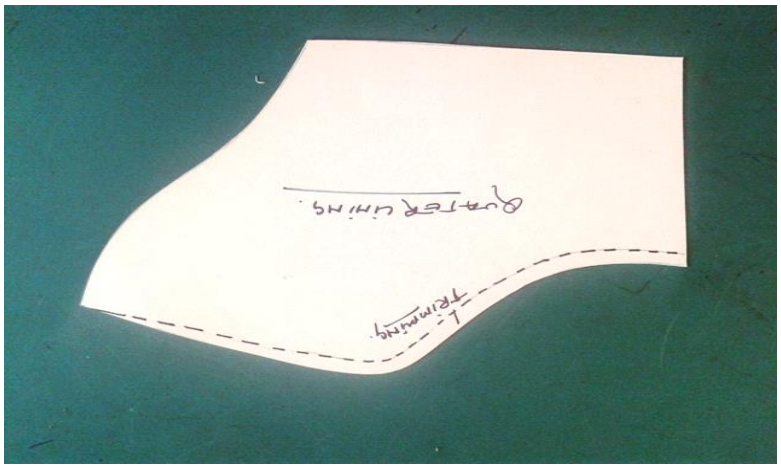


Figure 52 Quarter lining

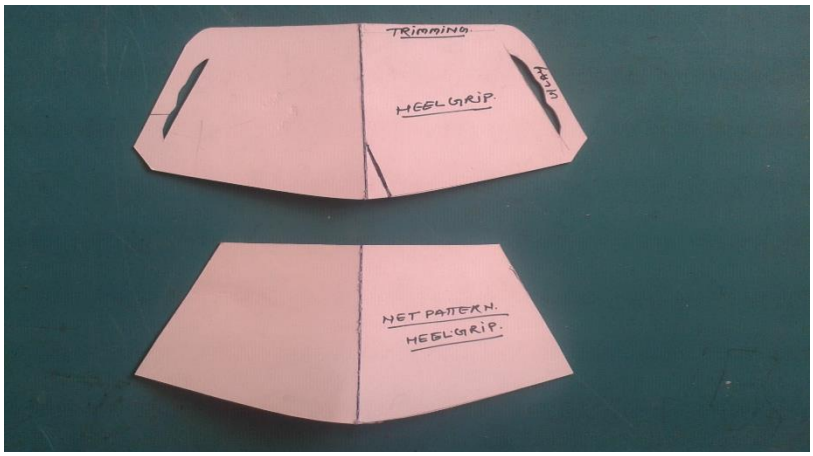


Figure 53 Heel grip pattern

2.2. Interlining parts of a shoe

These parts of shoe are sealed under the upper of shoe giving the shoe different purposes. These include:

- Toe puff
- Counter stiffener

Toe Puff

- It placed between upper and lining.
- This is the stiffener placed under the toe part of the vamp or toe cap to ensure that the shoe retains its shape or is stiffened in this area. It provides protection for the toes.
- It is made from thermoplastic materials or strong leather.
- Material is used instead of toe puff.

Counter stiffener

The counter is a reinforcement placed between the outside and the lining at the back of the quarters to prevent the upper from collapsing and to hold the heel of the foot securely.

Self-Check 2	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Total Marks: 18

Type 1: Fill in the blank

1. The parts of shoe are sealed under the upper of shoe giving the shoe different purposes include _____ (4)

2. List the types of last based on Hinge used (4)

Type 2: Short Answer Questions

1. What is Toe Puff (5)

2. What is Counter stiffener (5)

Note: Satisfactory rating – 18 points **Unsatisfactory –below 18 points**

Information Sheet 3 -Describing bottom parts of a shoe

3.1 Bottom parts of a shoe it includes

Insole: This is the inner sole of the shoe, which is next to the foot under the shoe sock. It is a hidden component of the bottom part of shoe. Shoe makers consider it as backbone or foundation of the shoe because it anchors the shoe together. Insoles may be made all in one piece, or alternatively in two pieces - a flexible forepart and a rigid backer.

When an insole is made from two pieces it is known as a BLENDED INSOLE. The blended insole is made from a flexible forepart and a rigid backer.

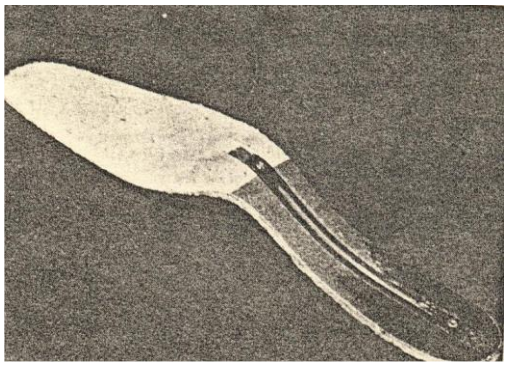


Figure 54 Insole

Insoles vs. inlays (socks): The insole is glued, stapled or sewn into place in a shoe whereas the inlay goes on top of the insole and is removable. The inlay will be the portion which comes into contact with the foot.

Sole: The layer of material which covers the bottom of the shoe and it is the walking surface of that shoe. The sole may be made of a diversity of material, i.e. leather, pure rubber, resin rubber compound, plastic etc.

Midsole

Additional soling placed between outsole and insole. It is common in wingtip shoes, work boots and athletic shoes. Used to give the shoe more heft or a sturdier, more rugged look

Figure 55 Soles and midsoles

Heel: It is the under part of the shoe which supports the heel of the foot, and may be stuck or nailed to the shoe bottom. It is a support placed under the quarter to ensure that the footwear lies correctly. The seat part of the footwear bottom, sometimes are attached separately and sometimes as an integral part of the sole.

It can be made of leather, wood, plastic, rubber, leather board, poly urethane, Masonite and etc. Heel shapes can be classified under these headings.

The level of support at the back of your ankle and heel is more important than you may think. If it's too loose and soft, it'll provide very little support and after walking for a while it may become uncomfortable. It could rub causing blisters. There are various heel shapes as shown in the following Figureure.

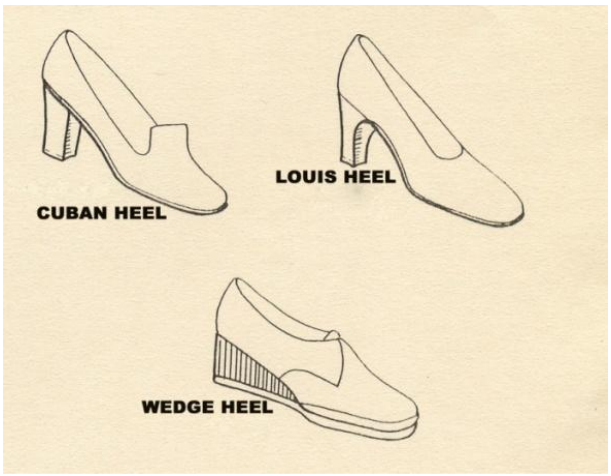


Figure 56 Different types of heels

Heel Lifts: It is layers of material such as leather or leather board, which are built up together and shaped to form built heels.

Top-piece: It is the top surface or walking surface of a heel.

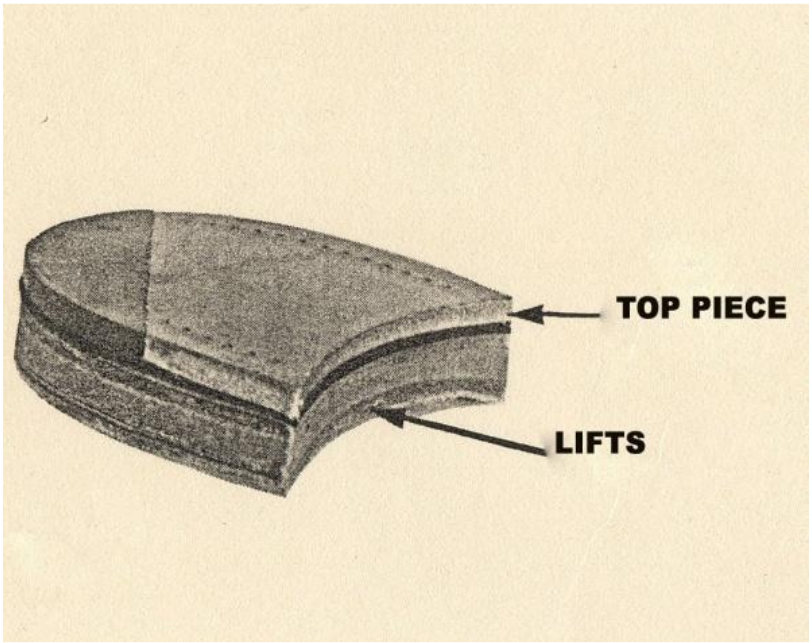


Figure 57 Top piece and heel lifts

Self-Check 3	**Written Test**

Name: _____ **Date:** _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Total Marks: 10

Type 1: Short Answer Questions

3. Describe the major bottom components. (4)

4. Write down the name of different types of heel. (4)

5. What is insole? What is the function of insole? (2)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

LG #18	LO #5- Describe footwear types, styles and construction

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Identifying the types of footwear and describing their uses
- Explaining footwear designs/styles
- Identifying design characteristics
- Describing common client requirements for footwear designs
- Identifying basic design tools used to develop design concepts
- Identifying accessories used to accent footwear designs
- Explaining footwear basic constructions

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify the types of footwear and describing their uses
- Explain footwear designs/styles
- Identify design characteristics
- Describe common client requirements for footwear designs
- Identify basic design tools used to develop design concepts
- Identify accessories used to accent footwear designs
- Explain footwear basic constructions

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 1- identifying the types of footwear and describing their uses

1.1 Footwear can be designed for various purposes. These basic designs are described as follows.

Safety boots

Safety boots are designed to protect the user from potential hazards or prevent injuries. There are different components that made up safety footwear. These components include safety toe guards, metatarsal guards, electrical hazard ratings, electro static dissipating ratings and the soles of the shoes.

Safety footwear protects the foot in areas where there is a danger of foot injuries due to falling or rolling objects or objects piercing the sole.

Figure 58 Different types of safety boots

Work boots and shoes

Work boots and shoes are used primarily at the construction, agricultural and cold work place. Work boots and shoes should offer good flex properties right down to low temperatures; tough, hard-wearing, improved anti-slip outsoles; oil, micro-cellular biological and hydrolytic resistance; and insulation of both foot and leg, which is particularly important in the cold area. Work shoes are designed to stand heavy wear, to protect the wearer, and provide high traction. They are generally made from sturdy leather uppers and non-leather outsoles.

Fashion shoes

A shoe is an item of footwear intended to protect and comfort the human foot while doing various activities. Shoes are also used as an item of decoration. The design of shoes has varied enormously through time and from culture to culture, with appearance originally being tied to function. Additionally fashion has often dictated many design elements, such as whether shoes have very high heels or flat ones. Contemporary footwear varies widely in style, complexity and cost. Basic sandals may consist of only a thin sole and simple strap. High fashion shoes may be made of very expensive materials in complex construction and sell for thousands of dollars a pair.

Casuals

Casual shoes are characterized by sturdy leather uppers, non-leather outsoles, and wide profile.

Sport shoes

Sport shoes are a shoe that worn during performing different sport activities. Serious sport enthusiasts and professionals require footwear which will both protect and enhance performance. Microcellular polyurethanes are the ideal material for producing high quality midsoles, which reduce the risk of leg joint and muscular injury without impeding performance. In addition, the ability to encapsulate inserts within the mould has allowed leading sports shoe manufacturers to enhance cushioning by inserting energy return devices into the midsole.

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Fill in the blanks: (Total points: 5)

1. _____ are designed to protect the user from potential hazards or prevent injuries (2 points).
2. ---------- protect the upper foot and toe area from potential “drop” hazards.(3 points)

Short answer questions: (Total points: 5)

1. What are the various purposes for which footwear is designed? (2 points)
2. Describe briefly the function of work boots and shoes. (3 points)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

Information Sheet 2- Explaining footwear designs/styles

2.1 Footwear styles

Shoe styles could be classified based on the following types: based on design and based on constructions. Shoe styles based on design are dealt in this subsection.

Design is feature of the product; the styles are created from the basic designs. Dynamic product-features are variable. On the other hand application of the footwear defines the construction. There are various types of shoe styles. These are Derby Shoe, Oxford shoe, Court shoe, Sandals, Slippers, Boot, Moccasin and Slip-on shoe styles are:-

- Derby shoes
- Oxford shoes
- Court shoe
- Slip-on
- Sandal
- Moccasins

Derby shoes

A **Derby** shoe is a style of Men's shoe characterized by shoelace eyelet tabs that are sewn on top of a single-piece vamp. It has a wide opening.

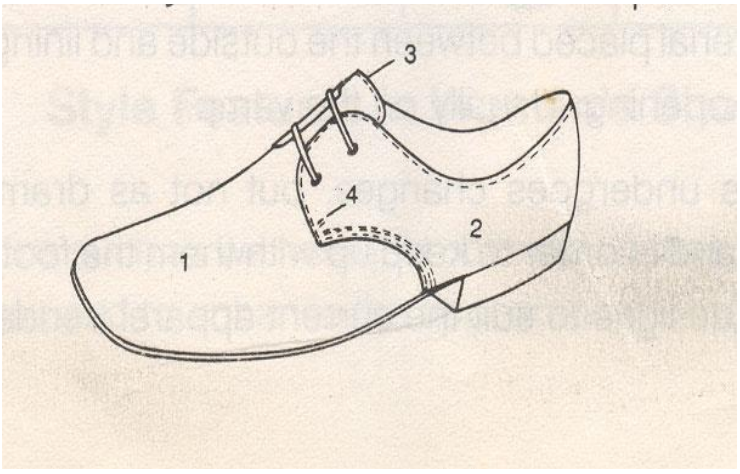


Figure 59 Derby shoe

Oxford shoes

- A general term indicating a low-cut shoe with lacing attachment over the instep.
- It is probably the most used design today.
- The main visual feature of these construction is that the vamp overlays the quarter (V/Q), unlike derby.
- It has narrow opening.

Figure 60 Oxford shoe

Court shoe

A **court shoe** or **pump** is a shoe with lowest cut design exposing instep and usually having no additional means of fastening. However, some may have an ankle strap. They are worn by women, but are still traditional menswear in some formal situations, where the style is sometimes called an **opera slipper** or **patent pump**. It is basically lowest cut design exposing instep and having no additional means of fastening.

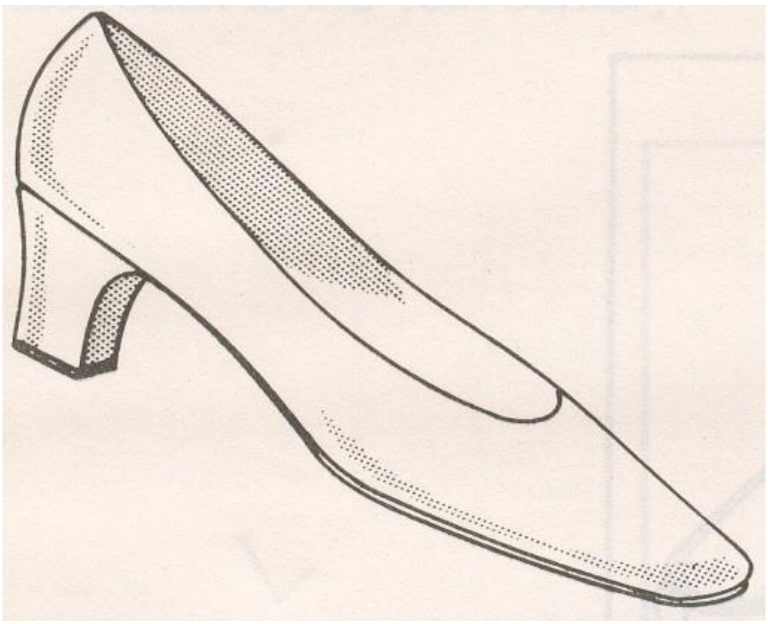


Figure 61 Court shoe

Sandal

Sandals are an open type of outdoor footwear, consisting of a sole held to the wearer's foot by straps passing over the instep and, sometimes, around the ankle. While the distinction between sandals and other types of footwear can sometimes be blurry the common understanding is that a sandal leaves most of the upper part of the foot exposed, particularly the toes.

Figure 62 Sandals

Slippers

Slippers are light shoes which are easy to put on and take off and usually worn indoors for indoor use, commonly worn with pajamas.

Figure 63 Slippers

Slip-on

Slip-on is typically low, lace-less shoe. The style most commonly seen, known as or slippers in American culture. They began as casual shoes, but have increased in popularity to the point of being worn in America with city lounge suits. They are worn in many situations in a variety of colors and designs, often featuring tassels on the front, or metal decorations (the 'Gucci' loafer). A less casual, earlier type of slip-on is made with side gussets.

There are no lacings or fastenings. The popular loafers are part of this category, as well as less popular styles, such as elastic-sided shoes.

Figure 64 Slip on shoes

Categorization of Slip-on

- Slip-on without Elastic w/o Saddle
- Slip-on without Elastic with Saddle
- Slip-on with Side Elastic
- Slip-on with Center Elastic

Moccasins

A moccasin is a shoe from soft leather, consisting of a sole and sides made of one piece of leather, stitched together at the top, and sometimes with a vamp (additional panel of leather). The sole is generally soft and flexible and the upper part often is adorned saddle, appliques etc. Though sometimes worn inside, it is chiefly intended for outdoor use, as in exploring wildernesses and running.

Figure 65 Moccasins

Long boots

A **boot** is a specific type of shoe. Most boots mainly cover the foot and the ankle and extend up the leg, sometimes as far as the knee or even the hip. Most boots have a heel that is clearly distinguishable from the rest of the sole, even if the two are made of one piece.

Traditionally made of leather or rubber, modern boots are made from a variety of materials. Boots are worn both for their functionality – protecting the foot and leg from water, snow, mud or hazards or providing additional ankle support for strenuous activities – and for reasons of style and fashion. High-top athletic shoes are generally not considered boots, even though they do cover the ankle, primarily due to the absence of a distinct

Figure 66 Ankle and long boots

Self-Check 2	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Total Marks: 10

Type 1: Short Answer Questions

1. How many basic designs are there? (3)

2. It is lowest cut design exposing instep and having no additional means of fastening. Which type shoe style is it? (2)

Type 2: Fill in the blank

1. _____ is the most common variation of derby. (1)

2. _____ is the most common variation of oxford. (2)

3. _____ is a shoe from soft leather, consisting of a sole and sides made of one piece of leather, stitched together at the top. (2)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

Information Sheet 3- Identifying design characteristics

3.1 Introduction

Product performance can be broadly evaluated based on its function, form, and fit. It is well known that fit or product compatibility is necessary for a person to experience comfort, safety and satisfaction during use. However, compatibility is not so well known for all types of interaction between people and equipment. Form has been the dominating factor in the sale of footwear over the last few decades. Even though technology enhancements are thought to improve the functioning of footwear, some of them are simply ornaments to enhance form rather than functional elements that protect people's feet.

Given the tremendous flexibility of the foot, it is important that the foot be accommodated in a way that allows a foot to function as "designed". Ergonomics dictates good posture and many other specialized areas such as quality control, perception, and biomechanics can be reasonably well integrated into the design and development of footwear.

Fit and sizing

In traditional mechanical engineering applications, there are different types of fit depending on function. For example, a bearing requires an interference fit on a. shaft. In this case, the difference between the shaft diameter and the internal diameter of the bearing has to be within a given tolerance in order to produce the required interference fit. In applications involving people, on the other hand, fit is generally not as well defined.

Clinical reports of foot problems such as blistering, chafing, black toes, bunions, pain, and tired feet are quite good evidence of poor fitting shoes. The need for a quality characteristic to evaluate the fit between a person’s foot and the footwear he or she wears is of utmost importance for the scientific development of lasts and for improvement of footwear fit. Most shoe manufacturers still depend on artistic lasts for shoes even though many of the designer shoe manufacturers have now realized that comfort is an important criterion for survival in this vastly improving trade.

A shoe last, . The different shoe sizes are then generated from the master last using a procedure known as grading. In order to keep shoe sizing simple, foot length and foot width are generally used, even though the size makings are rarely

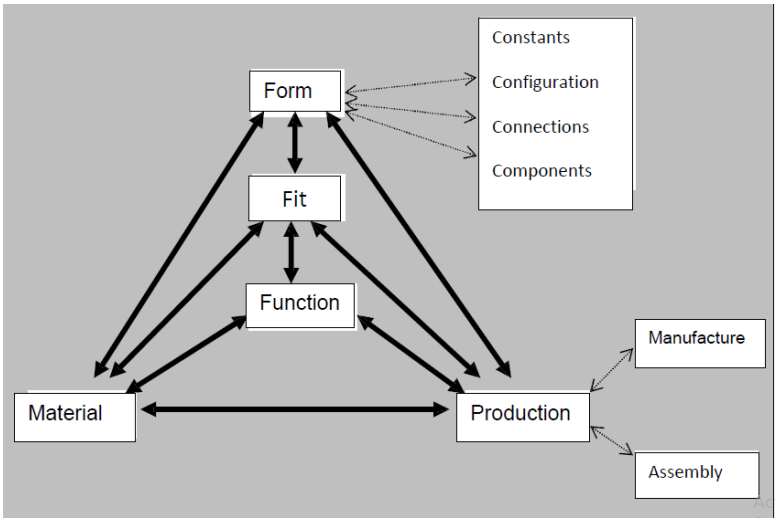


Figure 67 Elements of footwear design

Proper fitting of footwear to feet involves understanding feet, shoes, and the selection of shoes to achieve a required fit. With respect to feet, many sources of foot anthropometry are available. Up until sometime in the 18th century, shoes were symmetric and could be worn on either foot. People were able to extend the durability of shoes by interchanging them similar to rotating tires in a vehicle. Similarly, the history of shoe sizing is also quite interesting.

The measurement that three barleycorns placed end to end would equal 1inch has been traced way back to the 7th century. At that time, it was not a universal measurement. In 1324, Edward II decreed that three barleycorns placed end to end would be the "official" inch. After that, shoemakers began to use the barleycorn inch measurement. The largest foot was equivalent to 39 barleycorns (13 inches) and was designated as size 13. All other sizes were relative to this size 13 and differed by 1 barleycorn (or 1/3 inch). Even with the rapid advancement in technology over the centuries, it is quite surprising that this same measurement system is still in use today.

The footwear sizing system is primarily based on foot length and is sometimes based on foot length and foot width. Footwear manufacturers however, resort to using length, width and girth measures, and a mismatch in any dimension generally results in poor fitting.

Many footwear fitters have recommended the following procedure when fitting shoes:

1. Measure and fit shoes at the end of a day rather than at the beginning due to deformation and swelling

2. Fit shoes to the longer foot with a toe clearance of 9 to 12 mm at the longest toe.

Cushioning

During walking, the ground reaction force is approximately 1.25 times the body weight and during running, the ground reaction force can reach levels of 2 to 3 times the body weight. Thus, midsole cushioning is supposed to attenuate or dampen the impact forces acting on the body during usage. Shoe designs attempt to concentrate on stability and cushioning in addition to weight and durability. Good support (that is, stability) may feel uncomfortable to a person while too much cushioning will make activities such as walking and running quite difficult.

Most research has concentrated on comparing different shoes or materials rather than comparing the basic physical characteristics of the materials that are used midsole cushioning is supposed to attenuate or dampen the forces on the body, the actual force acting on the body remains relatively unchanged with footwear. .

In the early days, rubber was used as a cushioning material. In recent years, shoe manufacturers have resorted to using PU and EVA or similar foams. Most of the midsole foams in common use today are viscous elastic materials, i.e., they exhibit viscous and elastic properties. Thus, the physical properties that characterize these foams can be quite varied. Foam-cushioning glossaries give many different physical parameters that may be related to perceive cushioning.

Self-Check 3	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Total Marks: 10

Fill in the blanks: (Points: 6)

1. Product performance on the other hand, can be broadly evaluated based on its function, form, and ----------.

2. In traditional mechanical engineering applications, there are different types of fit depending on ----------.

3. Clinical reports of foot problems such as blistering, chafing, black toes, bunions, pain, and tired feet are quite good evidence of ----------shoes.

4. The footwear sizing system is primarily based on foot length and is sometimes based on foot length and ----------.

5. Foot length, width measurements and ---------- are generally performed using equipment.

6. ---------- dictates good posture and many other specialized areas such as quality control, perception, and biomechanics can be reasonably well integrated into the design and development of footwear.

Short answer questions: (Points 4)

1. Describe shortly fit & sizing. (2 points)

2. Describe briefly about cushioning effect. (2 points)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

Information Sheet 4- Describing common client requirements for footwear designs

4.1 Describing common client requirements for footwear designs

Common client requirements for footwear are:

Comfort

Choosing the right shoe can prevent or alleviate foot pain; the wrong shoe can exacerbate or cause foot problems.

Today's shoes are quite specialized to provide a higher level of performance for specific activities, from walking to running. The various designs, materials and technologies used affect the function and fit of a given shoe.

Cushion

Cushion is a term used to describe a specific type of athletic shoe. These shoes use soft material in the midsole and are intended for people with high arches that do not collapse.

Extra Depth

These shoes are more generous with space inside the shoe; they are deeper and provide additional room for orthotics or arch supports, as well as for bunions and other fitting challenges.

Most shoes are constructed on a last; the shape of the last determines the shape of the shoe and the type of foot or function best suited to that shoe. It is described as follows:

Lasts

Curved: It is intended for people with high arches that do not collapse.

Semi-curved: It is intended for people with higher arches and little to no pronation.

Semi-straight: It is intended for flat feet or moderate to heavy pronators.

Straight: It fits a wider, rectangle-shaped foot that is extremely flat, with a low or collapsed arch.

Maximum Motion Control

Maximum motion control is a term used to describe a specific type of athletic shoe. The midsoles of these shoes are made with a maximum amount of dense material along the medial side of the shoe (under the arch) to help support the foot. Shoes with maximum motion control are designed for the individual who has flat feet.

Many people require additional support in the forefoot, at the metatarsal arch, to alleviate pressure. In some shoes, over-the-counter arch supports can provide for this additional support.

Moderate Motion Control

Motion control is a term used to describe a specific type of athletic shoe. The midsoles of these shoes are made with denser material along the medial side of the shoe (under the arch) to help support the foot. Intended for flat feet or moderate to heavy pronators, depending on the size of the individual (height and weight) and intended activity.

Rocker Sole

Shoes with rocker soles are very stiff in the front of the shoe and have a little rounded, creating a rocking effect. This rocking effect helps alleviate foot pain due to conditions affecting the forefoot or ball of the foot, such as arthritis and neuromas. Rocker soles can also be used for walking or standing for long periods.

Stability and High Stability

Stability is a term used to describe a specific type of athletic shoe. These shoes are designed for a more curved foot with a higher arch. Much of the weight is on the outside of the foot.

Structured Cushioning

Structured cushioning is a term used to describe a specific type of athletic shoe. These shoes have a cushioned base, with light support under the arch. They are intended for people with higher arches.

Velcro: Athletic Shoes

For some people tying laces or buckling buckles is just too difficult, but a securely fitted shoe is critical for their safety and comfort. Velcro is the perfect solution.

Velcro: Casual Shoes

For some people tying laces or buckling buckles is just too difficult, but a securely fitted shoe is critical for their safety and comfort. Velcro is the perfect solution.

Velcro: Sandals

For some people tying laces or buckling buckles is just too difficult, but a securely fitted shoe is critical for their safety and comfort. Velcro is the perfect solution.

Fitting

When a retailer buys his stock, he selects from the manufacturers a range of styles in which he believes, will meet the appearance, performance and price needs of the customers he serves. He also chooses those styles in a range of sizes and fitting that will enable him to meet their fit requirements.

To help he selects quickly the correct size and/or fitting for a particular customer he uses a foot measuring device, or foot gauge. A good manual foot gauge includes a size (length) scale, plus a girth measuring tape which can be aligned correctly to the true joint angle of both left and right feet.

Electronic foot gauges measure length and width automatically, displaying size and fitting on a panel. For fitting footwear a set of rules should be applied:

Foot gauge are only a gauge. They measure only two dimensions, and indicate which size and fitting is likely to fit correctly. Both feet must be measured. The larger should be fitted. When using a manual foot gauge, body weight must be off the feet. When using an electronic foot gauge body weight must be on the foot being measured.

The foot must be correctly positioned on the foot gauge. The stool must be in line with the leg. The heel must be right back to the pillar. The angle between leg and foot must be 90 degrees. The foot must be correctly aligned.

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

True or False: (Total points: 6)

1. Choosing the right shoe can prevent or alleviate foot pain.
2. Cushion is a term used to describe a specific type of athletic shoe.
3. Both feet must not be measured.
4. Larger feet should not be fitted.
5. When using a manual foot gauge, body weight must be on the feet.
6. When using an electronic foot gauge body weight must be off the foot being measured.

Short answer questions: (Total points: 8)

1. What do you mean by comfort and its effect on foot? (2 points)
2. What are the parameters that affect the function and fit of a given shoe?(2 points)
3. What is fitting and how it affects the foot? (2 points)
4. What are the sets of rules that should be applied when fitting the foot? (2 points)

Note: Satisfactory rating – 14 points Unsatisfactory - below 14 points

Information Sheet 5- Identifying basic design tools used to develop design concepts

5 .1 Design tools used to develop design concepts

Storyboards

This is a visual representation of a new fashion trend, sometimes called 'Mood Boards' because they describe the 'mood' of a trend. The storyboard is used by the footwear designer to 'set the scene', before they start designing. It is often used by clients to understand a trend, or to explain a trend to a colleague. It can help a client decide the focus of a range of footwear, if it is relevant to their customer before the designer starts to design.

Storyboards are usually made from fashion magazine photos; they may include notes, material swatches, other inspirational pictures, sketches or photos. There is usually an element of forecasting involved. We look at current trends, we look at what the opinion formers are doing and wearing, we look at what is happening in the world generally and use this information to predict what might be popular next.

Catalogues, pictures

Catalogues and pictures are important materials that are used for shoe designing purpose**.** A designer is used this materials as a source for designing different style of shoes.

Drawings and illustrations

Drawing is the art of the draftsman. It is an art or technique of producing images on a surface, usually paper, by means of marks in graphite, ink, chalk, charcoal, or crayon. In its broadest sense it includes every use of the delineated line and is thus basic to the arts of painting, architecture, sculpture, calligraphy, and geometry. The word drawing is commonly used to denote works in pen, pencil, crayon, chalk, charcoal, or similar media in which form rather than color is emphasized. For centuries drawings have been made either as preparatory studies (see cartoon) or as finished works of art. Preparatory

drawings sometimes reveal a vigor and spontaneity lacking in the completed work. Drawings are often used as illustrations and are reproduced by such processes as etching, engraving, and lithography. Illustrations can also be graphs, charts and other forms of visual representations.

In general,

- Both drawing and illustration are visual representation used to convey a particular message.
- Drawings are visual expressions used to convey feelings and emotions evoked within the artist. On the other hand, illustrations are visual expressions that help people further understand and visualize the accompanying textual content.
- Drawings can stand alone, and still convey message. On the other hand, illustrations require text to accompany it, for it to be appreciated.

Self-Check 5	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Match the following. (Total points: 4)

A	B
1. Storyboards	A. This is a visual representation of a new fashion trend, sometimes called 'Mood Boards' because they describe the 'mood of a trend'.
2. Catalogues, pictures	B. is the art of draftsman
3. Drawings	C. are used for shoe designing purpose**.**
4. Illustration	D. visual representation to provide emphasis or to accentuate a particular text

Short answer questions: (Total points: 6)

1. Describe briefly the various types of designing tools used in footwear design and their uses? (2 points)
2. What are storyboard and its uses? (2 points)
3. What is the difference between drawings and illustrations? (2 points)

Note: Satisfactory rating – 10 points Unsatisfactory - below 10 points

Information Sheet 6- Identifying accessories

6.1 Identifying accessories

Once the main design of a shoe is completed, the designer may also choose to add several accessory components to the model. These include laces, fasteners, and ornaments.

Accessories

Accessories are decorative pieces that are functional or non functional components of the shoe. Accessories include materials such as decorative metal Trims, eyelets, rivets, buckles, eyelets, D- Rings, zippers, decorative laces, rivets and etc.

These are made in material similar to that of the shoe or a contrasting material. These are applied by means of a clip, or staple.

Figure 68 Accessories

Button and Sequins

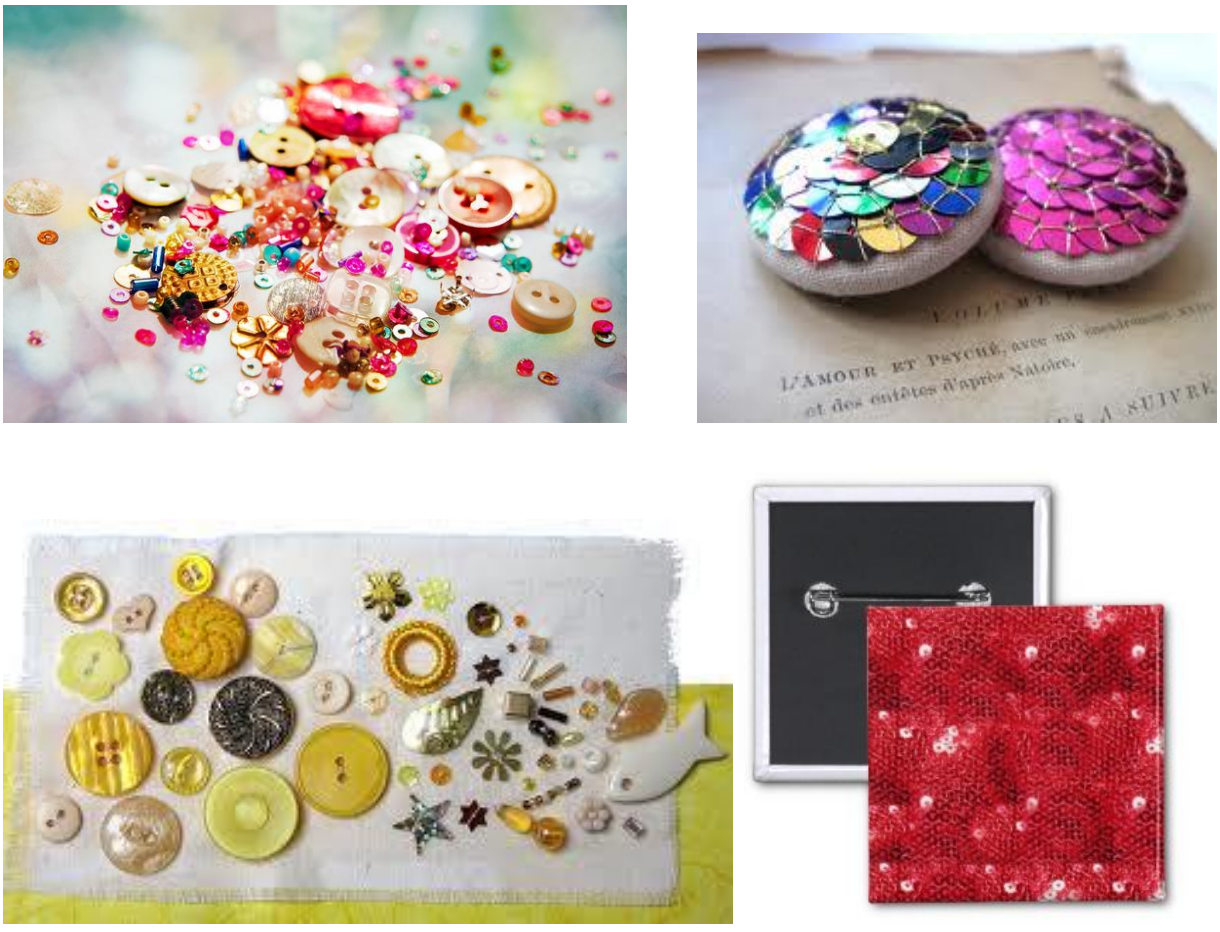


Figure 69 Buttons

D Rings

Figure 70 Buttons

Eyelets

Figure 71 Eyelets

Figure 72 Decorative metal trims

Buckles

Figure 73 Buckles

Zippers

Figure 74 Zippers

Decorative laces

Figure 75 Decorative laces

Rivets

Figure 76 Rivets

Buckles

A buckle for fastening the shoe on the foot, generally by means of a latchet or strip passing over the instep, of the same material as the shoe. Buckles throughout the latter part of the seventeenth century and nearly the whole of the eighteenth secured shoes. They were worn by both men and women. Such buckles were sometimes of precious material, and even set with diamonds. In the present century the fashion has been restored at intervals, but most contemporary shoe-buckles are sewed on merely for ornament.

Figure 77 Buckles

Self-Check 6	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Fill in the blanks: (Total points: 4)

1. Accessories components include laces, fasteners, and ----------.
2. The geometric variation on these components is almost ----------.
3. A ---------- for fastening the shoe on the foot, generally by means of a latchet or strip passing over the instep, of the same material as the shoe.
4. Most ---------- systems provide for users to create libraries, or catalogs of such components or assemblies.

Short answer questions: (Total points: 8)

1. List the accessories used in footwear design. (2 points)
2. What is trim and its use? (2 points)
3. What are buckle and its function? (2 points)
4. From what materials can trim and buckle prepared? (2 points)

Note: Satisfactory rating – 12 points **Unsatisfactory - below 12 points**

Information Sheet 7- Explaining footwear basic constructions

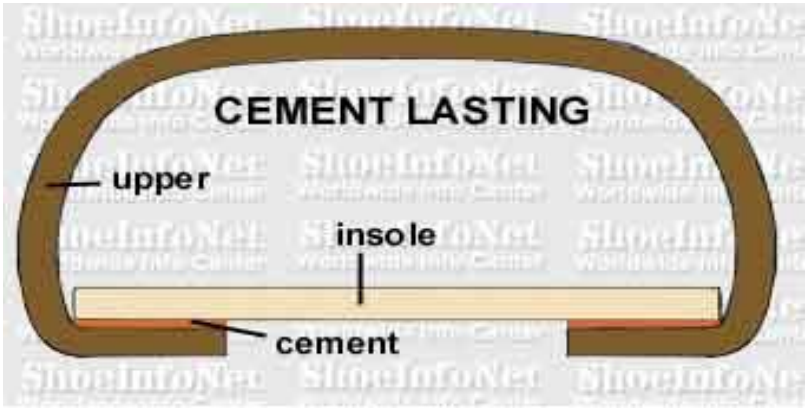
7.1 Construction

Construction is a method of assembly of the footwear. This is variable feature and in some product's application, special constructions are applied. In footwear manufacturing the 'construction' is associated with some specific operations in the making department, which is carried out in order to attach out sole, etc. with the upper. There are different types of footwear construction. These are described as followed.

- Cemented construction
- Good year Welted construction
- Stitch down construction
- Moccasin construction
- California construction
- Direct Injection process (DIP)
- Strobel construction

Cement lasting /Stuck-on/flat lasting/construction

It is a type of construction where Lasted upper is directly attached with the outsole by means of adhesive. Prior to sole attachment, the upper is mounted on the last (Lasting) and the lasting margin is secured with the insole by means of adhesive and/or tacks. Bottom filler is used to fill up the cavity between insole and lasting margin.



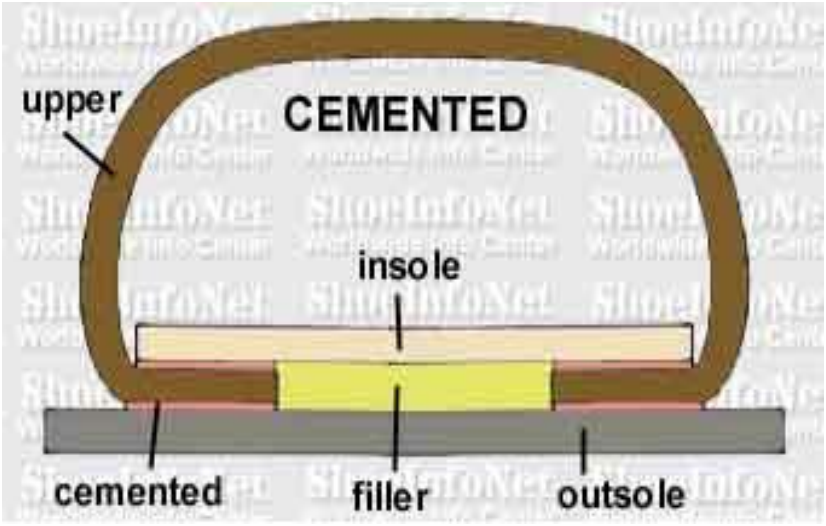
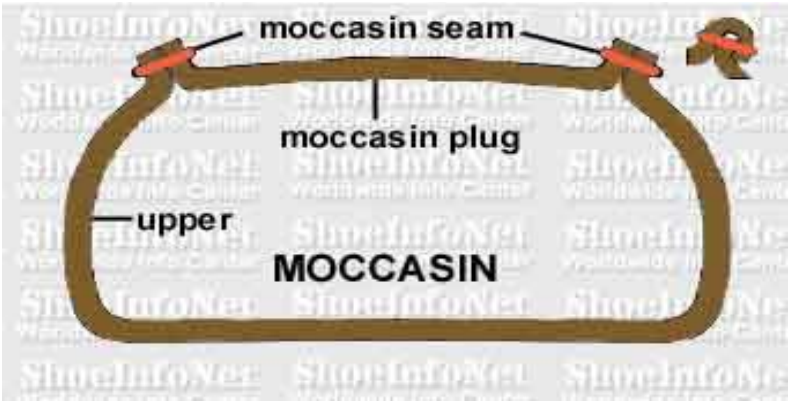


Figure 78 Cement lasting

Moccasin construction

It is a type of force lasting (i.e. the upper is forced over the front of the last with the back being pushed into right position) where the moccasin plug stitched before lasting.



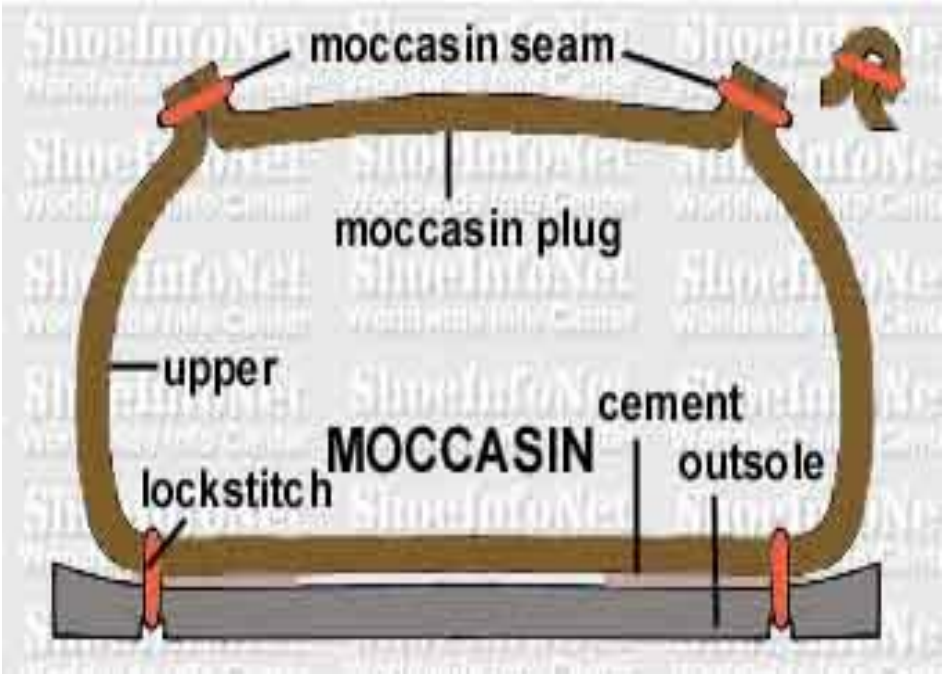
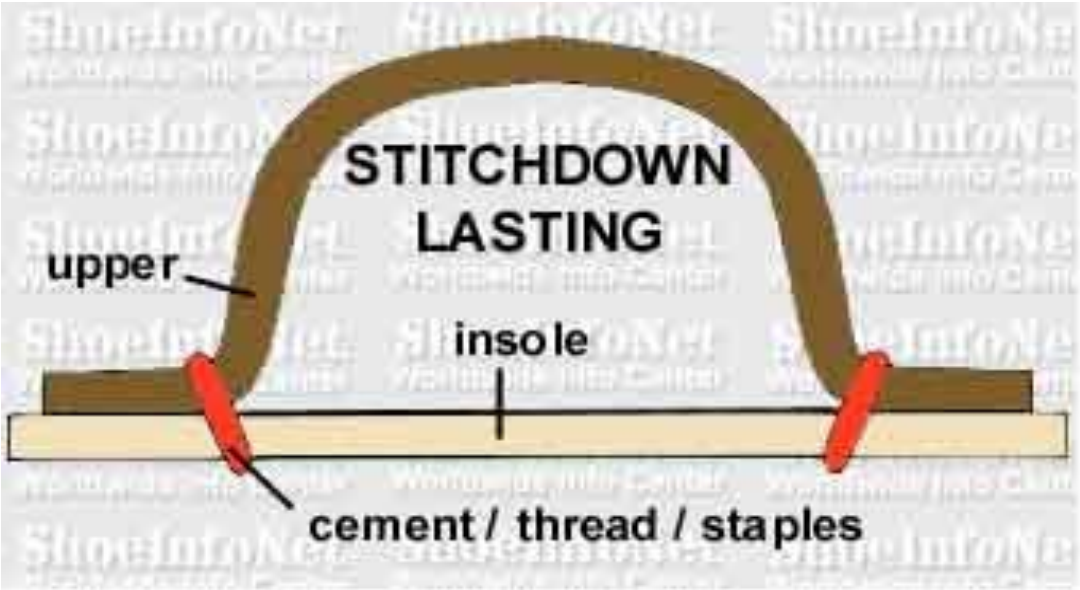


Figure 79 Moccasin construction

Stitch down constructions

Stitched construction is where functional stitching is used during assembly of upper to the bottom components. Amongst the existing manufacturing processes where stitching plays important role in fastening the upper with any of the components mentioned below is known as stitched construction. These components can be midsole, runner, welt and the outsole.



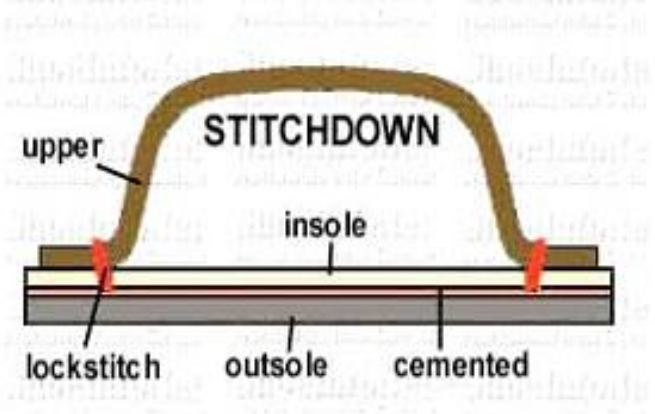


Figure 80 Basic stitch down construction

There are different types of stitch construction. These are:

VeldtSchoen: In this construction the upper is pulled over the last and attached over to the extended part of the insole (runner), and then sole is stuck on. Then the raw edge leaved (the upper materials, runner, insole and sole) is trimmed and coloring is done. A cheaper method used to produce lightweight flexible soles for children's shoes and some casual footwear describes the upper turned out (flanged) at the edge of the last. This is then stitched to the runner.

Directly stitched to sole: in this construction the upper is hand sewn or machine sewn directly through the out sole.

California construction

This construction follows a process of cementing, drying, activation and then finally sole press.

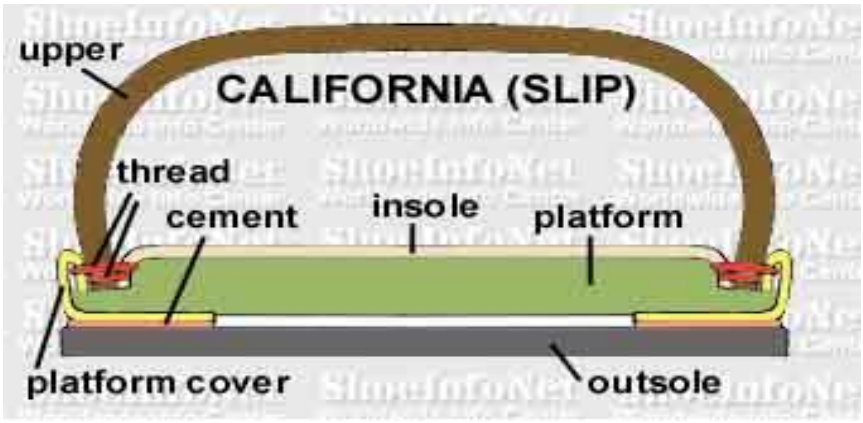


Figure 81 California construction

Good Year welted construction

It a construction type where the soles are attached to the welt or runner or any other intermediate component which are these already being attached to the lasted upper.

For high quality dress and town shoes the top section (or welt) is chain stitched to the upper and insole rib at the point where it curves under the last. This is supplemented by a lockstitch out seam bonding the welt and outsole. The outsole is then sewn to the welt around the edge. Goodyear Welt creates heavier less flexible footwear.

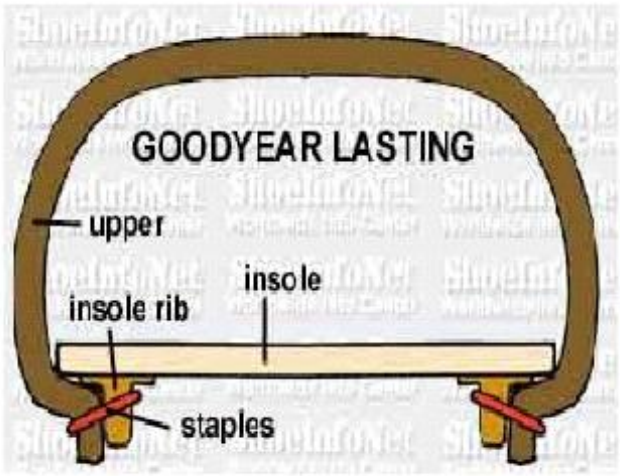


Figure 82 Good year lasting

Strobel construction

It is known as force Lasting (Strobel-stitched method or sew in sock).In strobel construction (sewn-in –sock) the upper is forced over the front of the last with the back being pushed into right position. Force lasting has evolved from sport shoes but is increasingly used in other footwear. The Strobel-stitched method (or sew in sock) describes one of many force lasting techniques. The upper is sewn directly to a sock by means of an overlooking machine (Strobel stitcher). The upper is then pulled (force lasted) onto a last or moulding foot. Unit soles with raised walls or moulded soles are attached to completely cover the seam. This technique is sometimes known as the Californian process or slip lasting.

Molded Methods

The lasted upper is placed in a mold and the sole formed around it by injecting liquid synthetic soling material (PVC, urethane). Alternatively, the sole may be vulcanized by converting uncured rubber into a stable compound by heat and pressure. When the materials in the molds become cool the sole-upper bonding is complete. These methods combine the upper permanently into the sole and such shoes cannot therefore be repaired easily. Molded methods can be used to make most types of footwear.

The vulcanized sole shoe: Almost all rubber-soled canvas footwear has been made by this process since the turn of the century, however, advances in machine design and rubber technology have made it practical to mould in place and vulcanize a complete rubber outsole and heel unit on an assembled leather upper in one operation.

The injection moulded sole shoe: This relatively new process of simultaneously moulding and attaching sole and heel units. This process is becoming increasingly popular, especially for casual footwear. The method used is fundamentally similar to the vulcanizing process as far as the lasting of the shoe upper is concerned. Canvas shoes to be soled by the injection moulded process; however, may be lasted by a process known as string lasting. The injection moulded process uses vinyl plastic material instead of rubber for the sole and heel.

String lasting

It features a special heavy gauge drawstring sewn by over locking sewing machine round the margin of the flat upper.

Self-Check 7	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

True or False: (Total points: 5)

1. **Construction** is a method of assembly of the footwear.
2. Cement lasting is a type of construction where Lasted upper is directly attached with the outsole by means of adhesive.
3. Moccasin is a type of force lasting.
4. Goodyear welted a construction type where the soles are attached to the welt or runner or any other intermediate component which are these already being attached to the lasted upper.
5. In VeldtSchoen construction the upper is pulled over the last and attached over to the extended part of the insole (runner), and then sole is stuck on.

Short answer questions: (Total points: 4)

1. What do you mean by footwear construction? (2 points)
2. What are the different types of footwear construction? Discuss each of them briefly. (2 points)

Note: Satisfactory rating – 9 points **Unsatisfactory - below 9 points**

LG #19	LO #6- Identify footwear materials

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics • Identifying materials used in footwear production • Identifying types and sources of materials • Identifying characteristics of materials • Identifying generic and trade names for materials This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Identify materials used in footwear production • Identify types and sources of materials • Identify characteristics of materials • Identify generic and trade names for materials
Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the information Sheets 4. Accomplish the Self-checks

Information Sheet 1-Identifying materials used in footwear production

1.1 Introduction

There are different types of materials with different characteristics that are used in foot wear production. These are the upper and lining materials, soling materials, adhesives, chemicals, fabrics, nails and tacks, toe puff and counter stiffener, and other materials.

1.2 Different types of upper leather

Leather can be made from the skin of any animal, bird, fish or reptile although only that from cattle and a few other farm animals, such as sheep, are of major commercial importance. It can be produced through different manufacturing processes, ranging from cottage industry to heavy industry. Upper leather is the leather that forms the upper of a shoe or the leather suitable for making uppers.

There are different types of leather used for upper making in shoe-making today. Upper leather can be prepared from the following.

- Cow leather
- Sheep leather
- Goat and Kid leather

Cow leather

Cow leather is leather made from cattle hides. It is the most common leather used for bath shoe uppers and soles.

It used for all types of shoes and goods. Cow leather is mostly used for making upper.

Calfskin: Skin of very young cattle, usually only a few months old. It is soft, fine grained, supple and strong. Widely used for uppers in higher priced shoes.

Sheep leather

Sheep leather is used for lining and uppers for certain types of footwear (men's and ladies shoe lining and upper), gloves and garments. The sheep upper leather is soft and supple leather and found with lesser defects.

Figure 83 Sheep leather

Goat and Kid leather:

They are made from skins of goats. It is soft and suited to women's fashion shoes. ''Kid'' is the term applied to full chrome leather made from the kid of goatskin for use as footwear uppers (men's and women upper). Even though goatskin is relatively thin, they are strong and have a very hardwearing grain. Glace kid is used for making upper of high quality dress shoes. This leather has a highly polished but natural grain appearance and with regular cleaning and polishing, retains its high polish and well-gloomed look. It is also used for glove making. Old goatskin is used for making suede and printed leather as they have coarse grain.

1.3. Different type of lining leather

Lining is the material which constitute the inside of the footwear i.e. the materials against the foot. Lining can be prepared from the leather of following animals:

- Cow
- Sheep
- Goat

Cow Lining

Cow lining is thinner leather made of cow. It is preferably used in the natural form as Drum Dyed (DD) lining in the high value shoes and is also available as finished leather. Cow lining is stronger leather and is used in the thickness range of 0.7-0.9 mm.

Sheep Lining

Sheep Lining is known for its softer, supple and warm feel. This type of lining leather is generally used in the thickness range of 0.6-0.8 mm.

Goat Lining

Goat Lining stronger compared to sheep lining leather.. The grain of goat leather is compact and hence the abrasive strength of goat lining leather is better. The preferable thickness range of goat lining is 0.6-0.8 mm.

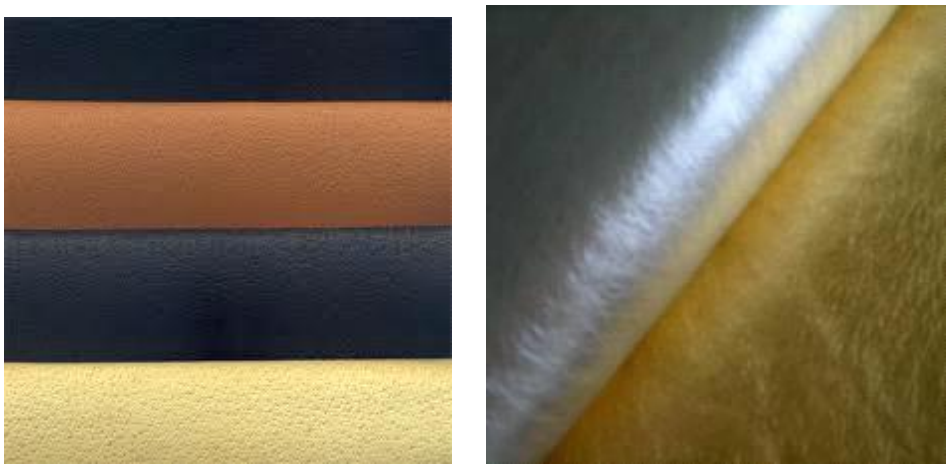


Figure 84 Lining

1.4 Different type of soling material

Sole is a bottom piece of any variety of footwear which comes in contact with the ground. Leather was always the main soling material in past. In recent years this has been largely superseded by other materials, for example, rubber (both vulcanized and microcellular), crepe, synthetic resins and more recently PVC (plastic) and polyurethane. .

Shoe bottom materials for industrial work shoes, for example, can be made oil and acid-resistant by the use of neoprene or nitrile rubber types. Cellular soling also enters into the picture, and it contributes to the insulation of such types of footwear, as do cork and rubber compounds. These materials have an added safety advantages in that they can be made relatively non-slip.

.

Figure 85 Sole

Soling materials are of two types. These are:

- Synthetic soling materials
- Leather as soling material

Synthetic soling materials

There are different types of synthetic soling materials. They can be described as follows.

Poly vinyl chloride Sole (PVC)

Polyvinyl Chloride (PVC) soling is used extensively where superior wearing qualities are required. PVC soles may be cemented or moulded directly to the shoe. Such soling is lightweight, long wearing and will not mark floors.

The advent of PVC as an injection moulded material for soles in the early 1960's was rapidly adopted by the footwear trade as an alternative to vulcanized rubber. It is suitable for direct moldings on to shoe bottoms or can be used to produce a wide variety of moulded unit soles. Fairly soft grades of PVC are used so that a good bond and good wearing properties (similar to that of a medium grade rubber) can be obtained. PVC needs to have a patterned surface to overcome a tendency to slip.

Poly Urethane Sole (PU)

Polyurethane [PU] soling are formed by a process called reaction moulding. It is a sort of polymerization process, compounding process, and moulding process rolled into one.

A polyurethane sole is made by metering the necessary chemical ingredients in liquid form (or ingredients rendered liquid by heating) into a mixing chamber, mixing them, and transferring the mixture into a mould. While they are still in the mould, they react to form polyurethane. To produce the soling, the two streams are mixed together by the moulder, in the right proportion and injected or poured into the mould. The measuring, mixing and moulding are also done in the machine. The two streams are usually called resin and hardener.

Rubber Sole

Solid rubber is mainly used in the trade for vulcanized footwear. The main attribute of solid rubber is that is can be compounded to any quality required. It tends to be rather heavy due to its density (specific gravity 1.2).

Microcellular Rubber is the same compound as solid rubber with a blowing agent added, which turns to gas at a certain temperature in the vulcanizing temperature range. The specific gravity of 0.85 makes it light in weight and cushions the foot better than solid rubber.

Thermoplastic rubber Sole (TPR)

Thermoplastic Rubber is a range of rubbers possessing the moulding and processing characteristics of a thermoplastic and the physical properties of vulcanized rubber. These

properties are obtained by synthesizing a rubber that contains chemical groups or chemical arrangements of that can act like cross link under end - use conditions but can be dispersed under moulding and processing conditions by the action of heat simply, thermoplastic rubbers are polymers containing movable cross link. Only two kinds of these materials are used in the shoe industry. One is the thermoplastic form of polyurethane which is quite hard and used mainly for football boots and spiked running shoes and some top-pieces.

EVA & Phylon Sole

EVA [Ethylene Vinyl Acetate] is a chemically blown compound which in appearance is similar to microcellular rubber. EVA is used as a substitute for microcellular rubber as soling material for sandals in the cheaper end of the trade. It does not have such good wearing qualities as microcellular rubber, and good bonds to the shoe are difficult to obtain.

Crepe Sole

Plantation Creep is a material made from pure rubber. It is produced by coagulating the rubber latex taken from the trees directly into sheet form. It is not extensively used because it is expensive and cannot be bonded directly to leather uppers, although it is hard wearing. It is adversely affected by oils and petrol and that it softens and spreads in wear.

Resin rubber

The introduction around 1950 of synthetic material manufactured from a combination of butadiene (synthetic rubber) and styrene (plastic) revolutionized finishing operations. This brought about a complete change in shoe manufacturing processes, in so much as old finishing operations have been eliminated by refinishing the complete sole and heel unit before it is attached to the bottom of the shoe. The majority of resin rubbers are used for women's footwear but a proportion has been used for men's and children's styles. Resin rubber is a uniform material and so lends itself to refinishing. It may be used in sheet form or as a moulded unit.

1.5 Leather as soling material

Leather sole: Leather can be used for making leather sole. Leather sole should be Solid, bold and flexible. It should not wear out easily, it must not increase in area as a result of shoe wearer's body pressure and at the same time it should not crack when subjected to a certain degree of bending on a specified metallic ball or rod.

Vegetable tanned sole leather

The real secrecy of vegetable tanning of heavy leathers like the sole lies mainly with their degree of tannages, which can be defined as the quantity of vegetable tannins fixed by 100gms of the hide substance. For high value of D.T. (Degree of tannage) a large quantity of tannins should enter into pelt and at the same time chemically react with collagen, so that the tannins cannot be extracted out with water..

Leather sole has the following advantages:-

- It is one of the most hygienic soling materials with ease of perspiration as the upper leather
- It gives product the unique/ antique class & appearance as desired in high class footwear.
- Good sole bonding with upper cement due to fibrous structure present.

The main disadvantages of its usage are-

- It is very expensive sole and the cost further increase due to restriction of various quality regions of hide.
- It is inflexible and sufficiency heavy.
- Its processing is quite time taking, skilled and expensive.
- It is less durable especially in wet conditions
- Cannot blend with modifiers as in polymeric soles to give a variety of properties.

1.6 Different types of adhesives

An adhesive is a material used for holding two surfaces together. It is a substance capable of holding the material together by surface attachment.

An adhesive must wet the surfaces, adhere to the surfaces, develop strength after it has been applied, and remain stable.

The material must remain unaffected by age, environmental conditions and other factors as long as the bond is required. An adhesive used in shoe industries are:

- Latex
- Rubber Solution
- Poly Chloroprene or Neoprene
- Polyurethane
- Hot-melt Poly amide
- Hot-melt Polyester

Latex/ Natural rubber

Natural rubber is a product existing as a milky substance known as latex. Latex is a colloidal dispersion of rubber particles (hydrocarbons) in water.

Adhesives of natural rubber are prepared by:

- Dispersing latex in water(water based latex)
- Mixing in suitable solvents
- By grafting with a polymer

It is used in shoe manufacture mostly for temporary attachment before stitching of various components. The commercial names used are water based latex and solvent based rubber solution.

Rubber Solution

It is prepared by milling latex, together with the compounded rubber (crepe or smoked sheets) and dissolving the same in a solvent such as benzene or gasoline. It is used for establishing temporary bonding for edge folding, upper to lining attachment and socks lining attachment to insole and so on.

Poly Chloroprene or Neoprene

A Polychloroprene adhesive is used extensively today in footwear industry. All types of shoe sole except PVC, TPR & PU can be attached by Polychloroprene adhesives. But different materials require the correct type of adhesives and the right method. Much of the art of adhesive bonding is concerned with preparing the substrate surfaces before the adhesive is applied and making sure there's no roughness of the surfaces and all dust particles are removed.

Poly Urethane

A Polyurethane (PU) is used extensively today in footwear industry. The introduction of new polymer materials for soles and uppers has introduced new problems for the adhesives manufactures. Polychloroprene systems no longer hold the PVC soles to uppers satisfactorily. Bond failure happens on occasion, due to migration of plasticizers into the adhesive films. The solution of this problem is presented in the form of a solvent based polyurethane adhesive, which is unaffected by these chemical compounds. It is used for sole attaching purpose.

Hot-melt polyamide

Most polyamide resins are used with epoxy adhesives; however those resins similar to nylon, (i.e. based on dimmer acids) are used as the thermoplastic adhesives in shoe and electronic industries. Hot-melt polyamide adhesive is used for seat and side lasting operation in shoe industry.

Hot-melt polyester

It is a synthetic resin having ester linkages in the main chain. Saturated - thermoplastic type mainly used in shoe lasting operations. Hot-melt polyester rod is used for toe lasting operation in shoe industry.

1.7 Chemicals

The different chemicals used during stages of footwear manufacturing are:

Toluene

Toluene is obtained from coal tar and petroleum by distillation. It is used as a solvent and as a starting material for the synthesis of many compounds, including dyes and explosives. When toluene is treated with a mixture of nitric and sulfuric acids (a process known as nitration), trinitrotoluene (TNT) is produced. Toluene is an important organic solvent, but is also capable of dissolving a number of notable inorganic chemicals such as sulfur.

Methyl Ethyl Ketone (MEK)

Methyl ethyl Ketone (MEK) is a colorless liquid with a sharp, sweet odor. Methyl ethyl Ketone (also known as 2-butanone) is a man-made chemical that is also found in nature. MEK is produced in large quantities. Nearly half of it is used in paints and other coatings. It is used for these products because it quickly turns into a vapor. It also dissolves in many substances. Other uses are glues and cleaning agents. In nature, MEK is made by some trees. It is also found in small amounts in some fruits and vegetables. Manmade MEK is released into the air from car and truck exhausts.

Methyl Ethyl Ketone (MEK) is the chemical that is used for PVC sole cleaning or wiping purpose in footwear industry.

Ethyl Acetate

It is a colorless, fruity-smelling liquid ester, CHCOOCH, formed from acetic acid and ethyl alcohol and used as a solvent, in flavoring, in manufacturing synthetic resins, etc.

TPR Primer: TPR primer is the chemical that is used for TPR sole cleaning purpose in footwear industry.

Rubber Primer: Rubber primer is the chemical that is used for rubber sole cleaning purpose in footwear industry.

EVA Primer: EVA primer is the chemical that is used for EVA sole cleaning purpose in footwear industry.

1.8 Fabrics

A variety of fabrics are used as upper and ling materials as per the fashion or choice of end user. The commonly used fabrics for footwear are:

Woven Fabric

A woven fabric comprises two elements of yarn known as warp and weft which are interlaced at right-angles to each other. Depending on the interlacement of weft and warp yarn they are classified as

Plain weave: The crimp in the warp and weft thread which alternate in the pattern of one up and one down in a plain or 1/1 weave.

Twill weave: One warp thread crosses over two weft threads and then under two. The next warp thread has similar interlocking but on subsequent weft threads.

Drill weave: There are two kinds of drill wears. The first, jean has the warp crossing over two weft threads and under one, the second the Florentine, which has the warp crossing over three weft threads and under one weft threads.

Satin weave: In the simplest satin weave the warp thread interlock over four weft threads and under one.

Non-woven Fabric

Non-woven is prepared by blending of polyester, nylon, polypropylene viscose rayon, and acrylic and by the help of needle loom it will be compacted. Then the fibres are passed through a bonding agent and pressed through a milling machine.

The two main types of non-woven are felts & bonding fibre fabrics. Felts are generally too weak for upper linings. Their main application is as bottom fillers.

Knitted fabric

Knitted fabrics can be produced more cheaply and rapidly than woven fabrics, but fewer structural variations are possible. They stretch further and more easily than woven fabrics, especially, across the roll, but are less stable and tend to ladder from cut edges and stretchiness.

Coated fabrics (Synthetics)

The fabrics coated with Poly Vinyl Chloride (PVC) or Poly Urethane (PU) for the development of leather look-a-like material known as synthetics.

The two main types of coated fabrics are PVC coated & PU coated fabrics. PUCF has have a more attractive appearance, handle than PVC coated fabrics, and are permeable. They are however, generally weaker, and the PU coating is less robust than PVC.

Rivets

Rivets are used in footwear manufacturing especially in children sandals. Main parts of rivets are Head- this can be in silver, gunmetal, bronze etc. Base- this is a shaft with flat base. The shaft must be just 1mm longer than the thickness of the material to be riveted.

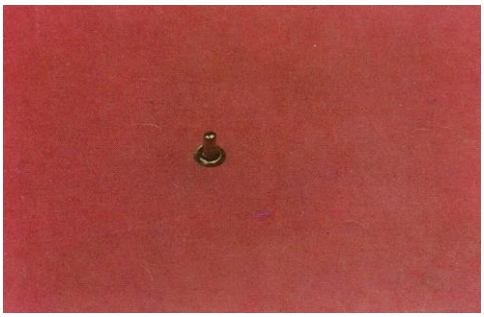


Figure 86 Base of rivets

Figure 87 Head of rivet

Pre punched holes are required to fix the rivets.The hole must be large enough for the base shaft. The shaft is placed through the holes. The head is then pushed firmly in to place by hand. When pressure is applied to the head, the shaft and head collapse around each other, locking them together. Thus holding the piece together. Single thickness material can also be riveted for decoration.

Figure 88 Rivet

Shank board

Shank Board/Becker board is a very hard and strong fiber board, able to withstand the tremendous loads which occur in the waist and heel of the shoe. It is again produced in much the same as way as paper.

However the main raw material is mixture of waste and recycled paper which, together with the vegetal bonding resins used in its manufacture, make shank board a very environmental friendly product. The molding quality of this type of board is less than cellulose board.

The standard sheet size of shank boards are 100 x 150 centimeter and the thickness is 2 – 3 mm.

Figure 89 Shank board

The following raw materials are used for the manufacture of backer board;

- Paper pulp
- Dye
- Hard resin binder
- Aluminium sulphate
- Preservative
- Steel Shank

It is a thin strip of material usually wood or steel used to stiffen or to prevent excessive bending of the plantar arch**.** Steel shank is one of the most vital components in a shoe. In providing essential support for the arch of the shoe, it has to withstand heavy bending and torsional stresses whilst maintaining accurate alignment of forepart and heel throughout all the stresses of the shoe's life. A steel shank is probably the most severely stressed component in a shoe. It can be:

- Steel shank(chrome /non chrome)
- Wooden shank
- Single Flute
- Double flute

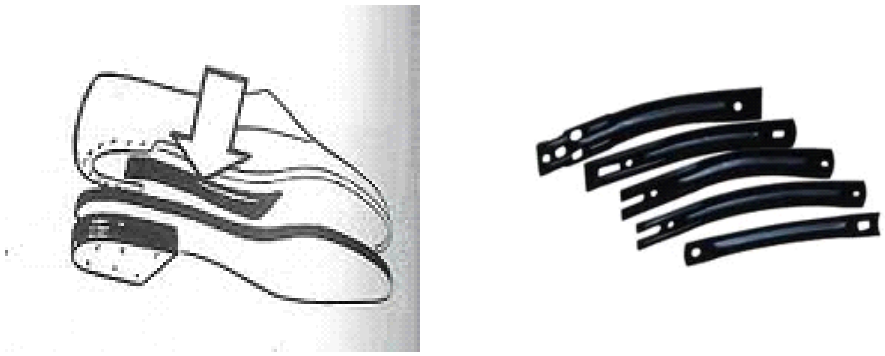


Figure 90 Shank board

Insole board /Cellulose board

Cellulose board for insole is made from wood pulp, resin and bonded with latex. As with leather boards it is supplied in sheet in various thicknesses, and in different grade. This material has better dimensional stability than leather boards.(i.e. does not shrink or grow). It is a flexible board. Common trade names are Texan, Bontex.

The characteristics of this material are:

a) Its ability to absorb moisture

b) Uniformity of substances

c) Resistance to shrinkage or growth (in change of humidity and heat)

Resistance to hardening or cracking due to moisture or perspiration.

Figure 91 Insole board /Cellulose board

Eye-lets

Eyelets are metal fittings, which are clenched in the holes of the quarters or tongues through which a string, ribbon or thong is passed to hold the shoe on the foot. It is a small metal disc with hole in the center used to reinforce lace holes. In footwear industry designs change rapidly. The use of eyelets in various shapes and sizes are sometimes used to effect these style changes. Eyelets can be fitted by hand held setting tool or by manual eyeletter or by electric powered eyeleting setting machine.

Eye-let selection

When a designer selects the eyelets to be used, he must ensure the eyelet dimension is suitable for the material being used no matter which shape of eyelet he chooses, whether it is round, oblong, oval or square. The size of the eyelet is measured as inside diameter or opening of eyelet and depends on the material and choice. Eyelet parts consist of:

- Barrel length,
- Head and
- Opening of eyelet.

Opening is usually measured in millimeters across the internal diameter. Width of the head depends on the designer choice and material to be eyeleted. Technically, the eyelets having wider head is found most suitable for softer the material

The barrel length is measured in millimeters along the barrel. The length required would be decided by the thickness of material the eyelet will hold onto. Barrel must go through the material and flange over approximately the same width as head.

When eyeleting synthetic, fabrics and canvas a washer is normally used, it is placed over the barrel and locked in place by roll spreader. The washer should fit tightly over the barrel and should be slightly wider than the eyelet head. Now days plastic or other similar material kind of eyelets are in use for delicate and sifter kind of materials.

Visible eye-lets

Visible eyelets are ornamental and shown on the surface. The eyelet must clench to the material being worked on, whether the shoe may be lined or unlined, if shoe is lined, then the eyelet must clench on the lining firmly enough to hold the two pieces together. Visible eyelet is also known as ordinary eyelet. Eyelet holes should be reinforced with suitable reinforcement material. These eyelets can be fixed manually or by machine.

Figure 92 Visible eye-lets

Invisible eye-lets

Invisible eyelets are not seen from the surface. And they clench only to the lining. They are also known as blind eyelets. A hole is made in the lining and upper and eyelet is inserted from the lining side. Then it is curled by roll spreader for invisible eyelets.

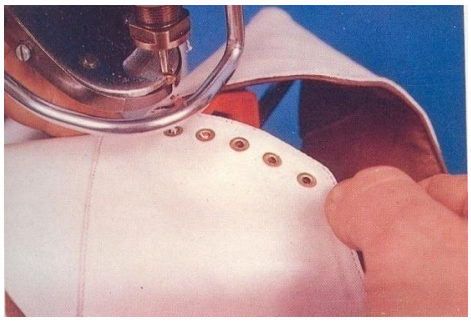


Figure 93 Invisible eye-lets

Tools and accessories required for invisible eyeleting is same as for visible eyeleting, but care should be taken during selection of punch and star spreader.

As it has already been made clear that the eyelets are fixed over the lining quarter during invisible eyeleting. When shoe is made and wear, the eyelets fixed on the upper are not visible that is why they are called invisible or blind eyelets.

The lining material used in upper making is always soft and thin as compared to the upper leather. If any kind of metal fixing (eyeleting) is done on lining, it is obvious that the size of the eyelets should be smaller than the visible eyelets as per the amount of strain and stress lies on the material. A small eyelet refers to the diameter of head and length and width of the barrel. To meet such requirements, punch and star spreader tools are used during blind eyeleting is selected as per the dimensions of the punch and spreader.

D-ring

D-ring is an item used for lacing footwear, usually a metal ring shaped like the letter D. It may be secured to a surface with a metal or fabric strap. D-rings are used in place of eyelets as per the design or fashion requirements.

Figure 94 D-rings

Hooks

Many shoes, sneakers and boots come with lugs instead of eyelets. These are usually flat loops made of cloth or leather, though they can also be rings, hooks or tubes made of metal or nylon. The shoelaces run through these lugs along the surface of the shoe rather than between the inside and outside of the shoe, resulting in somewhat different lacing.

Figure 95 Hooks

Laces

Laces are used to secure shoes, boots and other footwear. They typically consist of a pair of strings or cords, one for each shoe, finished off at both ends with stiff sections, known as aglets. Each shoelace typically passes through a series of holes, eyelets, loops or hooks on either side of the shoe.

How to keep your shoelaces tied is a question asked many times. It is a chronic problem everyone has that wears shoes with shoelaces. One reason shoelaces come untied is caused by worn and stretched shoelaces. With normal use, the location of the shoelaces

knot (bow) wears and stretches the fibers of the shoelace. These worn and stretched shoelaces will come untied more easily than shoelaces that are not worn and stretched. The main reason shoelaces come untied is because they are not properly tied.

Figure 96 Laces

Nails & Tacks

There are many types of nails and tacks used in the manufacture of shoes designed to suit numerous lasting and assembling operations. Machine tacks with special finishes to enable trouble free running in machines are produced in various lengths to suit the material being used.

Types of nails and tacks

(A)

Square machine tacks

(B)

Round machine

(C)

(D)

Hand tack

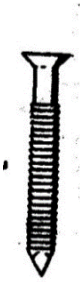
(E)

Heel building nail

(F)

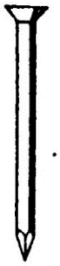
Screw eclipse nail

(G)



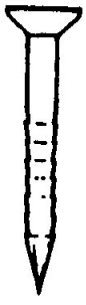
Buttress heel attaching nail.

(I)



Rubber heel nail

Lightning nail



Temporary attaching nail

Use of nails and tacks

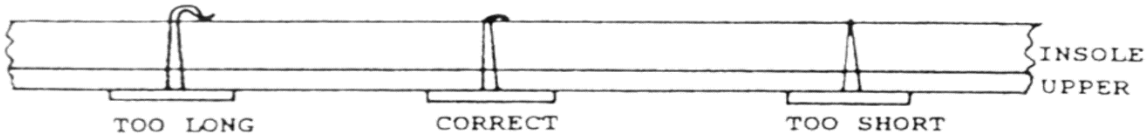
The nine tacks and nails illustrated are made for the following operations: -

- Used for seat, side and toe lasting
- A general-purpose tack used for hand lasting sandals and repair works
- Building leather heel and heel attaching
- The inside attachment of wooden heel
- The inside attachment of plastic heels
- The outside attachment of rubber heels
- The outside attachment of leather built heels

While deciding on the length of the tack required for lasting purposes, it is generally accepted that the tack is 1m.m longer than the thickness of material or materials it has to penetrate, to allow clenching. The tack or nail clenches when it hits the last bottom plate.

When uppers are lasted, the tacks penetrate the insole and must be turned over (clenched) so as not to stick into the foot.

Clenching



Hand lasting tacks and Machine nails

Hand lasting tacks are much sharper than machine tacks and have a much rougher finish to help penetration while hand lasting

Machine lasing tacks

Hand lasting tacks

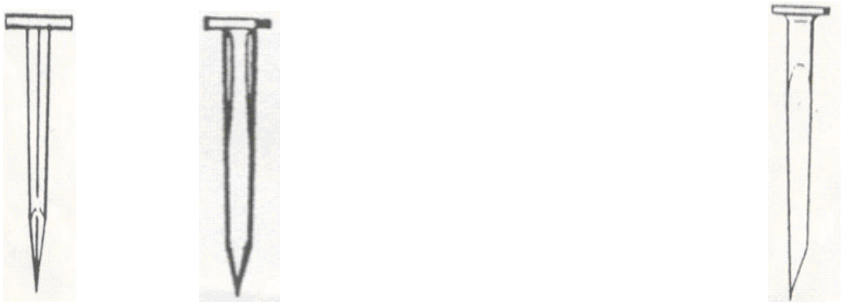


Figure 97 Machine and Hand lasting tacks

A hand tack has to be pushed by hand into the material before being driven home, a rough sharp tack gives a temporary hold into the material, whereas a smooth machine tack would not hold. A smooth finish is given to machine lasting tacks to enable the tack to run easily in the machines. Special points and spirals are put onto heel nails to ensure correct penetration and grip during wear.

Staples

There are numerous ways of attaching heels whether they are wood, plastic or leather. The heels may be attached by an ordinary staple, a specially designed nail or an ultrasonic staple Staples are used for various shoe making operations like:-

- Insole attaching
- Side lasting for stitch down or welted footwear
- Heel attaching in leather sole with knock on heels

Generally there are two types of staples are used, they are

a) Pre-formed staples

b) Wire staples

Pre-formed staples

Preformed staples are used for insole attaching or heel attaching in case of knock on heels. A driver fitted in to the machine drives the staples. In most cases the staplers are pneumatically driven.

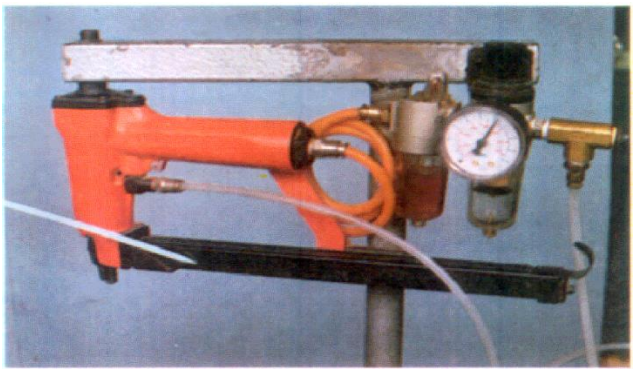
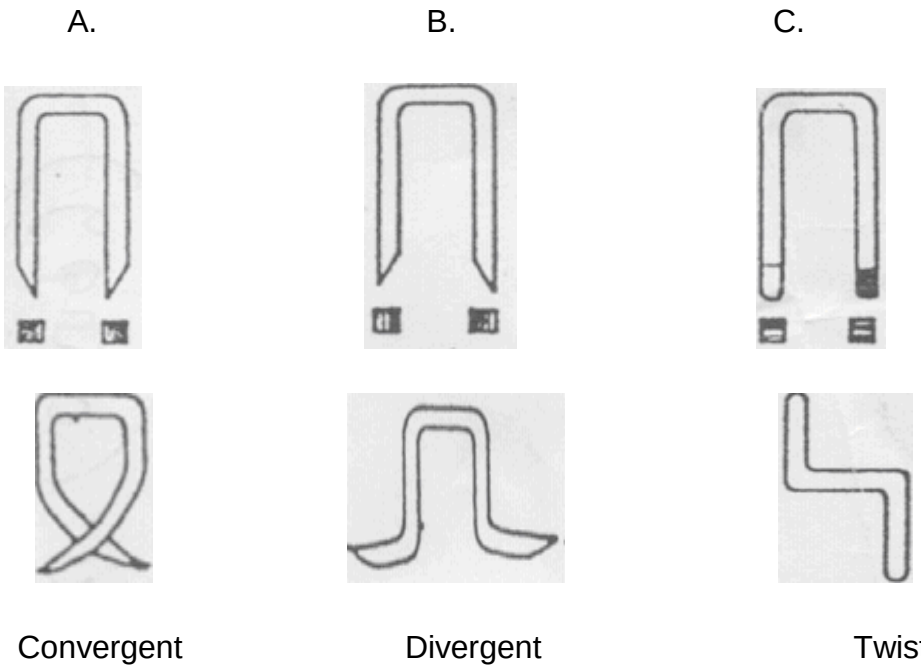


Figure 98 Pneumatic stapler

Wire staples

Wire staples Wire staples are used while side lasting of welted footwear or Stitch down lasting. The wire from a coil cut in a certain length by the lasting machine subsequently it takes the shape of a staple pin by an in built bending mechanism before being driven into the lasting margin.



Toe-puff

It is a reinforcement used to retain the original contour of the toe part of the shoe. The choice of the toe puff for any given footwear type is influenced by many factors such as last shape, upper material type, production methods to be used, fashion and the views of industrial customers. The basic types of toe puff used in footwear industries are as follows.

Solvent activated toe-puff/ solvent dip toe-puff

It is a type of toe-puff which is activated/become ease for use when dipped in the solvent dip such as MEK and etc. These toe puffs are impregnated with either nitrocellulose or polystyrene resin. The solvent blend should contain toluene, which dissolves readily with the resin.

Thermoplastic toe-puff: It is a type of toe-puff which is activated/become ease for use when heated.

Steel toe-puff: It is a type of toe-puff used in construction of safety shoes.

Paint-on toe-puff: This is mostly done for the veldtschoen sandals. For this purpose, a light puff is adequate and shellac or a celluloid solution is painted. In this case there are problems of contamination of the upper and the adhesion.

Filmic toe-puff

Filmic puffs are a further development of the celluloid impregnated puff, are made from such polymers as ABS, Surlyn A and EVA. All filmic puffs developed recently are thermoplastic, having a heat sensitive adhesive in the bonding press in the same way as the impregnated types are activated. Some filmic puffs can compress and thereby absorb the creasing action of the upper.

Textile (impregnated fabrics)

The fabric used to make this type of toe puffs are woven, non woven, needle punched and stitched- bounded. These types of toe puffs are in two forms or types.

Thermoplastic type: is which can be softened by heat and rendered sufficiently extensible and malleable to accept pulling over the lasting operations.

Solvent activated type: in which the toe puff is rendered soft and extensible in the factory by being treated with the solvent dipping or conditioning machine, again to make it receptive to shoe making operations.

Counter Stiffener

Stiffeners are stiff materials similar to that of toe puff which may be moulded to the shape of the last back part or, alternatively, inserted flat and moulded during the subsequent process. It is normally inserted between the lining and the upper to support the back part of the shoe and grip the foot. Apart from the materials used which are similar to that used for toe puff except for the thickness, leather board can be used.

There are three types of stiffener:

- Flat stiffener
- Semi-moulded stiffener
- Fully moulded stiffener

Stiffener can be:

- Solvent dippe
- Thermal activated
- Pre molded leather board

Self-Check 1	Written Test

Name: _____ Date: _____

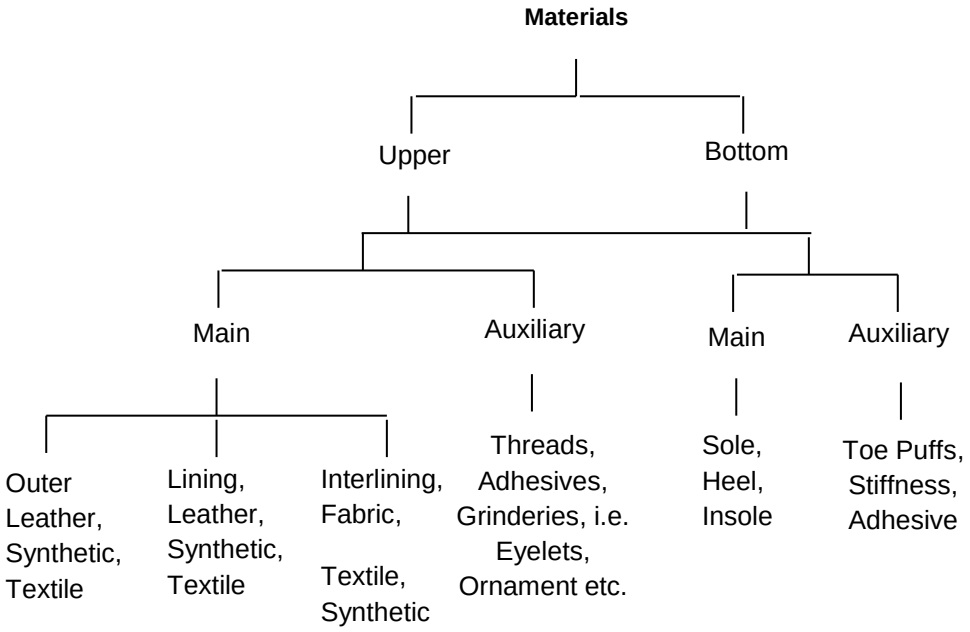
Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers. **(Total points: 14)**

1. What are the different types of leather upper materials that are used in footwear production? (2 points)
2. What are the different types of lining materials that are used in footwear production? (2 points)
3. Write down about the toe puff and counter stiffener (2 points)
4. Write down about the different types of soling materials? (2 points)
5. Write down about the PVC sole. (2points)
6. Write down about the different types of adhesives used for making the footwear. (2 points)
7. What is insole board? (2 points)

Note: Satisfactory rating – 14 points **Unsatisfactory - below 14 points**

Information Sheet 2- Identifying types and sources of materials

2.1 Shoe making materials are broadly classified into two groups. These are upper materials and bottom materials.



Leather upper and lining

Leather is a natural product, which is derived from the rawhide and skin of the animals.

Varieties of leather derived from cow, buffalo goat, sheep etc. are used for upper and lining making in various finishes and colors. Leather is the most suitable material to be used as shoe upper because of its breathability, texture, elasticity and plasticity properties etc.

Upper: is the material that constitutes the outside of the footwear. It can be leather or synthetic.

Lining: the material, which constitutes the inside of the footwear i.e. the materials against the foot and it, can be leather or synthetic.

Lining and upper materials can be made from different animal's skin and hide.

A. **Cow leather**: - is the leather derived from the hide of cow. It can be used for both upper and lining making purpose.
B. **Goat leather**: - is the leather derived from the skin of Goat. It can be used for both upper and lining making purpose.
C. **Sheep leather**: - is leather made from the skin of Sheep. With proper selection and processing they could be used as lining and upper leathers.

Footwear materials (non leather materials)

These are any fabricated or semi fabricated component made of various kinds of materials or combination of materials such as leather, textile, wood or synthetics for use in the manufacturing of the footwear.

Some these materials are:

1) Shank board	5) Foam	9) Inter-linings
2) Threads	6) Counters	10) Toe-puffs
3) Insole	7) Soles	11) Adhesives
4) Boxes	8) Laces	12) Eyelets

A. Insole board

Insole is the inner sole of the shoe which is next to the foot under the shoe sock. It is component usually multilayer (removable or not) covering the insole to improve the performance of the bottom assembly. Insole may be made of in one piece or, alternatively, in two pieces. When an insole is made from two pieces it is known as a blended insole. Insole can be made from the following materials. Cellular board

- Jelly filled PU insole
- Shank board
- Mid sole-Rubber
- Leather board

B. Shank board

Shank board is used in the shoe industry for supporting the sole of the footwear.

Figure 99 Shank board

C. Toe-puff and counter stiffener

The function of the toe puff & Counter Stiffener is basically to provide shape to the forepart of the shoe, and in certain case, in the industrial boots, to give protection to the foot of the wearer. It is the mean by which the shape of the last forepart is reproduced in the finished shoe, and thus plays an important part in the appearance and the general performance of the majority of the footwear types.

Toe-puff

It is a reinforcement used to retain the original contour of the toe part of the shoe. The function of the toe puff is to provide shape to the forepart of the shoe, and in industrial boots to give protection to the foot of the wearer. The shape of the last forepart is reproduced in the finished shoe, and thus plays an important part in the appearance and the general performance of the majority of the footwear types by the mean. The choice of the toe puff for any given footwear type is influenced by many factors of the last shape, upper material type, production methods to be used, fashion and the views of individual customers; all must be considered before a decision can be reached.

The basic types of toe puff used by the footwear industry are:

- Paint on liquids
- Impregnated Fabrics

- Thermoplastic /Thermo adhesive (heat activated)
- Solvent activated
- Print on Hot-Melt Resin
- Steel toe cap and etc.

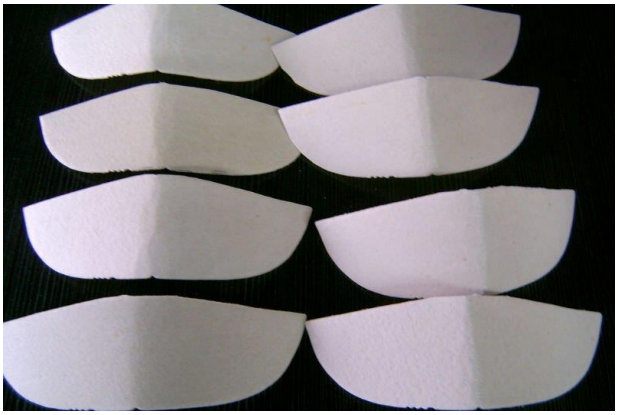


Figure 100 Extruded film (heat activated) toe puff

Counter stiffener

Counter stiffener materials are used to give stiffness, inserted between the lining & upper over the heel area. Stiffeners are stiff materials similar to that of toe puff which may be moulded to the shape of the last back part or, alternatively, inserted flat and moulded during the subsequent process. It is normally inserted between the lining and the upper to support the back part of the shoe and grip the foot. Apart from the materials used which are similar to that used for toe puff except for the thickness, leather board can be used. There are three types of stiffener:

- Flat stiffener
- Semi-moulded stiffener
- Fully-moulded stiffener

Stiffener can be:

- Solvent dipped
- Thermal activated

- Pre molded leather board

Figure 101 Counter Stiffener

D. Thread

It is a material used to join the components of footwear during stitching process.

Threads are made from fibers. Fibers used to make industrial sewing threads come from two major sources: man- made fibers or natural fibers. The ones used commonly in shoemaking are:

Natural Fibers

Natural Fibers come from plants and animals and are spun or twisted into yarns. Cotton is the most common natural fiber used to make thread. Other natural fibers include silk, wool, jute, ramie, hemp, and linen. Natural fibers are generally not as uniform as synthetic fibers and are affected by climatic changes.

Synthetic Fibers

Synthetic Fibers are made from various chemicals or regenerated from cellulose such as wood pulp and cotton waste. We select our synthetic fibers based on their sewing ability characteristics, seam performance, ease of dying, colorfastness, and pricing. Examples are: polyester, nylon, etc.

Figure 102 Thread

E. Adhesives

A general term for any of the several substances capable of bonding materials to each other by a chemical or a mechanical action, or both, and which may be activated either by water, non-aqueous solvents, pressure, heat, cold or other means.

An adhesive is a material used for holding two surfaces together. It is substance capable of holding the material together by surface attachment. An adhesive must wet the surfaces, adhere to the surfaces, develop strength after it has been applied, and remain stable.

In the closing room, the commonly used adhesives are: Latex, Rubber solution, Neoprene, and hot melt adhesive.

Generally two category of adhesives used in the closing room are **liquid** and **solid adhesives**. This category can be also divided further into **water base** & **solvent base** adhesives. Latex, Rubber solution and Polychloroprene come under the liquid category, while the solid category is followed by hot melt adhesive called Polyamide, which is used in thermo folding machines for folding purpose.

Latex, is rubber adhesive generally used for temporary attachments. This is mostly used for attaching the upper component and before some edge treatment (e.g. folding) before securing them with stitching. Spraying is the best method of application to avoid lump

formation on the component. In case of bottom components, roller is the most suitable method known for applying this adhesive.

Rubber solution is used for lining attaching. While attaching the components from flesh-to-flesh, we can use rubber solution. This is a temporary adhesive, as the bond produced by this is not very strong. This is applied with the help of brush.

Polychloroprene is the adhesive, which comes under permanent category and used for attaching purposes, where normal adhesive cannot serve that purpose. This is most suitable for attaching grain-to-grain surface like vamp and quarter or quarter and eyelet facing etc. After attaching by this adhesive, one can avoid stitching operation, hence known as permanent adhesive. This is solvent base adhesive and hence costly than water base adhesive. But too much use of this adhesive on the material surface makes the product more stiff, rigid and increases material cost.

Water-based adhesive is not suitable for oily type of leather.

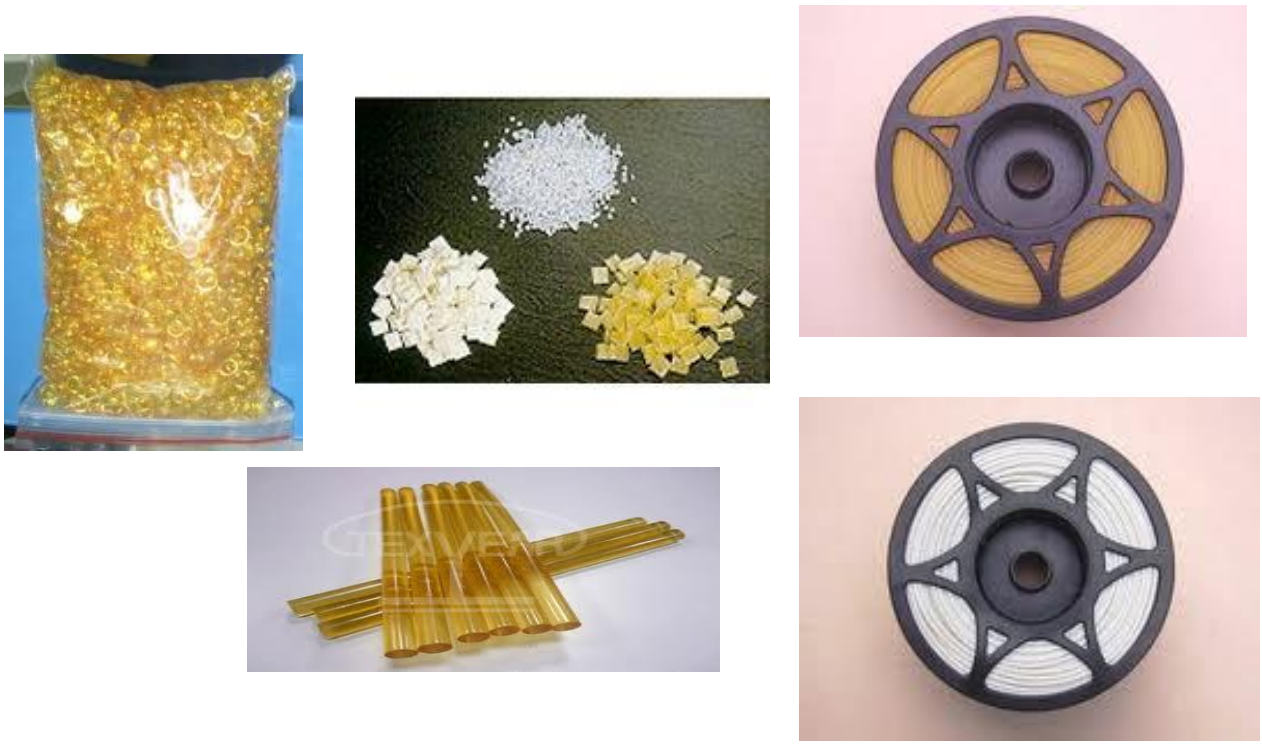


Figure 103 Different types of adhesive

F. Inter-lining

It is any material inserted between upper and lining for the purpose of improving the upper or lining materials' strength.

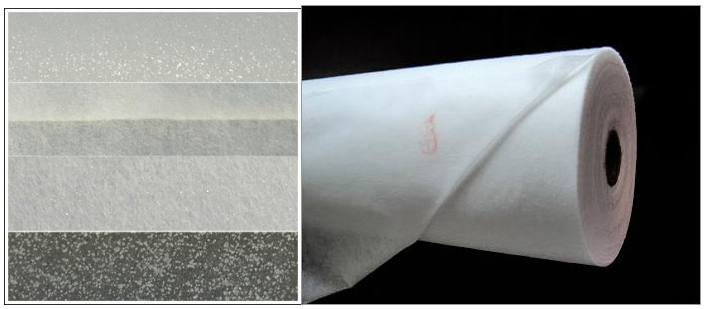


Figure 104 Interlining

G. EVA Sheets

Eva sheets (Ethylene Vinyl Acetate]):- It is a chemically - blown compound which in appearance is similar to microcellular rubber. EVA is used as a substitute for microcellular rubber as soling material for sandals in the cheaper end of the trade. It does not have such good wearing qualities as microcellular rubber, and good bonds to the shoe are difficult to obtain.

H. Textiles

Textile (fabric) is the term describes any woven or non-woven or knitted materials. Textile (fabric) derived from Fibers. Fibers may be of natural or synthetic (man-made) origin e.g. cotton, wool, silk, jute are the natural fibers whereas, nylon, viscose, Orion etc. are the synthetic fibers. Fibers are produced either as staples or filaments.

Fabrics and other man-made materials are being used more and more in shoemaking. Brocades have been used in footwear for hundreds of years, but today a wide range of fabrics and non-leather materials enters into the construction of all types of footwear. Textiles in all the well-known natural synthetic categories are specially produced to meet the particular needs of the shoe industry.

Self-Check2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

Fill in the blanks: (Total points: 6)

1. Shoe making materials are broadly classified into ---------- groups.
2. ---------- is a natural product, which is derived from the raw hide and skin of the animals.
3. ----------is the material that constitutes the outside of the footwear. It can be leather or synthetic.
4. ---------- the material which constitutes the inside of the footwear i.e. the materials against the foot and it can be leather or synthetic.
5. ----------is the inner sole of the shoe which is next to the foot under the shoe sock.
6. ----------is any material inserted between upper and lining for the purpose of improving the upper or lining materials' strength.

Short Answer Questions: (Total points: 24)

1. Mention and discuss the two shoe making materials classification. (2 points)
2. Leather is most suitable material to be used as upper. Why? (2 points)
3. Describe briefly the terms upper and lining. (2 points)
4. Discuss the sources of upper and lining materials. (2 points)
5. Discuss non leather footwear making materials. (2 points)
6. Briefly explain the following footwear materials. (6 points)

a. Shank board

b. Insole board

c. Toe puff and counter stiffener

d. Thread

e. Adhesive

f. Textile

7. Discuss the uses of materials listed in question number six. (6points)

8. List the category of adhesive used in foot wear industry and explain them. (2 points)

Note: Satisfactory rating – 20 points **Unsatisfactory - below 20 points**

Information Sheet 3-Identifying characteristics of materials

3.1 Identifying characteristics of materials

Footwear was formerly produced from one piece of material, later was made by attaching a few accordingly cut pieces combined together with strap and later sewed with needle and thread and other parts like sole as separate components is attached with footwear.

Materials used for construction of footwear are classified as upper materials, lining materials, reinforcement materials, accessories and fittings. The details of footwear manufacturing materials, their uses and characteristics are described as follows.

Leather - Leather is the most suitable material to be used as **upper, lining** and **socks** making because of its physical properties, elasticity, flexibility, ease of working, availability in varieties of colour and finish, thermal conductivity etc.

Leather is a durable and flexible material obtained from animal hide or skin, primarily cattle hide. The hide or skin is converted into leather by a process known as tanning. The two main methods are chrome tanning and vegetable tanning. Most shoe leather is chrome tanned although mixed vegetable/chrome treatments are also popular. Chrome tanned leather has good resistance to heat, moisture and perspiration.

The skin or hide of most animals consists of three main layers: the epidermis, the dermis (grain layer & corium layer) and the hypodermis (flesh layer).The epidermis is the outermost layer responsible for the color of skin or hide. In Dermis, grain is upper layer and the corium is the main layer with thicker fibers and provides most of the strength of the leather. The hypodermis is a thin layer between the corium and actual flesh of the animal.

The epidermis and hypodermis are partly or wholly removed during leather making and the leather actually consists of grain layer and corium layer

Most skins are split down in thickness and the best leathers have the grain layer intact with varying amounts of corium.

Flawed leathers have the grain bulled or corrected before finishing. Most suede's are made from splits without the grain. A split may also be coated to simulate a grain surface.

Leather is usually sold as whole skins or as sides. A side is one half of a whole hide cut along the backbone.

a) Line of stretch and tightness

The direction of lines of tightness and lines of stretch play a major role in cutting of pattern from hide or skin.

Lines of tightness are defined as the direction in which the material does not extend in length or very little increment in length takes place on applying force by two thumbs.

Whereas, in the direction of **lines of stretch**, material is increased in length or stretches more by applying the same amount of pulling force.

Normally, the line of tightness is just at 90° to the lines of stretch.

These lines are important in cutting because the upper component must be cut in such a way that the lines of tightness cut along the length of the shoe for proper shape retention in other words, we say that the component are cut “tight to toe”.

This rule is strictly adhered to in cutting most types of footwear. It is disregarded only in special circumstances e.g. open toe sandal, boots etc. The diagram shown below illustrates lines of tightness and lines of stretch on a hide/side.

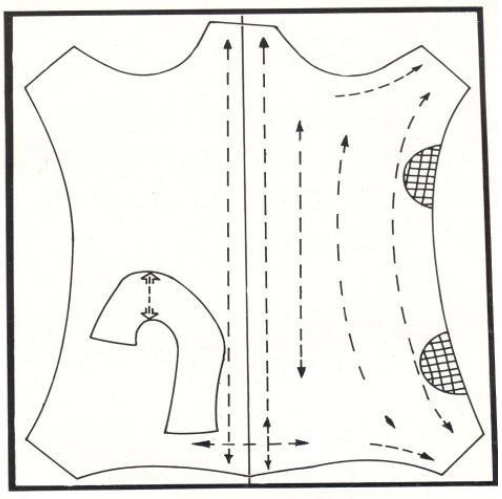


Figure 105 Line of tightness

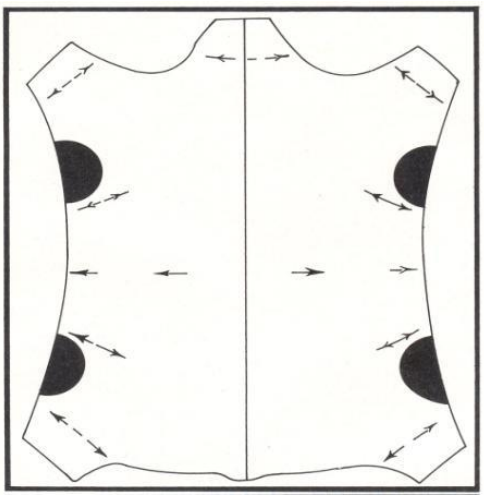


Figure 106 Line of stretch

Sheep leather has finer and softer grain surface and varies in grain structure depending on the age. Young sheep has close and smooth grain structure. Old sheep has firm and solid skin with coarser grain structure.

Goat leather has fine and compact grain surface and varies grain structure depending on the age. Young goat has close and smooth grain structure. Old goat has firm and solid skin with coarser grain structure.

Size

Skin of different animals have different size. The size of sheep and goat leather ranges from 2-10 sq.ft while cow side leather size ranges from 25-30 sq.ft.

Nap: Nap is leather softness and silky touch, and needs to be finished in a delicate manner.

Substa: Skins of different animals have different thickness. The thickness of sheep and goat leather ranges from 0.4mm-1.2 mm. while cow upper leather thickness ranges from 1.0 mm-2.5 mm

Properties of leather

For making footwear, leather is being replaced nowadays by varieties of synthetic materials available in the market due to the cost factor. But leather is still the most suitable material for making footwear and is superior to synthetic leather or any other leather substitutes.

The leather is fibrous in nature and due to this it can perspire giving the feet extra comfort. Also, the leather has got poor thermal conductivity, keeping the wearer cool in the summer heat and warm when it is cold. The elasticity and plasticity of leather allows it to adjust individual foot shape. The tensile strength, bursting strength, tear strength, flexing endurance, shrinkage temperature etc. are also observed to be considerably high when compared to synthetic materials.

Additionally, the leather is repairable and eco-friendly justifying its suitability as the best material. The structure of hides and skins and the tanning methods involved determine the actual properties of the given leather.

Suitability of leather for upper materials is due to its:

- Elasticity and plasticity
- Strength and stretch
- Permeability
- Surface characteristics
- Ease of working and maintenance

Adhesives

For a material to perform as an adhesive it must have four main requirements:

- It must "wet" the surfaces - that is it must flow out over the surfaces that are being bonded, displacing all air and other contaminates that are present.
- It must adhere to the surfaces - That is after flowing over the whole surface area it must start to adhere and stay in position and become "tacky".

- It must develop strength - The material must now change its structure to become strong or non-tacky but still adherent.

Soling materials

The ideal qualities for a soling material are as follows:

- Durability
- Flexibility
- Water proof
- Lightness in Weight
- Slip resistant
- Uniformity/Dimensional stability
- Cement holding
- Temperature resistant
- Stitch / Tack holding

Testing of soling materials

It is obvious that soling material possess some basic requirements in order to make them suitable for soling purposes. Testing is done to evaluate the required properties and to ensure the fitness for use. Very common tests are essential in case of soling materials are:

- General state of soling
- Flex crack resistance
- Abrasion resistance
- Dimensional stability
- Sole adhesion
- Slip resistance
- Durability

General state of soling: Soling materials are to have some basic properties like light weight, flexible, offer adequate strength, water resistance etc. Those are very common responsible factors for selection to solve the purpose as well as to feel comforts. To

evaluate them following are very usual tests. (a) Hardness/Softness (b) Density (c) Tensile strength (d) Water proofness (e) Water absorption

Flex crack resistance: The shoe is repeatedly subject to compression forces and flexing deformation at each step during walking. The area gets increased when it is bending during stepping and comes to the normal state when the step is completed. The sole should posses adequate flex resistance to prevent from flexing deformation**.**

Abrasion resistance: The sole as the bottom surface of the shoe is in continuous friction with the ground under body pressure during walking. It can be abraded of gradually by reducing its volume by contact area. Such abrasion may be quiet significant or quiet justify.

Dimensional stability: The shoe while in wear is subject of repeated compression forces, which may spread cellular soling material and thus make the sole deformed and ugly. To evaluate this property some sort of testing is carried out which are (a) Compression set (b) Heat shrinkage (c) Shrinkage due to all change in moisture content

Sole adhesion: It is one of the very important properties of the soling materials that it should readily stick on to the upper with a permanent strong bond to avoid bond failure during wear. The sole adhesion and bond strength depend upon various factors like type of material, type of adhesives quantum of pressure, heat reactivation, temperature and preparation of soling upper.

Slip resistance: Slip resistance is expressed as coefficient of friction which is obtained numerically by dividing the horizontal force required to cause slip by a vertical force applied on a material.

Durability: Durability of soling material in a combination of property such as abrasion resistance, hardness, stress applied, and density of the soling material. All these characteristics can influence the tear and wear resistance or as such durability.

Textile materials

Textile (fabric) is the term describes any woven or non-woven or knitted materials. Textile (fabric) derived from Fibers. Fibers may be of natural or synthetic (man-made) origin e.g. cotton, wool, silk, jute are the natural fibers whereas, nylon, viscose, Orion etc. are the synthetic fibers. Fibers are produced either as staples or filaments.

Fabrics and other man-made materials are being used more and more in shoemaking. Brocades have been used in footwear for hundreds of years, but today a wide range of fabrics and non-leather materials enters into the construction of all types of footwear. Textiles in all the well-known natural synthetic categories are specially produced to meet the particular needs of the shoe industry.

Toe-puff and Counter stiffeners

Even with the current demand of less structure footwear, particularly in the search for foot comfort, the toe- puff & stiffener are still one of the most important ingredients in the production of footwear. Whether it is the high fashion, welted, or even sports shoes most of it requires reinforcement at the front and back side of the shoe. We have a wide variety of both the materials and also the several application techniques to suit both the application as well as artistic look of the footwear.

From the wearer's point of view both perform a similar function in maintaining the shape of the footwear and both must have a good wear performance which necessitates the ability to retain their shape & strength when repeatedly collapsed or exposed to moisture.

Additionally, a toe-puff should be able to flex with the foot in wear without causing discomfort or creasing.

The required hardness of the toe-puff and stiffener depends on the type of footwear. In lightweight casual shoes, soft materials are sufficient. Also the properties and shape of toe-puffs & stiffeners are influenced by fashion trends.

Flat Stiffener

This could be both solvent activated and Heat Activated and Cut from the sheets as per pattern to insert at the time of lasting.

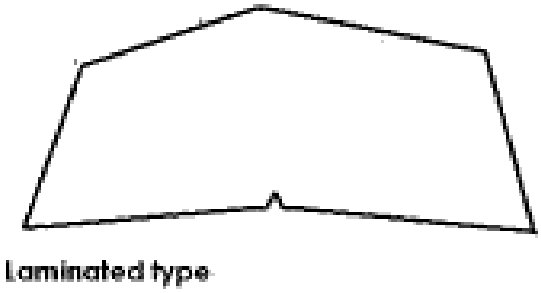


Figure 107 flat stiffener

Semi Molded Stiffener

Stiffener is added in closing section itself, Stiffener is finger molded before insertion. This type of stiffener is thermoplastic and needs to be softened by heat at some stage of lasting process.

Figure 108 Semi Molded stiffener

Fully Molded Stiffener

High quality shoemakers who wish to use high-grade leather board stiffeners often use this type of stiffener. The stiffener manufacturer molds it to the shape of the back of the last and the flange is molded in.

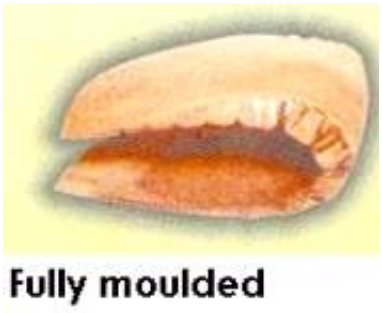


Figure 109 Fully Molded Stiffener

Solvent Activated

These puff are impregnated with either nitrocellulose or polystyrene resin. Polystyrene has recently become popular as the impregnating resin in solvent activated puffs. Production of the polystyrene sheet material is similar to that for the nitrocellulose type. The solvent blend to activate the puff should contain toluene, which dissolves more readily then the resin.

With all solvent activated materials, thorough activation is essential so that the materials easily conforms the shape of the back & fore part of the last. It is also essential that some portion of solvent is still present while lasting. However too much solvent's presence leaves the stain marks in the lining as well as upper.

The toe-puff must immediately be applied to the upper. The bonding takes place only when the toe-puff has sufficient amount of solvent in it.

Figure 110 Solvent Activated

Thermoplastic Materials:

Adhesive coating on heat – activated puff (for heated press application) are based on P.V.A (poly vinyl acetate), E.V.A.(ethylene vinyl acetate),polyacrylate, polyurethane. Resin and plasticizer are added to impart the required adhesive properties. More recently, hot melt adhesive have been used. The adhesive is heated to 120-140 C and is applied as single coating.

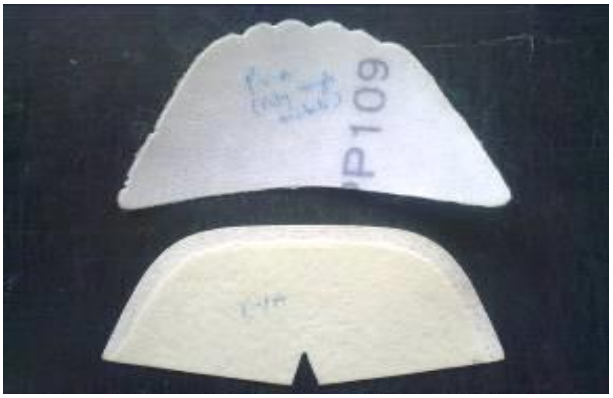


Figure 111 Hot melt activated puff

The following recommended uses of various types and thickness of puff are given as guidelines rather than as hard and fast rules.

Table 2 uses of various types and thickness of puff

	Solvent activated fabric-based puffs		Thermoplastic
	Cellulose – Nitrate impregnated	**Polystyrene impregnated**	**Polystyrene impregnated**
Women's shoes	0.7-0.9 mm	0.5-0.8 mm	0.4-0.7 mm
Women's heavy shoes and boots and children's and men's light shoes.	0.9-1.2 mm	0.8-1.0 mm	0.7-1.0 mm
Men's and Boy's shoes	1.2-1.6 mm	1.0-1.2 mm	1.0-1.2 mm
Men's heavy shoes industrial boots and sports shoes	1.6-2.0 mm	1.2-1.6 mm	1.2-1.5 mm

Steel Toe- Cap: These toecaps we use in safety shoe Steel protective toecaps are extremely hard and difficult to damage. They are heavier than aluminum or plastic toe**caps**, and bend under pressure, anti-rusty.

Figure 112 steel toecap

Plastic Toe- Cap

Superior strength-to-weight ratios: At the same strength, thermoplastic plastic shoe toe is 50% and 20% lighter than using steel and thermosetting plastic respectively. No rusting, excellent corrosion, chemical and climate resistance.

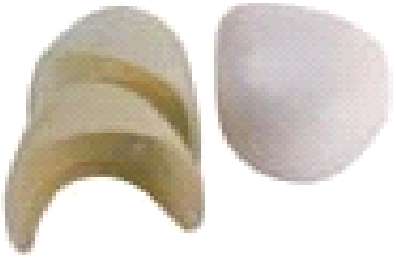


Figure 113 Plastic toecap

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What are the properties of leather? (2 points)
2. What is the line of tightness in leather? (2 points)
3. Define the properties of soling materials. (2 points)
4. Define the properties of adhesive. (2 points)
5. How many types of testing we do in soling materials. (2points)
6. Define the properties of toe-puff and counter stiffeners. (2 points)
7. Write down about the steel toecap. (2 points

Note: Satisfactory rating – 14 points **Unsatisfactory - below 14 points**

Information Sheet 4- Identifying generic and trade names for materials

4.1. Identifying generic and trade names for materials

For the awareness of the different footwear materials available in the market, it is required to know the Generic and Trade names. Following are the generic/trade names associated with selected footwear materials:

Leather:

Cow: Cow Softy, Cow Burnish, Cow Smooth C.G., Cow DD Lining

Sheep: Sheep Nappa, Sheep Cabretta

Goat: Goat Glazed, Goat Suede

Toe Puff and Counter Stiffener

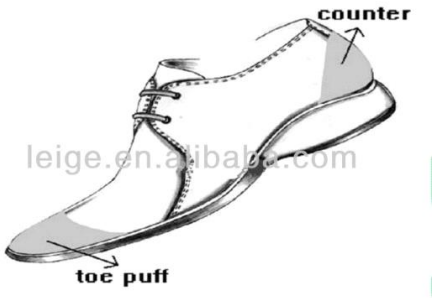


Figure 114 Toe Puff and Counter

Textile: Drill Cloth, Sugar coated lining, Mesh, Tricot, Skinfit etc.

Adhesive: PU, Latex, Rubber Solution, Bostik, Fevicol, Dendrite etc.

Soles: TPR, PU, EVA, PVC, VT etc.

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What are the generic or trade names in leather category? (2 points)
2. What are the generic or trade names in Adhesive category? (2 points)
3. What are the generic or trade names in Textile category? (2 points)
4. What are the generic or trade names in Sole category? (2 points)

Note: Satisfactory rating – 14 points **Unsatisfactory - below 14 points**

LG #20	LO #7- Identify Leather Manufacturing Processes

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Identifying types of leather
- Identifying basic structure of the skin/hide
- Identifying tanning types and stage process
- Identifying basic crusting operations
- Identifying basic difference between corrected grain and full grain leather
- Describing types of finished leather
- Explaining and demonstrating method of storing leather
- Demonstrating the leather bundling

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify types of leather
- Identify basic structure of the skin/hide
- Identify tanning types and stage process
- Identify basic crusting operations
- Identify basic difference between corrected grain and full grain leather
- Describe types of finished leather
- Explain and demonstrating method of storing leather
- Demonstrate the leather bundling

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 1- Identifying types of leather

1.1 Introduction

Leather is derived from raw hide and skin, which is a byproduct of meat industry. The outer covering of large animals is called hide whereas the outer covering of small animals is called skin. Raw hide/skin (H/S) is highly susceptible to bacterial attack. To make this highly putrescible material usable they are converted into a permanently preserved form. This permanently preserved form of raw hide/side is called leather.

Raw hide/skin is first converted to wet blue, which is in turn converted to crust and finally converted into leather by finishing. This can be explained by the following diagram.

Raw hide/skin – –> wet blue – –>crust – –> leather

For making footwear, leather is being replaced nowadays by varieties of synthetic materials available in the market due to the cost factor. But leather is still the most suitable material for making footwear and is superior to synthetic leather or any other leather substitutes.

Leather is fibrous in natural and is still the most suitable material to be used as upper making because of its physical properties, elasticity, strength, plasticity, flexibility, ease of working, availability in varieties of color and finish, thermal conductivity etc.

The leather is fibrous in nature and due to this it can perspire giving the feet extra comfort. Also, the leather has got poor thermal conductivity, keeping the wearer cool in summer heat and warm when it is cold. The elasticity & plasticity of leather allows it to adjust to individual foot shape. The tensile strength, bursting strength, tear strength, flexing endurance, shrinkage temperature etc. are also observed to be considerably high when compared to synthetic materials.

Additionally, the leather is repairable & eco-friendly justifying its suitability as the best material. Now the structure of hides & skins and the tanning methods involved determine the actual properties of the given leather.

Upper leather

Different types of leathers are used for upper making purpose in footwear industry today. Some of these are listed and described as follows.

Full grain leather

Full grain leather is often denoted by F/G. This type of leather has original grain pattern. Since, covering or hiding of grain is not done by finishing or plating the raw hide /skin from which this leather is made, it is almost defect free. Hence, the full grain leather is costly leather.

This type of leather has a natural look. This is mostly finished with aniline or semi-aniline. Sometimes, we have F/G leather in pigmented finish and also called F/G pigmented leather. Full grain refers to leather which has not been sanded or buffed.

Sanding or buffing removes surface imperfections from the leather, except in the case of nubuck where the buffing is very light.

Figure 115 Full grain leather

Corrected grain leather

A large proportion of the hide or skin coming to the tannery are full of defects and they are either unusable or it is very costly for shoe manufacturers to use them. The tanner

therefore, endeavors to improve the quality by eliminating or rendering these defects by a procedure called “Correcting the grain side”.

If the raw hide/side is defective from the grain side, in tannery, the leather is buffed (rubbing with fine emery paper) from the grain side and then finished, plated at high temperature & pressure to give it a good appearance and again finished with heavy coats of pigmented finish. Since, correction of grain pattern takes place in the whole process, to hide the defects and increase the cutting value, this leather is called corrected grain leather often denoted by C/G.

Based on different design and different plates, different names is gives to C/G leather e.g. smooth C/G is a plain plated leather, hair cell printed, booty print etc.

Figure 116 Corrected grain leather

Resin finished leather

This kind of finish is normally given on a leather whose grain side needs covering or correction to hide the defects or imperfections. A heavy coat of pigment finish, which gives a very good covering effect, is applied on leather.

Finish for corrected grain leather, prime constituent is acrylic or meth acrylic binder, good covering power due to high content of pigments (coloring material), better water resistance, cannot withstand high temperature.

Suede leather

If the grain side of leather is having more deep defects it is made velvety by buffing the flesh side. This leather is called suede. Suede leather is basically buffed leather with a

fine velvety nap on the flesh surface. Dye finish is carried out in this case without binder and then proper fixation of the dye is done.

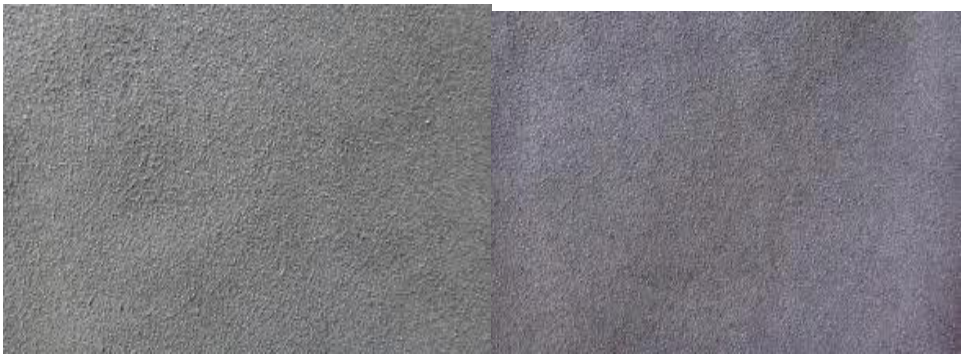


Figure 117 suede leather

Split suede

If the leather is made velvety from both sides, it is called split suede. Course fibres of similar look are visible from both the sides. This leather can be utilized from both the sides.

If the grain side is very defective then the fresh side is made usable by giving it a velvety appearance. This leather is called **reverse side suede.**

Figure 118 split suede leather

Nubuck leather

In nubuck leather, the grain side of the leather is made velvety by snuffing. The nap in nubuck leather is very fine because of the tight fiber structure in the grain layer. The dye finish is done on Nubuck leather.

This leather has got a very good writing effect. Writing effect is the effect caused due to raised naps on the surface. When we apply our finger on the surface we get finger marks on this leather. This effect is called writing effect.

Note: Buff nubuck has low writing effect.

Figure 119 Nubuck leather

Burnish leather

This finish is given by a special kind of wax called burnishing wax which gives shine or burning gloss on high abrasive action (by rubbing on the surface). This finish is normally given on full grain leather.

Good burnishing effect can be observed using the specific tool as in this case a type of burnishing wax is used during finishing giving dry & shiny surface effect.

When you burnish something, you are making the object shiny using friction and pressure. Leather is usually burnished at the edges, such as on a belt, using a metal tool, like a spinning disk. Burnishing is different than polishing as no polish is used in the process. Leather must be fairly moist when burnishing, but not wet.

Figure 120 Burnished leather

Glazed leather

It is a type of leather in which a type of protein finish is done and the glazing effect is obtained by glazing machine. Glazed leather is leather treated with a pigment containing not only gloss, but also protection.

Compactness of grain is required to sustain the high temperature & pressure of the machine. Glazed finish is again a natural finish given normally on goat/kid leather. This has a very brilliant & natural gloss.

Figure 121 Glazed leather

Oily leather

This leather is oily in nature. It is carried out on full grain leather (partially snuffed). The pull-up oil (free oil) is when sprayed with the season and finally the oil is sealed inside by top coat permitting the oil to move freely inside, responsible for color change when pulling the leather. On pulling this leather or folding this leather, the oil deposited in between the layers is removed and give the folded pulled area a light color. Hence, this finish also gives a two-tone effect to leather. This effect is normally given on full grain leather. Cow leather having a pull up effect is called cow oil pull up. Sometimes, we have oil pull up effect even on milled leather. This leather is called milled oil pull up.

Figure 122 Oil pull up leather

Patent leather

Patent finish is a P.U. finish in which a special coating is carried out. The finish film thickness is restricted to be less than 0.15 mm. The mirror like appearance is the unique feature of this finish.

Patent PU Coated or PU Film Coated**:** A patent or PU coated leather is split leather with a thick film of PU laminated on it. This leather does not have breakability like leather because of thick PU film.

PU film coated leather is either a split or sometimes-full grain leather with a very thin film of PU laminated on it. This leather breathes.

Figure 123 Crimpled leather

Figure 124 patent leather

Crimpled leather

Distressed leather is any type of leather that has been treated to age the appearance of the leather while not weakening the overall integrity of the product. There are a number of different methods used to distress leather clothing and upholstery. Often, the goal is to give newly produced products a weathered and broken in quality that is sometime more appealing to consumers.

The use of distressed leather is common with many different types of items. Accessories like gloves, belts, wallets and handbags are sometimes aged using one or more distressing methods. A jacket or coat, along with other clothing such leather pants and vests, are often aged to make the leather more supple without causing the material to weaken. Even leather furniture may be distressed, as the look and feel of the aged leather on a couch, sofa, or chair is often considered inviting.

While treating leather products is often conducted at home, there are manufacturers who offer new clothing and other products with distressed leather. While techniques vary, the leather is usually treated with a thin coating of some type of alcohol based agent, and then subjected to a series of steps aimed at creating wrinkles and creases in the grain. This pre-distressed leather may also undergo treatments that effectively scrape the material to lighten the color in random areas.

Figure 125 crimpled leather

Dry milled leather

Very high quality Natural Dry Milled (NDM) leather refers to the high end vegetable tanning process of bovine (cow) leather. NDM is a softer leather finish which contains the natural texture of a top grain cowhide. Inside leather is durable cowhide leather.

Figure 126 Dry milled leather

Velvety

The leather is given a velvety look either on the grain side or flesh side by buffing (rubbing by course emery paper) or snuffing (by fine emery paper). In this process small fibres called naps are raised on the surface which gives a velvety look. Nubuck, suede, split suede and reverse side suede comes under this category.

Lining leather

Lining leather is the leather that is used to constitute the inside of the footwear i.e. the materials against the foot. Lining can be prepared from the following different types of leather.

Drum dyed leather

Drum dyed leather is obtained when leather is immersed in a drum with dyes and tumbled to insure complete color absorption.

Pigmented leather

Pigmented (protected) leather is the most durable but is less natural in appearance, having a polymer coating. Pigmented leather is leather whose surface has a finish containing pigment particles that render the finish completely opaque.

Pigmented Leather is used in the majority of furniture upholstery and almost all car upholstery. The durability is provided by a polymer surface coating which contains pigments.

The surface coating allows the manufacturer more control over the properties of the leather, e.g. resistance to scuffing or fading. The thickness of the surface coating can vary.

Full grain pigmented leather: The grain surface is left intact before applying the surface coating.

Corrected grain pigmented leather: The grain surface is abraded to remove imperfections before the surface coating is applied. A decorative grain pattern is then

embossed into the surface it is indistinguishable from full grain pigmented leather to the naked eye.

Figure 127 Pigmented leather

Pigmented split

Pigmented leather is any top grain leather to which a clear topcoat and pigments have been applied. The pigments are what usually give the shiny even top color to the leather. The leather may or may not be aniline dyed. Sometimes the pigments (color) are applied to a base crust of a different color and in this case the leather in not dyed all the way through. If the pigments are applied to a hide that has been aniline dyed and matched for color then this leather is called protected aniline leather. Leather is usually pigmented to give it durability and hide its natural blemishes. Pigmented leathers are easy to maintain and have maximum resistance to wear, soiling, and fading from light. Pigmented split leather is the split pigmented part of pigmented leather.

Split

Split leather is leather created from the fibrous part of the hide left once the top-grain of the rawhide has been separated from the hide. During the splitting operation, the top grain and drop split are separated. The drop split can be further split (thickness allowing) into a middle split and a flesh split. In very thick hides, the middle split can be separated into multiple layers until the thickness prevents further splitting. Split leather then has an artificial layer applied to the surface of the split and is embossed with a leather grain. Splits are also used to create suede. The strongest suede are usually made from grain splits (that have the grain completely removed) or from the flesh split that has been shaved to

the correct thickness. Suede is "fuzzy" on both sides. Manufacturers use a variety of techniques to make suede from full-grain. Reversed suede is grained leather that has been designed into the leather article with the grain facing away from the visible surface. It is not considered to be a true form of suede.

Sole & insole leather (vegetable tanned)

Sole and Insole leather: Leather was always the main soling material. The leather which is used as soling material is vegetable tanned buff leather and varies thickness from 4mm - 7mm.Sole leather should be Solid, bold, flexible; it should not wear out easily; it must not increase in area as a result of shoe wearer's body pressure and at the same time it should not crack when subjected to a certain degree of bending on a specified metallic ball or rod.

The real secrecy of vegetable tanning of heavy leathers like the sole lies mainly with their degree of tonnages, which can be defined as the quantity of vegetable tannins fixed by 100gms of the hide substance. For high value of D.T. (Degree of tannage) a large quantity of tannins should enter into pelt and at the same time chemically react with collagen, so that the tannins cannot be extracted out with water.

The degree of tannage of sole leather is highest and lies between 90 & 95, even though this D.T. for leather can be raised up to 120 or more. When D.T. exceeds 100 the fiber structure of leather gets disoriented or destroyed and the leather becomes hard like piece of horn which cannot be made flexible with the best lubrication.

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

Fill in the blanks: (5 marks)

1. Raw hide/skin – –> ---------- – –>crust – –> leather
2. Pigmented (protected) leather is the most durable but is less ---------- in appearance.
3. The leather is given a velvety look either on the grain side or flesh side by buffing (rubbing by course emery paper) or ---------- (by fine emery paper).
4. Patent finish is basically a ---------- in which a special coating is carried out.
5. Full grain leather is often denoted by ----------.

Match the following: (5 marks)

A	B
1. Glazed leather	A. Leather is immersed in a drum with dyes and tumbled to insure complete color absorption.
2. Drum dyed leather	B. Basically a P.U. finish in which a special coating is carried out.
3. Patent leather	C. A type of protein finish is done and the glazing effect is obtained by glazing machine.
4. Full grain leather	D. By product of meat industry
5. Leather	E. This type of leather has original grain pattern.

One word answer: (5 marks)

1. In the leather making process after wet blue what is formed?
2. What is the meaning of F/G.?
3. What is the meaning of C/G.?
4. In what leather the grain side of the leather is made velvety by snuffing.
5. What is the full form of NDM?

Note: Satisfactory rating – 15 points **Unsatisfactory - below 15 points**

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Information Sheet 2- Identifying basic structure of the skin/hide

2.1 Rawhide & skin structure

Raw hides & skins of domestic animals are commonly used for making leather. They consist of cattle hides (cow, ox, and bull), buffalo hides, calf skins, goat skins and sheep skins. Hides and skins differ in their structure depending upon the breed and origin of the animal, its mode of life, its food, its environmental conditions, age, sex etc. These factors also influence the leather manufacturing process.

Furthermore, there are differences in quality between different parts of the same hide or skin. In case of cattle hide the fibers are heavier in the back (butt) areas than in the belly and the hair is longer.

From anatomical structure point of view, in case of calf skins there is firmness of grain, smaller collagen fiber-bundles, smaller and closer hair follicles found as compared to cattle hide. As a result, calf skins have a very fine structure and therefore useful for finest of leather. In case of buffalo hides the hair pores are less in number and the pore diameter vary widely. Goat skins as compared to sheep skins have very tight, firm fiber structure but have fewer fats (grain is also very compact) and so are used in the manufacture of shoe upper leather for premium market segment. The wool sheep are more porous whereas the hair sheep is tighter.

The pig skin cross section shows the hair follicles going completely through & through the skin, the grain surface is rough having grouping of follicles. The horse hides have a structure resembling hair sheep or goat. It has also got a strong & tight fiber structure.

The alligator (reptiles) has the characteristic woven network of hide fibers with no hair follicles or fat glands.

Raw material Commercial use

Cow hides sole, upper, furniture, clothing, bags, splits Buffalo hides sole, upper, furniture, clothing, bags, splits Calf skins upper, clothing, lining, bags Goat & Sheep skins upper, clothing, lining Pigskin upper, clothing, lining Reptiles upper, bags, applications etc.

Structure of hides/skins:

A.) Anatomical structure

B) Chemical structure

A.) Anatomical structure

- Epidermis
- Dermis or true skin
- Hypodermis or flesh layer

Epidermis

This layer forms the upper boundary of the skin. It constitutes only 1% of the total thickness of the h/s and serves to protect the layer beneath known as corium. This layer is made up of hard wearing layer of keratinous cells. The dead cell of keratin can be identified in the form of dandruff. The epidermis is removed from H/S during pre- tanning operations (liming & unhairing).

Dermis

This layer consists of two layers:

- Grain layer
- Corium

A) Grain layer: Grain layer is also known as corium minor. It is the top of corium constituting about one fifth of the total thickness in case of cattle hide. This layer has a characteristic grain pattern due to the presence of hair follicles (responsible for the

perspiration) in this layer. The grain pattern thus depends upon the density and structure of the hair follicles.

B) Corium

Corium or reticular layer is the main part constituting leather and appearing like net like fibers of connective tissues. The entire corium is an inter-woven structure consisting of several fibers grasped together. Again each fiber consists of several fibrils bundled together. The unique properties of leather are largely dependent upon the interwoven fiber structure which is more or less preserved as it was in the original skin.

The fibrous elements of skin float in or surrounded by a soft mucous substance caleed "Cementing substance" or "Interfibrillary tissue". By the partial or complete removal of the cementing substance and by the permeation of tannins into the fibers and even into fibrils, the fibers are prevented from being cemented together when the hides or skin are dried. They are thus free to move over each other and the leather becomes flexible & pliable.

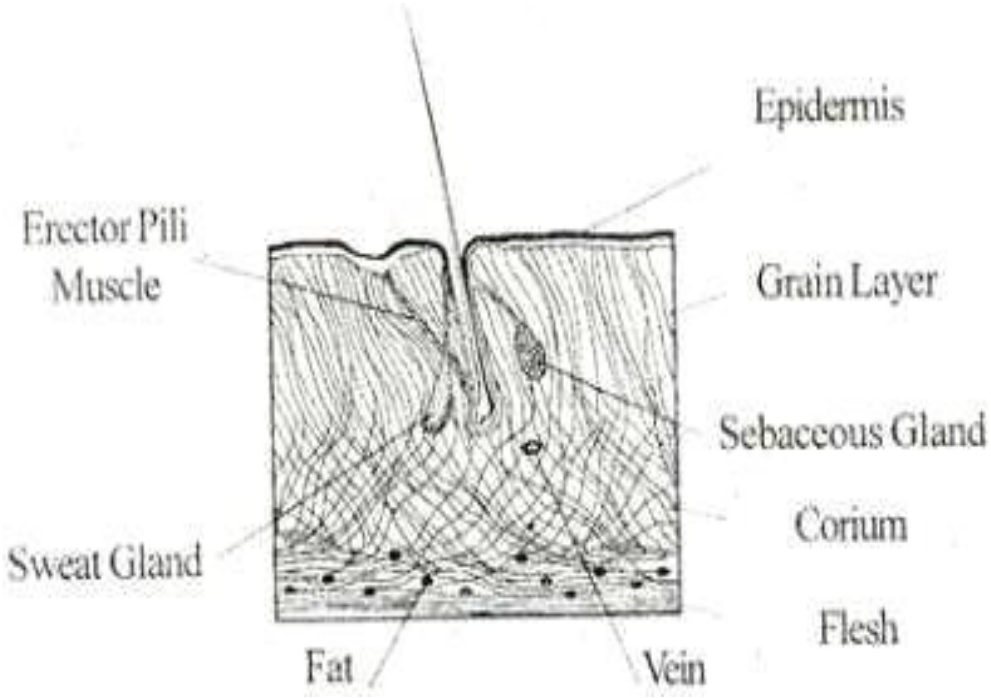

Figure 128 Cross section of cattle hide showing major parts of the skin

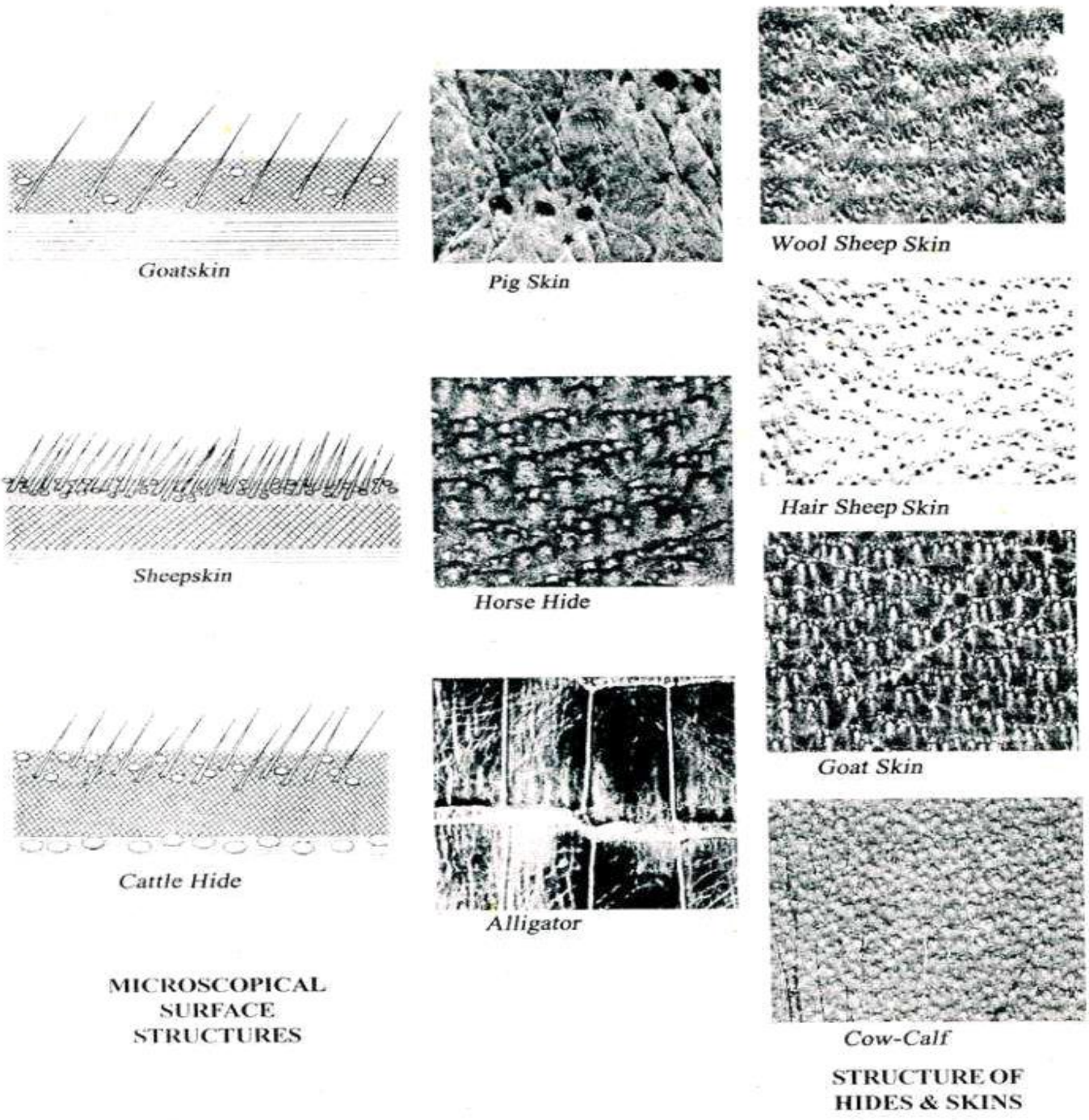

Figure 129 Structure of hide and skin

Hypodermis or Flesh Layer:

This layer is found below Dermis adjacent to the flesh of the animal therefore known as flesh layer. It consists chiefly of fat cells, with a few scattered fibres. There is also some muscular tissue. All these structures are useless for leather manufacture and must be removed during Pre-Tanning (Soaking and Liming) operations.

Chemical structure of hides/skins

Chemical structure of hides/skins includes Water ,Protein, Fats and Mineral & Pigments.

Structural Proteins: Collagen, Keratin, Elastin and Reticulin

Non Structural Proteins: Albumens, Mucins, Globulins and Mucoids

The chemical constituents of hides & skins can be divided into following groups:

- Proteins 19.2 - 32.75%
- Water 60 - 70%
- Fats 1.5 - 10.5%
- Minerals, Pigments etc. 0.36 - 1.5%

The relative proportions of these materials vary from skin to skin depending upon the species, age, breed, feeding and other habits of the animals.

1. Proteins

Proteins are structural units of a living thing containing carbon, hydrogen, nitrogen, oxygen, sulphur etc.

a) Structural or fibrous proteins: There are four types of structural proteins found in hides & skins namely- Keratin, Collagen, Elastin & Reticulin.

b) Non Structural or non fibrous proteins : Three types of non fibrous proteins known as Albumins, Globulins & various protein Mucins are also the constituents of hides & skins removed during Pre- Tanning operations. In leather manufacture, Collagen is of interest to the tanner. Collagen, a fibrous protein is composed of rope like bundle of smaller fibrils (made of molecules consisting very fine & long thread like structure). Collagen constitutes 90% of the total hide or skin protein. Proteins other than Collagen are removed during Pre- tanning operations.

Protein synthesis

Protein synthesis can be understood by chain: Amino acids simpler peptides Polypeptides Peptone Protease Protein

Amino acids: Amino acids are derivatives of the carboxylic acids (say Acetic acid) in which the hydrogen atom in the carbon chain has been replaced by an amino (-NH2) group.

Amino acids have both acidic & basic properties. The result is that, in aqueous solution, Glycine is neutral to litmus but forms salts with acids as well as bases. Amino acids have properties like high melting point, low solubility in organic solvents and high solubility

Zwitter ion: In aqueous solution the amino acids lose a proton and the amino group accepts that proton. Hence the resultant molecule exists largely as an internal salt known as a Dipolar ion or a Zwitter ion.

Simpler peptide: When two amino acids form amide-linkage together eliminating water, it is known as Peptide-linkage.

Polypeptide: Polypeptides are the chain of peptides constituting protein Molecule.

Structure of proteins: There are Primary, Secondary and Tertiary levels of the protein structures. The Primary structure gives a complete description of covalent linkage in a protein molecule. The Secondary structure is geometrical conFigureuration of polypeptide chains (Spatial relationships of near neighbors).

The Tertiary structure refers to as the arrangement of several polypeptide chains (Spiral, Stretched or both) in one molecule. It also determines the shape & size of protein molecule. The bonds which are of importance could be listed as: Electrostatic, Covalent, Hydrogen, Sulphide etc.

2. **Water**

Two forms of water are present in H/S

- Free water
- Bound water

The free water can be removed easily by squeezing or mechanical pressure. The bound water can be partly removed by chemical treatment and partly by constant drying.

3. Fats: The fats found in hides and skins are of two types:

- Glycerides or fatty acids
- Non Glycerides

The Glycerides of fatty acids found in corium and flesh layers, whereas the non Glycerides are found in the fat glands of the grain layer. The fat content in hides and skins may vary widely and the maximum is found in sheep skins. Both these fats are removed during Pre-Tanning operations (Liming, Bating and Degreasing).

4.) Minerals, Pigments etc. : Raw hides and skins contain mineral salts in small quantity in the form of chlorides, sulphates, carbonates, phosphates of sodium, potassium, calcium, and magnesium. Hides and skins also contain small amount of carbohydrates, pigments (coloring matter), enzymes etc. All these minerals are removed before Tanning operation.

Self-Check -2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid

Some explanations /answers:

Match group A with group B (5 points)

	Group A	group B
1.	Fats	a) Sulphates & carbonates
2.	Water	b) Keratin & collagen
3.	Minerals, Pigments	c) Bound water
4.	Structural Proteins	d) 19.2-32.75%
5.	Proteins	e) Glycerides or fatty acids

Choose the correct answers (2 points)

1. Water can be of:

a) Free water b) Bound water c) Both d) None

2. Fats can be of : (1 points)

a) Glycerides b) Non-Glycerides c) Both d) None

Fill the right value in blank space (5 points)

The chemical constituents of hides & skins can be divided into following groups:

1. Proteins ----------%
2. Water ----------%
3. Fats ----------%
4. Minerals, Pigments etc. ----------%

Note: Satisfactory rating – 12 points **Unsatisfactory - below 12 points**

Information Sheet 3- Identifying tanning types and stage of process

3.1 **Basic tanning requirements**

Chrome tanning chemicals

Earlier tanning agents were leaves, roots, barks and fruits containing tannins (chemical agents capable of converting raw H/S into leather).Later Alum salts (sulphates) and afterwards other salts were used for tanning.

In the middle of nineteenth century Chromium salt was discovered as suitable agent for tanning. Chrome tanned leather is ideal for footwear & most of the upper of the shoes worn now are made either of fully chrome tanned leather or combination tanned leather.

Vegetable tanning chemicals

The principal materials used for vegetable tanning are Wattle, Babool, Myrobalan, Avaram (Turwar), Gambier, Cutch, Quebracho, Chest-nut, Oak, Valonia, Sumac etc. Infusion of tanning materials obtained from different sourcesgreatly differs in color, tanning properties and the texture of leather they produce. This is due to the presence of soluble Non-tans in various degrees.

Practical tanners are of the opinion that no single vegetable tanning material is capable of imparting all the qualities in the finished leather as per demand. A blend of several tanning agents is therefore used by the tanners to get the specific properties viz. solidity, flexibility, fullness & color. Proper blending also influences the rate of penetration of tannins.

Classification of tanning materials

Vegetable tannins are divided chemically into two groups namely: i) Pyrogallol (Hydrolysable, Acid producing)

ii) Catechol (Pyro Catechol, Condensed) When the tannins are dry distilled at 180*-200*C with the air excluded, the Pyrogallol tanning materials yield Catechol. Other differences can be displayed by the following comparison:

S.No.	Particulars	Pyrogallol	Catechol
1.	Iron-Alum Treatment	Blue Colouration	Greenish Black
2.	Bromine Water Treatment	No Ppt.	Ppt.
3.	Boil with HCHO & Hcl	Incomplete Ppt.	Complete Ppt.
4.	Color of Liquors	Yellowish Tan	/Tan Reddish
5.	Color of leather	Creamy Yellow/Tan	Red Brown
6.	Action of light	Slight Darkening	More
7.	Average Weight	Much lower	much higher
8.	Tan-Liquors	Higher natural acid content	smaller content
9.	Penetration	Relatively Slow	relatively fast

The tanning material available can be classified chemically as:

Catechol Tannins Tannins:	**Mixed Tannins**	**Pyrogallol**
	(Catechol tannins predominate)	
Cutch	Wattle	Oak Wood
(Acasia Catechu)	Babool	Valonia
Quebracho		Sumac
Cutch		
(Mangrove)		
Goran, Gambier		

Non-Tan Materials

The vegetable tanning materials contain not only various kinds of tanning materials (Tans) but also the Non-tans. These non tans consist of Sugary matter, Gallic acid, soluble mineral salts & other acids (usually organic). The presence of non-tans in reasonable quantity gives soft leather with full handle. Non-tans, however, does not have the capacity to tan protein.

The higher Tan/Non-tan ratio gives Harsh, Astringent liquors (e.g. Quebracho). The rate of diffusion of Non-tans into pelt is more than the Tans. The presence of Non-tans also enhances the water absorption capacity of leather. Among the Non-tans, the sugary matter ferment to form organic acids (Acetic, Lactic and Prop ionic acids etc.) which are particularly desirable in the early stages of tanning if it is desired to produce fullness & plumpness in the finished leather.

Purpose of tanning

Leather Technology deals with the technical aspects of making leather from raw hides and skins. Basically it is a conversion process involving a number of operations starts right from the death of animal. The operations (methodology, sequencing, controlling parameters etc.) vary according to the type of leather to be produced. These operations solely depend upon the tanning method involved. Compare the soft feel and stretch of Gloving leather with the solid firmness of Sole leather. These qualities are obtained either by the choice of skin or by variation of the sequence of tanning operations.

Tanning is the process to convert putrescible hides and skins into non-putrescible material known as leather.

Earlier tanning agents were leaves, roots, barks and fruits containing tannins (chemical agents capable of converting raw H/S into leather).Later Alum salts (sulphates) and afterwards other salts were used for tanning. In the middle of nineteenth century Chromium salt was discovered as suitable agent for tanning. Chrome tanned leather is ideal for footwear & most of the upper of the shoes worn now are made either of fully chrome tanned leather or combination tanned leather.

Combination tanning is carried out either with a combination of chrome and vegetable, synthetic or other tanning agents.

3.2 Different stages of tanning

3.2.1 Different stages of making chrome -tanned upper leather:

- Curing or Preservation, Raw-Sorting
- Soaking, Pre-Fleshing
- Liming (Unhairing), Fleshing, Green-Splitting
- Deliming
- Bating
- Drenching, Scudding
- Degreasing (For Buff, Sheep etc.)
- Pickling
- Depickling (For Veg. Tanning)
- Chrome Tanning, Ageing, Wet-Blue Sorting

Post tanning or **pre-finish operations**:

After the completion of tanning, the leathers have to pass through many operations to prepare them finally for finishing.

- Sammying
- Splitting
- Shaving
- Washing
- Neutralization
- Dyeing / Fat liquoring / Retanning, Piling, Setting, Drying, Conditioning, Staking, Toggling, Buffing, Snuffing, Crust-Sorting, Dry Drum (If Required), Impregnation (If Required)
- Setting
- Drying
- Conditioning

- Staking
- Toggling
- Buffing
- Snuffing
- Crust sorting
- Finishing
- Staking (If Required)
- Ironing
- Area- measurement,
- Final Inspection
- Packing

Sequence of operation for making vegetable tanned sole leather:

- Curing or Preservation, Raw-Sorting
- Soaking
- Liming (Unhairing), Fleshing
- Deliming
- Tanning
- Bleaching
- Filling
- Oiling & Stuffing

Self-Check -3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid

Some explanations /answers:

Short answer questions:

1. Write down the different stages of making wet blue.(5 points)
2. Write down the different stages of making vegetable tanned upper leather. (2 points)

Note: Satisfactory rating – 7 points **Unsatisfactory - below 7 points**

Information Sheet 4- Identifying basic crusting operations

4.1 Identifying basic crusting operations

After the completion of tanning, the leathers have to pass through many operations to prepare them finally for finishing. The leather in this stage is known as **crust.**

- Sammying
- Splitting
- Shaving
- Washing
- Neautralisation
- Dyeing / Retanning / Fatliquoring,
- Fixation
- Setting
- Drying
- Conditioning
- Staking
- Toggling
- Buffing
- Snuffing
- Crust Sorting

1. **Sammying**

In this operation the excess water content of the leather is reduced so as to bring it to a suitable condition for subsequent Splitting & Shaving operations. It is carried out by mechanical squeezing using Sammying machine.

2. **Splitting**

After proper sammying the thick /heavy leathers could be splitted into two layers The Grain split & Flesh split using Band knife splitting machine. Thus it is possible to utilize the flesh split by processing it further for conversion into a valuable by-product to reduce the manufacturing cost. Excessive splitting could lower the tensile strength of the grain split. Splitting is carried out at 0.2 mm above the thickness of the shaved leather.

3. **Shaving**

The objective of shaving is to make the thickness uniform all over the hide/skin area. The appearance and the value of the finished leather depend upon efficient shaving which require high skill.

Two types of shaving machines are available in the market: 1) Single width (older) and 2) Double width. The thickness of the shaved leather should be kept about 0.2 mm above the required thickness of the final leather. The allowance also depends upon the type & method of Retanning.

After shaving the shaved weight is taken and for all further post- tanning operations the percentage of chemicals will be based on this weight.

4. **Washing**

Leather is properly washed after shaving so as to clean the H/S for effective dyeing and other post tanning operations. The washing is carried out in drum with soft water for approximately 30 minutes. The bath is then exhausted and then Neutralization is carried out in new bath.

5. Neutralisation

The process of neutralization signifies the removal of neutral salts, uncombined chromium salts & strong acids from the chrome tanned leather. The main objective is to reduce the positive charges to a level (p H) suitable for dyeing, fat liquoring etc. This operation is of great importance and must be carefully controlled to avoid difficulties during subsequent operations affecting the physical characteristics of the final leather.

Objective:

- Removal of Acids and Salts
- Bringing pH to neutral ranges.
- Preparing chrome tanned leather for effective Dyeing, Retanning & Fat liquoring

Control: p H - 4.5-5.5, Float Temp. - 25-30*C

- **Processing Equipments**: Drum.

Chemicals used

Neutralizing agents should be mild so as to avoid drastic change in p H on the surface of the leather, causing rough leather surface and poor grain break of the finished leather. The agents are:

- Sodium Bicarbonate
- Sodium Sulphite
- Ammonium Bicarbonate
- Sodium Format
- Calcium format
- Neutralising Syntans
- Borax etc.

The neutralizing Syntans can be very effective for leveling effect and also for the extra filling effect.

Process & Duration: The Process and the duration of neutralization depend upon the acidity level of the incoming wet blue.

Normally the process is carried out with water (100%) and neutralizing agents (1.5-2.0%) for 30-40 minutes in total adding the agents in installments of 10 minutes. The indicator is used to check the p H of the cross section of leather. The optimum p H level of the central layer should be less (4.5-5.0) than the surface p H (5.5) for better penetration of dyes, fat liquors etc. subsequently.

6. Dyeing / retanning / fatliquoring:

Dyeing, Retanning and fat liquoring are three distinct and important operations which are normally carried out in the same bath nowadays for the better and controlled results & in shorter duration.

A) Dyeing: The Objective of this process is to give color and appearance to the leather by which the value can be improved. The dyeing is carried out after neutralization and is a continuous process.

- **Processing Equipment**: Drum
- **Controls**: pH: 5.5- 6.0

  Float Temp. : 60 *C
- **Dyeing Agents**: The selection of the dyeing agents depend upon various factors eg. I) the fiber-structure (The Origin of animal)

ii) End use of leather

iii) Types of tannage /Re tannage / fat liquoring

The Dyes can be broadly classified as:

A) Anionic

B) Cationic

C) Reactive

a) Anionic Dyes: These dyestuffs can be further classified into three sub-groups as:

I) Acid dyes

ii) Direct dyes

iii) Metal-complex dyes

I) Acid dyes: The acid dyes are the compounds possessing negative charges having good affinity towards Chrome tanned Leather.

Ii) Direct dyes: These are also having negative charges but bigger particle size compared to the acid dyes. Hence these dyes are having less penetrating power and good covering power. These dyes are also fast to light.

Iii) Metal-complex dyes: These dyes possess metal radical coordinately bonded with the complex. The metals are Cr, Co, Cu, Fe etc. There are 1:1 / 2:1 Metal complex dyes

available in the market in which the dye : metal ratio determines the properties of the dyes. These dyes give shade levelness and very good fastness characteristics to leather.

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Reactive dyes: These dyes are having good covalence characteristics with substrate in question. It gives good wash fastness, very good leveling and exhaustion characteristics.

Dyeing Auxiliaries: Neutral syntans capable to reduce the cationic charges of chrome leather for dyeing with anionic dyes are the dyeing auxiliaries. The dyeing auxiliaries assist in:

a) Better penetration of dyes

b) Good leveling effect.

IV) Dyeing Method:

The method of dyeing depends upon the quality of final product required. There are basically three methods for leather dyeing:

A) Drum Dyeing

b) Brush Dyeing

c) Spray dyeing

a) Drum dyeing:

For through & through dyeing the drum dyeing method is carried out during other post tanning operations.

Float - 100 % (Temp. 60-65*C)

For black color - 1.0 %

Direct dye for Other Color - 0.75-1.0 %

Acid dye Run for 60 minutes, check penetration, if through, Fix with Formic Acid - 1.0 % (Diluted with 10% Water) Add in 2 installments, Total running 15-20 minutes. In case of black color, top dyeing is preferred with basic dyes (1.5%) to give richness of color on the surface. The total dyeing process can take 90-120 minutes. For better exhaustion of dyes the process can be carried out along with Fat liquoring / Retanning.

(R.P.M. of Drum: 15-20)

b) Brush Dyeing:

Application of dye by means of brush is carried out in this method. This method is used during the Finishing operation so as to give leveling of color and making a suitable base for the season application. The dye-solution (solvent based) is used for this purpose.

c) Spray Dyeing:

Spray dyeing method is used for dyeing the leathers meant for aniline look. This method may cause color bleeding if not finished or fixed properly. Generally basic dyes are used for this purpose.

The other means of dyeing can be:

1.By Curtain Coater

2. By Roller Coater

3. By Screen Printing etc.

V) Factors affecting dyeing:

The dyeing process is very critical regarding the final quality related to uniformity of shade as well as the dye penetration. There are various factors influencing the final quality of leather:

- Pre-tanning & Tanning operations
- Retanning & Fat liquoring
- The type of Dye & its quantity
- Dyeing auxiliaries
- Duration of process
- Dye-fixation to prevent bleeding

VI) Precautions for effective Dyeing

For better quality of dyeing, some precautionary measures must be taken:

I) Wet-blue Selection

ii) Proper washing before neutralization

iii) Neutralization

iv) Proper fixation of dyes

v) Proper cleaning of drum especially for light colors.

vi) Proper piling after drumming (Covered well in case of light colors).

VII) Color Concept:

The concept of colors is a very important aspect required for effective color matching. This concept involves the basic understanding of the constituents of white color, classification of primary, secondary, tertiary colors (Color Triangle concept) and the shade generation.

Constituents of white light: The white light is composed of seven basic colors of rainbow Violet, Indigo, Blue, Green, Yellow,

Orange & Red. Out of these colors some are classified as primary, secondary colors. The combination can give Tertiary etc colors. The color-triangle can better explain the formation of a new color using two parent colors. This concept of color-triangle helps a lot in shade matching practices.

Color-Triangle Primary colors: Blue, Yellow & Red are known as primary colors.

Secondary colors: Green, Orange & Purple are the secondary colors.

Tertiary colors: The Russet, Citron & Olive are called as tertiary colors.

Vision: The color of a particular body is the color which is reflected by that body and rest are absorbed by the body. In case of white body all colors are reflected and the black body absorbs all colors. The primary and secondary colors are bright but the tertiary colors and so on are dull in nature.

B) Fat-liquoring:

Fat liquoring is the process by which the oils & fats are incorporated into leather to make the leather soft, stretchy and waterproof. In this process, some amount of selected oils (2-6% on the dry leather weight) is provided to the leather in place of the natural fats removed during pre-tanning operations. The purpose is to provide lubrication for fibres, so that they can slip over each other more easily when the leather is flexed and also to avoid crankiness when the leather is dry. Fat liquoring greatly affects the physical properties of leather such as:

Break peppiness

Tensile Strength

Comfort characteristics etc.

I) Factors affecting fat liquoring:

Fat liquoring process is influenced by a number of factors such as:) Selection of oils/fat liquors

Tanning / Retanning operations

- Drying system (Rapid drying cause's patches on the surface).
- Float concentration
- Temperature of float

- Running time
- pH of the substrate as well as the liquor

II) Types of Fat liquors

Fat liquor is a solution consists of an emulsifier and a water insoluble oil or fatty matter (fatty acids etc.). Useful oil should be of:

a) High molecular weight

b) Non Volatile

c) Fairly linear structure

d) Reasonably viscous fluid or paste.

The types of Oils/Fats commonly used for making fat liquors are:

- Vegetable Oils : Castor Oil, Olive Oil, Coconut Oil
- Marine Oils : Cod-Liver Oil / Fish Oil
- Animal Oil : Neat's Foot Oil, Lanoline
- Mineral Oil : Petroleum products act as solvent
- Synthetic Oil

The emulsifiers are means of dispersing the oils finely in water to enable it to penetrate into leather at 60- 65*C float temperature, eg. Soap, Sulphated oils, Polyamines etc.

The classification of fat liquors used for leather manufacturing can be carried out on the basis of Ionic charge :

A) Anionic B) Cationic C) Non-ionic

Anionic fat liquors possess negative charged particles and they are having good penetration into chrome leather.

Cationic fat liquors are having positively charged particles and used for surface-oiling effect in case of chrome leathers. For vegetable leathers these fat liquors show good penetration.

The Non-ionic fat liquors do not combine with the leather cross-links and serve as free oil inside the leather.

Chemical Properties:

A) Sulphonated fat liquor: This fat liquor is obtained by the treatment of vegetable/mineral/animal oils with sulphuric acid in controlled conditions. The sulphur-oxygen-carbon linkage forms in this case. 1.0-1.5% combined sulphate is better for penetration of fat liquor inside the leather. Sulphonated or sulphated fat liquors contain other constituents as neutral oils, emulsifying agents, & filling agents.

B) Sulphited fat liquor: Treatment of fish oil or cod oil (oxidized) with sodium bisulphate gives this type of fat liquor. Very soft leathers can be produced using this fat liquor. It is best suited for garment and gloving leathers.

C) Synthetic fat liquor : The Sulpho-chlorinated fat liquors are the category of the synthetic fat liquors. These do not contain free fatty acids (hence chances of mould growth are minimum). Partial replacement of sulphonated fat liquors & oils gives improved lubrication effect inside the leather.

D) Solvent fat liquors: Oils in high boiling solvents come under this category. This fat liquors can provide softness with minor staking in case of upper leather manufacturing. This type is recommended for the leather used for vulcanized shoes.

III) Fat liquoring process:

Fat liquoring is carried out with an emulsion in water at 60-65*C. The Float-Temperature is required to be maintained throughout the process so as to avoid the surface

Anionic Fat liquor - 3.0-5.0% (in 3-4 installments) (in combination)

Run for approx. 45-60 minutes for every installment of adding fat liquor. Fixation is carried out with Formic acid (0.751.0%), added in 2-3 installments. When cross-sectional p H is found to be 3.0-3.5 cationic fat liquor (0.5-1.0%) can be added (run for another 15-20 minutes) in case of making soft leathers. The total fat liquoring process can be completed in 5-6 hours.

Fatty Spues

The Spue formation on leather may occur when the leathers contain high amount of free fatty acids (Palmitic or Stearic acids), they are more liable to occur on chrome tanned leather than vegetable tanned leathers. At higher temperature of Plating or Glazing operation, the free fatty acids are liable to migrate to the surface of the leather and they solidify on cooling.

The other reasons may be the hydrolysis of these fatty acids by moulds. It is recommended to use 0.2- 0.3% fungicides during the post tanning operations. The addition of mineral oils/Chlorinated paraffin's also helps in this case.

B) Retanning:

The main objectives of this important post tanning operation are:

- To improve the quality by filling up the looser & softer parts.
- To give tightness of grain (esp. in shanks & belly areas).
- To enhance the strength properties.

I) Retanning Agents:

- Vegetable tannins eg. Quebracho, Wattle ext., G.S.Powder etc.
- Synthetic tanning agents (Syntans) eg. Resin syntan, Chome syntan etc.
- Other tanning agents eg. Alum, Aldehyde etc.

These retanning agents are used in combination as per the final properties of leather required. Also the type of retannage determines the percentage of different tanning agents used in combination.

II) Control:

pH - 5.0-6.0

Float Temp. - 55-60* C (If used with fat liquors)

- 25-30* C (If only retanning is done)

The retanning process is generally preferred to be carried out with low float (For better penetration and uniform distribution of retanning agents and also the risk of D/G* is minimized). Sometimes the re- chroming of the wet-blues is also required before actual retanning, in case the chrome content of the wet-blue stock is found to be less than 8%. But, this Rechroming is essential for the Semi-chrome leather manufacturing.

The total retannage for upper leather should be 10-15%, depending upon the type of final leather and also upon the quality of W/B, E/I as an input material. Retanning process is generally carried out for 3-4 hours but if the percentage of retannage is required more, as per specific quality requirements (Thicker leather, shrunken grain leather etc.), the duration can be more accordingly. The fixation of retanning agents is carried out using the same formic acid (0.5-1.0%) added in installments.

IV) Types of Syntans

There are variety types of synthetic tanning agents available in the market according to the requirements of the tannery people and also research & development activities are going on to get better results at lesser cost . Broadly the syntans are classified into:

- Replacement Syntans: Replaces veg. Tannins, Bigger Particle-size, good filling effect
- Exchange Syntans: Neutralizes the positive charges of chrome for better penetration of vegetable tannins inside
- Resin Syntans: They have also got very good tightening effect
- Other Combination Syntans: Combination of various mineral tanning agents after the drumming operations are over, unloading of drum is carried out and the stock is piled grain to grain and left overnight for ageing.

Next day on wards, some mechanical operations are carried out:

- ✓ Sammying
- ✓ Setting
- ✓ Drying
- ✓ Conditioning

- ✓ Staking
- ✓ Toggling
- ✓ Trimming
- ✓ Buffing / Snuffing

1. Sammying

In this operation the excess water content of the leather is reduced so as to bring it to a suitable condition for subsequent Setting operation. It is carried out by mechanical squeezing using Sammying machine.

2. Setting

The objective of Setting out is to make the leather flat (removal of wrinkles & fold marks) and to smoothen the grain. This operation is carried out using Setting M/c, having helical cylindrical blunt knives with other pressure rollers. The Pressure adjustment can be done for light & heavy leathers.

3. Drying

After Setting, the leather is dried for subsequent mechanical processes. The moisture content should be 15-20% after drying. The methods of drying could be:

Normal air-drying

A. Ordinary drying: The stock is hanged to dry in normal environmental condition.

B.Nailed drying: The leather are nailed on a flat surface in stretched condition & dried under natural air. The dried stock will be flatter. Direct Sunlight is not recommended for this purpose.

Forced Drying

A. Hot Air-Blow: For this, the stock is hooked in stretched condition with the wire-frame & the stock can be dried inside the drying chamber with the arrangement of blowing hot air.

B.Vacuum Drying: This is the latest method of drying leather & the drying time is also very less. The stock is spread in between hot metal plates and the moisture is removed under vacuum. It is required to hang the leather in normal condition for some time after removal from the Vacuum dryer.

4. Conditioning

Condition is the process of dampening back of the dried lot for quality staking subsequently. This process is carried out by applying the damp saw-dust on the flesh side of the stock or by light-spray of water. The stock should be kept under such condition overnight. The moisture content after proper conditioning should be 25-30%.

5. Staking

Fig. Hand staking

The objective of Staking is to provide proper softness to the leather by separating the opening the fiber- structure mechanically. There are two types of Staking machines used for the purpose:

A.Molissa type: This machine gives the mild effect by pin-vibration method. Suitable for Upper leather.

B.Slocomb type: This type of machine can give additional softness (as desired) and suitable for garment/gloving leathers. The mechanism is based on two combs acting together.

6. Toggle-drying

By this method, the leather is dried finally and the area yield is observed to be approx. 10%. Nowadays the machine toggling came in practice which reduced the drying time and also the stretch of leather can be done automatically during the process.

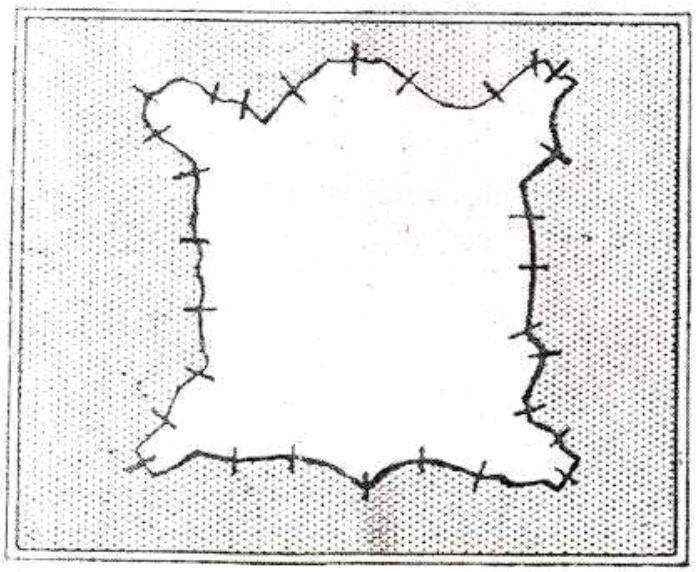

Fig. Togglestraining

Fig. Teggle

Figure 130 Toggling

7. Edge-trimming

The Stock should be trimmed well round about the area for efficient Buffing and Snuffing subsequently and also it prevents the damage of leather. This objective of this process is to give proper shape to the leather also.

8. Buffing / snuffing

The process of removal of a very thin layer from the grain surface is known as Snuffing, whereas if the same process is carried out on the flesh surface of leather, it is called as Buffing. The removal of the layer is carried out by means of rubbing with emery paper roller (using pressure) provided with the Buffing / Snuffing machine. Normally, 80-120 Grit paper is suggested for Buffing whereas. 600-800 Grit Emery paper can be used for Snuffing operation.

Dust removal is also very essential operation before the leather is sent for finishing. After cleaning Grain/Flesh surfaces the stock (Now known as “Crust”) should be sorted out as per Grade, Type of finish etc

Self-Check -4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid

Some explanations /answers:

Match the correct answer. (10 points)

A	B
1. SAMMYING	1. The stock is hanged to dry in normal environmental condition
2. SPLITTING	2. Dampening back of the dried lot for quality staking subsequently
3. SHAVING	3. To make the leather flat (removal of wrinkles & fold marks)
4. WASHING	4. To clean the H/S for effective dyeing and other post tanning operations
5. NEAUTRALISATION	5. To make the thickness uniform all over the hide/skin area
6. FATLIQUORING	6. The thick /heavy leathers could be splitted into two layers
7. SETTING	7. The removal of neutral salts, uncombined chromium salts & strong acids from the chrome tanned leather
8. DRYING	8. Provide proper softness to the leather
9. CONDITIONING	9. The oils & fats are incorporated into leather to make the leather soft, stretchy and waterproof
10. STAKING	10. Water content of the leather is reduced

Fill in the blank (7 points)

1. The process of removal of a very thin layer from the grain surface is known as --------- (1 points)
2. Normally, ---------- Grit paper is suggested for Buffing whereas. (1points)
3. ---------- Grit Emery paper can be used for Snuffing operation.
4. Nowadays the machine ---------- came in practice which reduced the drying time and also the stretch of leather can be done automatically during the process.
5. ---------- machine gives the mild effect by pin-vibration method.
6. The objective of ---------- is to provide proper softness to the leather by separating the opening the fiber- structure mechanically.
7. ----------is the latest method of drying leather & the drying time is also very less.

Note: Satisfactory rating – 17 points **Unsatisfactory - below 17 points**

Information Sheet 5- Identifying difference between corrected grain and full grain leather

5.1 Identifying difference between corrected grain and full grain leather

FULL GRAIN LEATHER

Full grain leather is often denoted by F/G. This type of leather has original grain pattern. Since, covering or hiding of grain is not done by finishing or plating the raw hide /skin from which this leather is made, it is almost defect free. Hence, the full grain leather is costly leather.

This type of leather has a natural look. This is mostly finished with aniline or semi-aniline. Sometimes, we have F/G leather in pigmented finish and also called F/G pigmented leather. Full grain refers to leather which has not been sanded or buffed.

Sanding or buffing removes surface imperfections from the leather, except in the case of nubuck where the buffing is very light.

Only the best hides are selected for this type of leather as any imperfections in the hide will show in the finished leather.

Full grain leather is given an aniline or semi-aniline finish in a manner similar to that for calf leathers. The resulting leather has “natural” leather; look that is much sought after. The current fashion for natural leathers has, in fact, overtaken the supply of suitable hides.

Full-grain leather is considered among the best quality leather you can buy. It can be made from a variety of different animal hides, but most usually is made from cow skin. Leather can undergo complex treatment processes in order to create numerous products. Many of these treatments may result in weaker leather that will not wear as well. This is especially true when the leather is treated with chemicals. Full grain leather is desirable because of its minimal treatments and its durability.

With full-grain leather, the hides of the animal used are not treated significantly. Instead they have the hair of the animal removed but they are not sanded. This can result in some minor flaws in the leather, but as used in fabric, it also results in the most

breathable leather you can wear. Like a great pair of jeans, full-grain leather clothing actually gets more comfortable the more you wear it, becoming softer and some say even more attractive as it gets older.

Though full-grain leather is not sanded, it can still be dyed, called an aniline finish. Non-dyed full-grain leather is harder to find. In fact if you don't buy full-grain leather with an aniline finish, you will usually find it with a semi-aniline finish. This is a clear finish placed on the leather that will allow imperfections in the leather to show. Actually many desire the semi-aniline finish in full-grain leather because it gives a more natural look to the leather.

Unlike other types of leather, full-grain leather uses the whole hide rather than layers of the hide. In contrast, top-grain leather, another very desirable product uses the top layers of the animal hide. Using the whole hide makes full-grain leather much thicker, and great for products that require a certain amount of durability.

Generally, it is the grain split of a hide from which nothing has been removed except the hair and associated epidermis.

The surface of full grain looks like this under the microscope:

Figure 131 Full grain leather

Aniline leather

It is a type of leather dyed exclusively with soluble dyes without covering the surface with topcoat paint or insoluble pigments. The resulting product retains the hide's natural surface with the 'grain', i.e. visible pores, scars etc. of the complete original animal's skin structure.

Originally, the dyes used for this process were synthesized from aniline through chemical reactions. These dyes used to be called 'aniline dyes' or 'tar dyes'. In modern times, the dyes used are subject to laws and regulations in many countries, and the use of certain compounds is prohibited as there are reasons to assume health risks. Typically, leather is dyed both for aesthetic reasons and to conceal blemishes. The dye colors leather without producing the uniform surface of pigmented leather. Any visible variations on the surface which is not dyed leather such as natural blemishes will remain visible.

There are different kinds of aniline leather, but the same kinds of dyes are used in the process. The dyes used are clear and transparent chemicals that allow the grain structure of the leather to be seen. These dyes show the natural texture, but do not protect the leather from damage.

Aniline leather may be referred to as full aniline or full savage leather to differentiate between this dye treatment and variants. Semi-aniline leather is produced through a very similar process to full-aniline, but has a thin protective top coat added to protect it from wear and staining. Pull up aniline leather has additional oil or wax applied to the leather to give it a distressed look.

Semi-aniline leather

Looking at semi-aniline leather through a magnifying glass will look quite similar to aniline. The hair follicle holes are slightly visible (as indentations) but you will notice a thin pigmented coating covering them. Some semi-aniline has thicker coatings than others and so the holes may not always be identifiable.

The Absorption Test

Drip a small amount of leather cleaner or water on to the semi-aniline leather. It will sit on the surface so dab it with a piece of cloth to absorb the liquid. You will notice that the leather will absorb a very small amount of this liquid, this shows by a slightly darker patch. It can take between 3 – 4 minutes for semi-aniline to absorb a drop of cleaner.

The Touch Test

Semi-aniline feels quite natural and soft to the touch. The finish is often smooth and you can feel the lacquered surface, which makes the leather semi slippery compared to an aniline.

The Visual Test

The color of semi-aniline will look quite uniform, not as varied as aniline and not as uniform as pigmented. The grain pattern will be natural looking as only a thin pigmented coating is applied. You may be able to see natural markings, but you will have to look closely to spot them. Semi-aniline is often two toned but this two tone effect can sometimes be very slight and so hard to spot.

If you do not maintain the leather using the leather protection cream, the top coat of color can wear off in high use areas. To make the leather last longer, apply the protection cream once every three months to reduce friction and so, stop the color wearing away as quickly.

CORRECTED GRAIN LEATHER

A large proportion of the hides coming into the tannery are marked by scar marks, barbed wire scratches and growth marks the shoe manufacturers would find them very costly to use because of the large amount of wastage that would result. The tanner therefore endeavors to improve the quality by eliminating, or reducing, these defects by a procedure called “correcting the grain”.

This is done by snuffing the grain surface with a very fine abrasive paper, which takes off the shallower surface marks. The sides are finished with pigments bound with resins in water. The method involves padding on a base coat to the corrected grain surface, (A pad

is wooden block covered with plush). Applying the finish in this manner ensures good uniform penetration of the resin binder into the surface and good anchorage of the finish. The leather is then plated in a heated press (150^{o}c) under pressure (150 kg/cm^{2}). As the resins are thermoplastic the finish will flow under the influence of heat. This aids the anchorage of the finish and its smoothness.

Two coats of the pigments resin mixture dispersed in water are then sprayed on. The leather is again plated to bind the finish coats together. The final operation is the application of a spray coat of nitrocellulose emulsion, to improve the resistance of the finish to soiling and to wet and dry rubbing.

Corrected leather has been significantly processed so that lower quality top-grain hides may be used. CORRECTED, means the application of more chemicals and paint, the stamping of an artificial texture and other processes. This tends to produce leather that is not as soft as less-processed top-grain but has a more uniform look and finish, making the product very durable. Corrected leather allows for a lower price for the final product. It is often best suited for recreational rooms or other places that require exceptional durability.

Protected Leather

This is simply another way of saying “corrected” leather, except it may not be limited to top-grain. It refers to the fact that enough paint or other finish was applied to make the surface more durable than more natural and less-processed leather.

Top Grain Leather

Top grain leather is leather from the uppermost layer of a hide. It is the highest quality part of the hide.

This leather comes from the outermost upper layer of the cowhide, and is the only leather recommended for all high quality sofa leather. The best top-grain hides reflect that the animal has lived in an environment that resulted in limited scratches, insect bites or other damage. These hides can be minimally processed and used in their most natural form.

Generally, less processing allows the hide to be softer and display a more natural character.

Pure Aniline Leather

Pure Aniline is top grain leather that is dyed for color without any pigments applied. These hides will exhibit some natural characteristics such as healed scars, scratches, neck and belly wrinkles. Expect color variation from the swatch to the actual leather, due to the fact leather is a natural product and will absorb dye differently within the hide and from hide to hide. This leather will develop a rich patina over time and will fade with prolonged exposure to sunlight.

Protected Aniline Leather

Protected aniline leather is top grain leather that is dyed for color and then receives pigment to ensure color consistency. Without pigment protected leather is not color consistent. The pigment also ensures fade resistance and helps the leather wear over time. A clear water based topcoat is applied for additional protection. The natural imperfections of the hide are also less noticeable. Hides average 50-55 square feet. Protected Aniline Leathers are easy to maintain and have maximum resistance to wear, soiling, and fading from light.

Semi-Aniline Leather

Semi-Aniline leather is pure aniline leather that has a small amount of pigment or clear finish thus allowing the natural characteristics of the hide to still show through while offering some of the benefits of color consistency and increased wear ability.

The difference between full grain and top layer leather

Full grain leather is the highest quality of leather that you can get and is made from the entire cowhide. It is thick, making it very strong and durable. It also is costs a lot more than many other types of leather.Top grain leather is leather that has imperfections on the surface of the hide that are removed by sanding and then refinished. It has also had

the "split" layer removed, meaning that the bottom layer of the hide is taken away. Top grain leather is thinner than full grain and is less expensive. It also is suppler.

Which is more durable semi aniline leather or corrected grain leather?

Semi aniline leather is really more of a dying process. Usually a semi aniline leather has a corrected grain, hence the use of semi aniline. What happens on semi aniline leather is that small defects on the leather hide have been buffed or sanded and then get an embossed grain or corrected grain. In order to have color consistency, a semi aniline dye is utilized.

Self-Check 5	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

Fill in the blanks: (5 marks)

1. Full grain leather has a ---------- look.
2. Full grain leather has original ----------.
3. ----------is a type of leather dyed exclusively with soluble dyes without covering the surface with topcoat paint or insoluble pigments.
4. Some ---------- has thicker coatings than others and so the holes may not always be identifiable.
5. Improving the quality by eliminating, or reducing, defects by a procedure called ----------.

One word answers: (5 marks)

1. What is the full form of F/G.?
2. What is the full form of C/G.?
3. What type of finish is given in full grain leather?
4. In aniline leather what is used for finishing (dye or pigment).
5. What is the name of the procedure when we improve the quality by eliminating the defects?

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

Information Sheet 6- Describing types of finished leather

6.1 Describing types of finished leather

Below is a look at some of the quality finishes.

Aniline Finish

Only the highest quality Full Grain Leather can receive an Aniline Finish. This is because the grain remains exposed, and must have as few blemishes as possible. As only the finest hides can be made into aniline, only around 5% of them are adequate.

The result is a leather that looks and feels much better than other finishes.

Aniline finishing involves using aniline dyes, which are water-soluble pigments. This creates an effect closer to staining, as opposed to the heavy opaque coating left by other finishes. The purpose of this is to reveal more of the natural colorings and patterns of the leather, such as fat lines and wrinkles. This is sometimes followed by a pigment-free polish or glazing. When inspected under a magnifying lens, pores should be clearly visible.

There are many benefits to Aniline Leather. The lack of finish allows the leather to breathe and adjust to body temperature quickly. This makes it great for clothing, shoes, and small accessories. It also ages incredibly well, developing a much sought-after patina that comes with wear.

This type of high-quality leather requires proper care, as it may fade in direct sunlight or be susceptible to staining and soiling. To reduce this, micro pigments may be applied to offer some protection. This is referred to as “protected aniline” or “aniline plus.”

If you’re gentle with your accessories, seeking the look of a beautiful patina, and don’t mind the required maintenance, Aniline Leather can be a great option for you. As one of the softest, most pliable finishes, it is well suited for most applications, but is best for smaller accessories that are easier to maintain, such as belts, shoes, and wallets.

Semi-Aniline Finish

Semi-Aniline leather leaves the grain exposed, but has a thin protective/corrective layer.

Between variations in grain and color, scratches, insect bites, and other wear and tear, it is very common for hides to have at least a few unsightly blemishes. To rectify this, a light coat of finish can be applied with enough opacity to mask variations, without hiding the natural grain of the leather.

Semi-Aniline finishes are applied to full grain leathers, with only a small amount of pigment being used. The pigment provides a degree of durability and stain resistance that can take more wear than true aniline leather.

This finish can result in a slight sheen, but still retains the high-quality look. Unlike aniline leather, it is resistant to sunlight and water damage.

Semi Aniline leather is a good fit for those who want high quality leather without the frequent maintenance. Like Aniline leather, it is suitable for most applications, including larger items like handbags and upholstery. It may not patina, but it is still soft and will hold up nicely to gentle use.

Pigmented Full Grain Leather

While this type of leather finish requires a heavier layer of material to mask details than semi-aniline finishes, it is still made of high-quality Full Grain leather. A resin-based pigment is applied to hide defects, but it still maintains the look and feel of a quality product.

Unlike the aforementioned finishes, this finish does not leave the pores visible, and hides the natural color variations in the leather. Instead, the color and surface are uniform and evenly coated with pigment, giving it great light fastness and stain resistance. It does have reduced breathability, which is at times compensated with perforation.

This is one of the most common high-quality leather finishes. It's also suitable for most people, needing little maintenance, and being more durable that non-pigmented leathers. It is not as soft as aniline and semi-aniline leathers, but its stiffness and thicker top coat

allow it to hold up to rougher use without as much upkeep. Pigmented Full Grain leather is great for most applications, especially those that experience frequent wear. This finish is ideal for “everyday” accessories.

Suede

A process of abrasive action, called buffing, raises the corium fibers to produce an even and short fiber, or “nap” finish. The raised nap is finished by buffing the flesh side, or inner layer, of the hide.

Suede can be made from the flesh side of grain split leather or any side of a flesh split. Suedes are attractive and tough, with springy fibers that rebound quickly to the upright position. This means that there is no “finger mark” or “two-way rubs” that appear.

Suede is highly durable, yet maintains an appealing look and softness to the touch. It’s great for shoes, jackets, and gloves. At CrookhornDavis, you can find it lining handcrafted Italian leather belts, for a luxurious and comfortable feel.

Nubuck

Also referred to as velvet suede, Nubuck has a finer buff than suede and is buffed on the grain surface of leather. This is also referred to as “snuffing.” The collagen fibers of the surface are finer than the corium, which makes for the finer nap. Nap is then brushed or plush wheel padded to produce velvety, lustrous looks and feel. Wax, grease, or oil are sometimes applied. These leathers are referred to as oil nubucks.

Nubucks have the “two-way rub” or “writing effect” that suede does not. Nubuck is made of more expensive, higher quality leather than suede. As a result, it is softer and more durable. While the two have similar applications, nubuck is for those willing to pay for the extra softness and durability that comes with using the grain side of leather.

Pull-Up Leather

Leather which has extra oil added during the manufacturing process and is finished with a spray coating of wax is called Pull-Up leather. This gives the leather a dark, almost greasy, look and feel that imparts a rugged, outdoor look.

Pull-Up leather is similar to nubuck and suede in that it does not have a protective finish coating applied. This type of leather is prone to color changes in areas of high wear and is associated with water resistance and high quality.

The finish is designed to lighten as it is stressed or stretched, resulting in a worn effect. Pull up leather is an excellent option if you love the distressed look of a well-worn leather accessory.

Embossed Leather

When leather is pressed against a hot, raised-patterned metal plate, the surface fiber structure will retain an impression. This is a process of leather that has been used for hundreds of years and opens up many possibilities.

Leathers can be embossed to mimic the look of crocodile, lizard, snake, and many other skins. The softer the leather, the easier it is to emboss, but the less permanent the embossing becomes.

Vegetable-tanned leathers are usually easier to emboss as they retain the impression better than the more elastic chrome-tanned leathers.

The resulting leathers tend to be firm and stiff, with compromised breathability. However, embossed leathers can be an affordable alternative to rarer animal skins that are difficult to work with. They have the added benefit of looking exotic without requiring additional, more complicated care.

Dry Milled Leather

To achieve this finish, leather is loaded into milling drums and rotated. The soft falling action intensifies the natural lines in the leather to give it an attractive pebbling effect. It

also makes the leather considerably softer and is one of the techniques used to soften vegetable-tanned leathers. This is a great finish for clothing and upholstery.

Antiqued Grain (Two-Tone Leather)

To achieve a two-tone leather, a top coat is applied unevenly, or partially removed to show a contrasting underlying color coat. The leather may have had hollows or creases embossed before application of two pigmented coats, so that the first coat, usually the darker one, settles into the depressions. This finish creates a classy, aged look, without having to wait for a natural patina.

Patent Leather

Traditionally, patent leather is made when linseed oil-based products are applied to the leather to produce a high gloss finish. Modern patent leather has either a liquid resin coating or a layer of plastic laminated to the surface. This produces a beautiful, shiny surface with a high-end feeling.

Self-Check 6	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Total marks (5 marks)

1. Write and illustrate the types of finished leather.

Note: Satisfactory rating – 5 points **Unsatisfactory - below 5 points**

Information Sheet 7- Explaining & demonstrating method of storing leather

7.1 Leather sorting

Reason for leather sorting

Leather is a natural product and is subject to **variation** from one skin to another, even though most tanneries try to ensure uniformity within batch. In some batches variation may be slight, in order they may be more noticeable. Even variation of leather not only might happened on the same batch of different leathers, variation of grain, color and shade may also happen on the same(one) leather.

Variation in leather may include the following:

a) **Color:** different skin can show color variation which is a very normal phenomenon with aniline dyed leather.
b) **Substance:** skin of the same area and from the same type of animal can often considerably in substance,(thickness) correct leather sorting will ensure that the various substance can be selected and allocated for different styles.
c) **Amount of stretch:** the direction of stretch does not very but the amount of stretch does zoning the tanning process the leather can be made finer or softer, which influence the amount of stretch but it is impossible to make the amount of stretch totally uniform.
d) **Grain:** the grain of the leather can vary from skin to skin even within single skins; changes in grain structure can also affect color and dyer glass.
e) **Defect and marks:** these one caused by numerous natural and man-made sources and vary widely in degree.

The sorting is done as follows

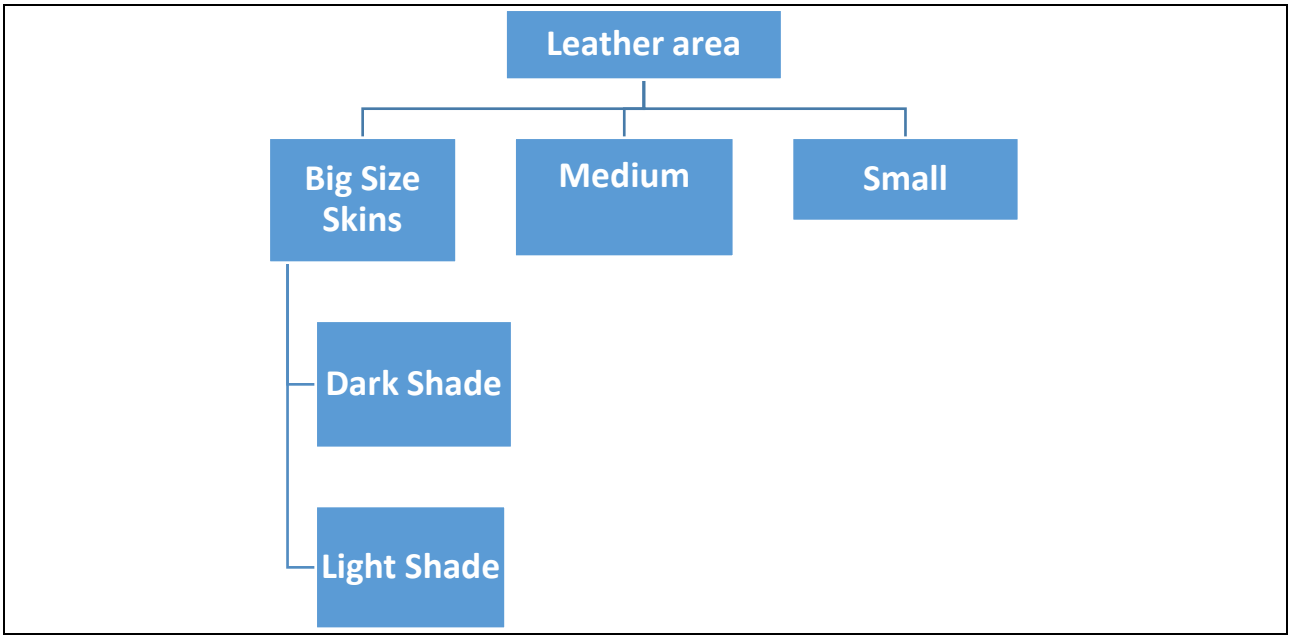

Figure 132 Sorting

Sorting of Leather Done by a Cutter (If Necessary)

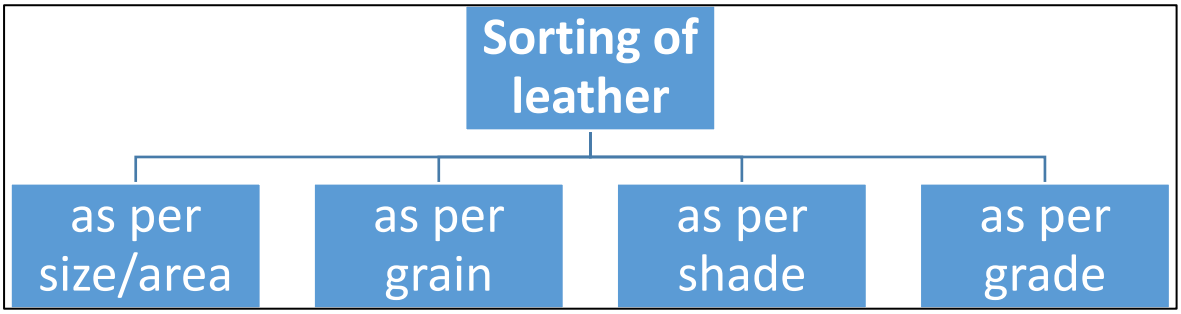

Figure 133 Sorting of Leather Done by a Cutter

Once a cutter receives material according to his ticket, he may sort skins from standard size, grain and shade. This increases his productivity.

Before starting cutting the cutter must check

- Knives and patterns
- Work tickets
- Production samples and production guide
- The perfect state of clicking dies has the important task at clicking out. At the check the clicker concentrate on
- Cutting edge quality
- Dimension (time to time the dies are checked with the master pattern in production)
- Design
- Faults

The material is put on the leather horse according to the following rules

- At first, he can put thinner leather and thicker ones are put up.
- Color shades are put from the darkest to the lightest ones step by step (for an easier pairing).
- Whole leather is over loaded at the longitudinal axis by grain up and shifted out slightly.

Self-Check 7	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

Fill in the blanks

1. The main reason for leather sorting is in order to minimize leather _____ in the same batch and to maximize _____.(2 points)
2. Sorting of leather is conduct as per the _____, _____(2 points)
3. Before starting cutting the cutter must check ----------, ----------?(2 points)
4. Leather is a ---------- and is subject to ---------- from one skin to another?(2 points)
5. Randomly the ---------- is inspected and the whole batch may be pass or fall. (1 point)
6. The grain of the leather can vary from ---------- even within single skins. (1 point)

Choose the correct answer:

7. Which one of the following is the common variation that may happen on the leathers? (1 point)

   a) Color b) grain C) substance D) amount of stretch E) all

8. Leather variation not only might happened on the same batch of different leathers, instead following may also happen on the same (one) leather: (1 point)

   a) size/area b) grain C) grade D) all

Note: Satisfactory rating – 12 points **Unsatisfactory - below 12 points**

Information Sheet 8-Demonstrating the leather bundling

8.1 Leather storage

After grading operation is completed, the skin should be stored properly. The leather received in bundles and plastic bags of max of 10 skin of the same grade should be re-bundle for storage attaching each bundle a ticket showing:

- Tannery or supplier name
- Types of leather
- Color
- Thickness
- Quantity
- Grade of leather

Roll/bundle method of leather storage: commonly leathers are stored in the roll/bundle form and 8 to 12 leathers are included in one roll/bundle. Roll method are preferable to utilize the space than stack on method .because once it is rolled/bundled it is possible to keep it on the rack so that more leather can store within the small area/space. But when we tried to store leather using roll/bundle form, we have to be take cure for the leather because grain crack and damaging might happen due to improper rolling, excess bundling of leather together and over lapping of one roll over the others. While bundling, if we use the 10 leather in one bundle, 9 leather roll inside by keeping the grain side of the leather outside and visible and the flesh side inside. The remaining one leather will be on the top of the other nine leathers and rolled in opposite form (flesh side outside and grain side by keep inside.). This leather used as a cover / wrapping leather for the other nine leathers.

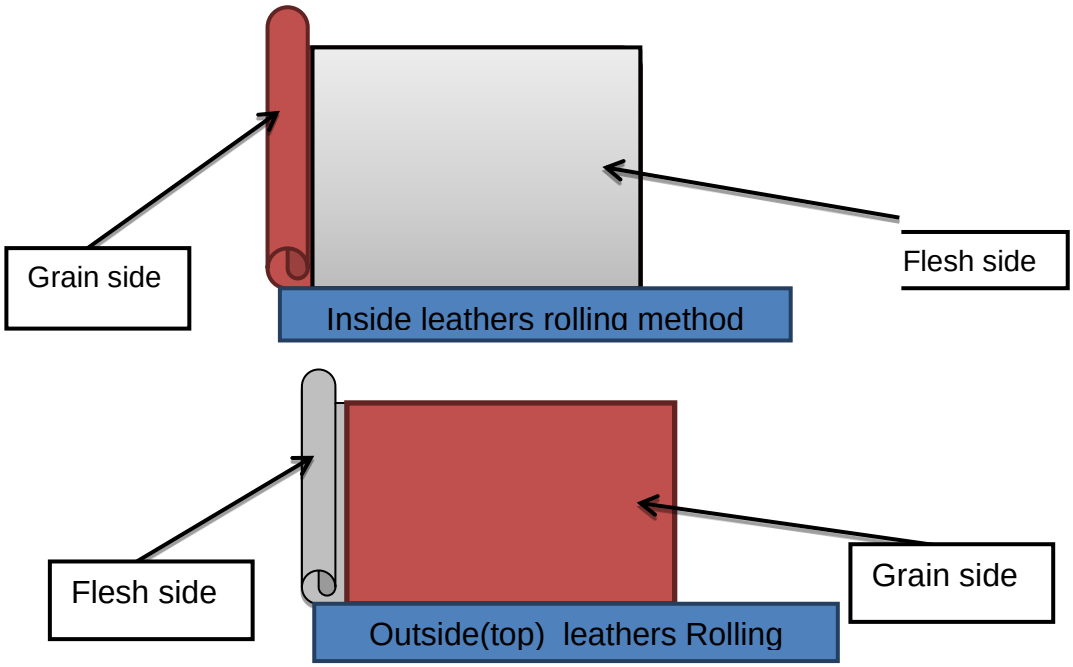

Figure 134 Leather storage

Stack on method of leather storage: this kind of leather storage system commonly applicable if the quantity of leather are few or if there is wide and enough space in the store. Stack on or flat method of leather storage is better to keep the leather safely without any kind of damage as compare to roll/bundle method. Usually sheep /goat skin are stored by this method. But if we have the space it also applicable to cow and other big types of leather. Even though there is no standard that have been set before about the number of quantity that have to be stored in stack on/flat form at a time, most footwear factories and even tanneries used to stored 120 – 150 skin/hide once.

Figure 135 Stack on method of leather storage

Avoid various factors that can affect the performance/usage of leathers and its natural property. Proper storage and handling are also including below:

- **Temperature:** most leather best stored should not be more than 10°c -20 °c temperature. Very high storage temperature may cause finish blocking and finish cracking caused by the finish adhering itself or taking the imprint of the flesh side of the text skin. Rapid decrease in temperature normally during winter nights may cause space formation. Room with external wall area the most susceptible to such temperature fluctuation and should not be used as leather store. If this is unavoidable some heating in the leather store during the winter months. This reduces the risks of finish cracking, a potential problem when unwrapping bundles of leather which have been stored at low temperature.
- **Humidity:** the ideal atmospheric humidity level is between 50 – 60% RH. Above this there likely to be an increased risks of mould growth whilst below it grain in cracking can be a problem. In addition since the grain crack resistances of the leathers are relative to its moisture content, prolonged storage in the low humidity environment tends to increase the risk of grain crankiness in lasting.
- **Lighting:** avoid strong light or direct sunlight. Prolonged exposure of leather to strong light, whether natural or artificial often leads to color changes or fading. in extreme cases it may even cause un-brittleness and loss of suppleness. As a general rule the best types of lighting to use in the skin room defuse day light or some form of relatively weak artificial light source.
- **Method of storage**: in order to minimize the risk of cracking all leather should be ideally stored flat or hung over a horse. Unfortunately, flat storage more space than is available therefore, they are stored in rolls. It is good practice to restrict the number of rolls that

are stacked one on top of other. Particularly if wire storage racks are available since these can inflict pressure marks on the bottom roll if overloaded. Also there should not be excess overlap of leather and suffocation in the store.

- **Duration of storage:** if leathers are not used immediately, it is not preferable to maintain long time stock.
- **Leather storage:** Different types of leather (in color, in types, in grain and in size) should not be stored together. Similar types of leather are preferable to keep together.
- **Proper labeling:** in order to easily identified each types of leather and to distinguish one types of leather from the others proper labeling is required. The label should include the required dates.

Problem due to improper storage and handling

- Grain crack
- Finish crack
- Fungal growth
- Color fades.

Leather labeling Include

- Color
- Leather grade
- Leather types
- Number of leather in the bundle(quantity)
- Total area in the bundle or shelf(total area/quantity)

The following data should be record in the store regarding the leather:

- Stock number
- Delivery date
- Invoice number
- Area
- Number of skin/hide
- Grade
- Supplier name
- Rate
- Issued quantity
- Received quantity
- Balance/stock quantity, etc…

Self-Check 8	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

Fill in the blanks:

1. Leather commonly stored in the factory in _____ and/or _____ forms.(2 points)
2. Avoid strong light or direct ---------- while storing the leather. (1 point)
3. Most leather best stored not be more than ---------- temperature. (1 point)
4. The ideal atmospheric humidity level is between ----------. (1 point)
5. Which one of the following is not happen due to improper storage and bundling of leather.(1points)

   A) Grain crack B) finish crack C) brand mark and scratch D) all
6. Leather labeling include:- (1 point)

   A) Color B) Leather grade C) Leather type D) All
7. The following data should be record in the store regarding the leather: (1 point)

   A) Stock number B) Delivery Date C) Invoice number D) all

True and false:

8. Stack on/flat method of leather storage is more preferable to utilize the space. (Say true or false) (1 point).
9. Roll method of leather storage is more preferable to keep lather safely and utilize the space. (Say true or false) (1 point).

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

LG #21	LO #8-Determine the use of material and accessories in footwear production

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Identifying handling and care requirements for materials
- Identifying common problems and faults of materials
- Identifying relevant OHS practices

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify handling and care requirements for materials
- Identify common problems and faults of materials
- Identify relevant OHS practices

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 1- Identifying handling and care requirements for materials

1) Leather

After the leather grading operation is completed, the leather should be stored properly. The leather received in bundles and plastic bags of maximum of 10 skins of the same grade should be rebundled for storage attaching each bundle a ticket showing tannery or supplier name, type of leather, colour, thickness, quantity and grade.

A variety of factors can affect the performance of leather during and after storage. These include:

- Temperature
- Humidity
- Lighting
- Method of stacking

Temperature

Most leather best stored at 10-20 degree Celsius temperature. Very high storage temperature may cause finish blocking and finish cracking caused by the finish adhering itself or taking the imprint of the flesh side of the next skin. Rapid decrease in temperature during winter nights may cause space formation. Room with external wall area the most susceptible to such temperature fluctuation and should not be used as leather store. If this is unavoidable it certainly wise to avoid storing skins directly adjacent to the outside wall. In addition, it is advisable to maintain some heating in the leather store during the winter months.

Humidity

The ideal atmospheric humidity level is between 50-60 RH. Above this ideal atmospheric humidity level there likely to be an increased risks of mould growth whilst below it grain cracking can be a problem.

Lighting

Avoid strong light or direct sun light. Prolonged exposure of leather to strong light, whether natural or artificial often leads to colour changes or fading.

Method of stacking

In order to minimize the risk of cracking all leather should be ideally stored flat or hung over a horse. Unfortunately flat storage requires more space than is available therefore, they are stored in rolls. It is good practice to restrict the number of rolls that are stacked one on top of other. Particularly if wire storage racks are available since these can inflict pressure marks on the bottom roll if overloaded.

2) Adhesives

To overcome all the problems in adhesive utilization, it must adopt a minimum use of adhesive or not using policy, so that the final shoe can be made technically sound. This system of upper making will make the shoe more competent in the market. Following points are also to be kept in mind during use of adhesive in upper closing room:

- Latex should not be used on greasy leathers and PVC, as it does not make bond with them.
- Natural rubber solution can be used for folding and attaching lining with the upper.
- Hot melt polyamide adhesive is used in thermo folding machine.
- Pot life and shelf life must be checked before buying the adhesive.

Factors affecting selection of adhesives are described as follows:

1	Safety	Whether flammable/non-inflammable; whether vapors harmful for inhalation, skin protection
2	Application	Hand (brush); machine; roller; spray-gun
3	Drying Time	Quick; Slow
4	Tack Retention Time/Open Time	Time available to make bond after drying
5	Shelf Life	The length of time an unopened package of adhesive can be expected to remain in usable condition under specified conditions of temperature and humidity.
6	Pot Life	Length of time, it can be used after opening of the container
7	Type of Stick	Dry; wet; self adhesive; heat & pressure
8	Compatibility	With materials to be bonded
9	Final Bond Strength	Permanent/Temporary; Flexibility; Resistance to heat/moisture
10	Cost	Low; High
11	Storage	Temperature conditions

3) Finishing Material

Shoe polish-usually a waxy paste or a cream, is a consumer product used to polish, shine, waterproof, and restore the appearance of leather shoe thereby extending the footwear's life.

Various substances have been used as shoe polish for hundreds of years, starting with natural substances such as wax.

Shoe polish is usually flammable, can be toxic, and, if misused, can stain skin. It should be used in a well-ventilated area.

Shoe polish is applied to the shoe using a rag, cloth, or brush. Shoe polish is not a cleaning product, and therefore the footwear should be both clean and dry before application. A strong rubbing action to apply the polish, followed by further buffing with a clean dry cloth or brush, usually provides good results.

Another technique, known as spit-polishing or bull polishing, involves gently rubbing polish into the leather with a cloth and a drop of water or spit. This achieves the mirror-like, high-gloss finish sometimes known as a spit shine.

4) Chemicals

Chemicals are a part of everyone's life. There are five to seven million different chemicals known in the world. At the first 400 million tones of chemicals are produced worldwide each year including agricultural chemicals, food additives, pharmaceuticals, fuels for power production, chemical consumer products, etc.

The frightening reality is that for the vast majority of the chemicals used and being developed, little or nothing is known about their possible immediate or long-term or uses them at work. Yet workers continue to be required to work with potentially toxic (poisonous or harmful to the worker) substances. In some countries, workers are required to work-with little or no protection- with chemicals that are known to be hazardous to human health. Workers in some developing countries are often required to work with toxic chemicals that have been banned in developed countries because of their hazardous effects.

In most developed countries, workers using those same chemicals dress up almost like spacemen in protective clothing to avoid contamination from the chemicals, and are provided with washing facilities and regular medical checkups.

Though each chemicals is not necessarily hazardous to human health, one must be aware that the inherent source of the hazard can be either the chemical itself, any emission generated during the use or handling of the chemical (e.g. vapors, fumes, effluent) or the containers used for storage and transport of these chemicals.

The impact of such exposure can range from temporary effects such as dizziness, headache, irritation of eyes, skin or lungs, allergic reaction, collapse due to lack of oxygen, poisoning of liver, kidney, nervous system to long term impairments such as ulcer, bronchitis, genetic defects and, in some rare cases, even instantaneous death.

Besides the adverse effects on the human body, chemical can be the sources and the cause of fire, corrosion and damage to structures and electrical installations and may have harmful effect on the surrounding environment when released in an uncontrolled manner.

Chemical can enter the body by:

- Inhalation through the lungs
- Absorption through the skin
- Ingestion through the mouth

Note: exposure to toxic substances in the workplace can also lead to higher accident rates. It is important to learn about the substances you work with, make sure the proper control measures are in place, and to know your rights.

Note: to prevent bringing workplace chemicals home to your family, wash/shower and change your clothes when necessary before you leave work. Leave your dirty clothes at work. If you must wash them at home, wash them separately- never with the family wash!

Tips for control of chemical hazards:

- To find out and effectively manage the inherent hazards of chemicals, the first and most important step is collecting information. Immediate sources of information are labels on chemical containers, chemical danger signs and chemical safety data sheets.
- Do not use new chemicals until you have obtained the above information on the chemicals.
- No chemicals should be brought into the tannery, if these are not properly labeled or marked.
- Avoid chemical exposure of workers whether through inhalation, ingestion or skin contact!
- Eliminate hazardous chemicals and processes.
- Generally good house keeping practices such as regular cleaning of work areas, floors, walls and machines, removal of waste and adherence to safe storage and handling practice reduces the number of potential pollutant in the work place.
- Reduce the number of workers in areas with hazardous chemicals.
- Limit access to areas where hazardous chemicals are like to be present.
- Use personal protective equipment.
- Wherever it is impossible to prevent personal exposure to chemicals and pollutant at levels at which there is no hazard to health, personal protective equipment must be used.
- Ensure good personal hygiene of workers.
- Store chemical safely.
- No smoking and use of open fire in chemical stores.
- Find the right storage space for chemicals.

- Avoid storage of chemicals directly on the floor.
- Transfer of chemicals from chemicals containers.
- Always add acid to water, not water to acid!
- Do not let the waste containers be used for storage of drinking water or food grains!

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Test I: Short answer questions: (Total points: 8)

1. List out the various factors that affect the performance of leather while storage. (2 points)
2. What is the problem of exposing leather to strong sun light? (2 points)
3. Define factors affecting the selection of adhesives. (2 points)
4. Define the ways that chemicals can enter the body. (2 points)

Note: Satisfactory rating – 8 points **Unsatisfactory - below 8 points**

Information Sheet 2-Identifying common problems and faults of materials

6.1 Identifying common problems and faults of materials

Leather is a natural product, which is derived from the raw hide and skin of the animals. We all know that Hide is the outer covering of animal of large skins e.g. cow, buff etc. whereas, skin is the outer covering of animals of small species e.g. goat, sheep etc. A hide is normally divided into two parts through the backbone for convenience in handling. Each part is called a side.

A large proportion of the hide or skin coming to the tannery are full of defects and they are either unusable or it is very costly for shoe manufacturers to use them. The tanner therefore, endeavors to improve the quality by eliminating or rendering these defects by a procedure called “Correcting the grain side”.

Defective portion is removed partly by snuffing (rubbing with fine emery paper) and then finished and plated at high temperature & pressure to give it a good appearance. This leather whose grain side is corrected by snuffing & plating is called **“Corrected Grain Leather”**. Corrected grain leathers are available in various forms depending on the plate that has been used i.e. smooth corrected grain, hair all printed, printed milled etc.

Defects that can be found in the finished leather can be classified into two basic groups. These are natural and man made defects. Some of the **natural defects** are vein marks, growth marks, tick marks, warble-fly marks and etc. while **man made defects** are brand marks, barbed wire marks, flay cuts, flesh cuts and etc. From these defects, mostly the man- made defects affects the quality and cutting value of the leathers. Some of the common leather defects are listed below:

a) Looseness

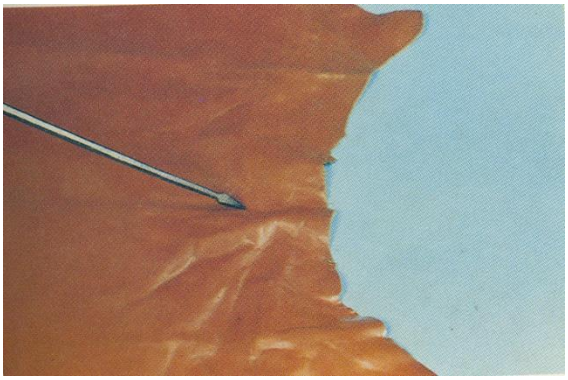

Figure 136 Loose flanks

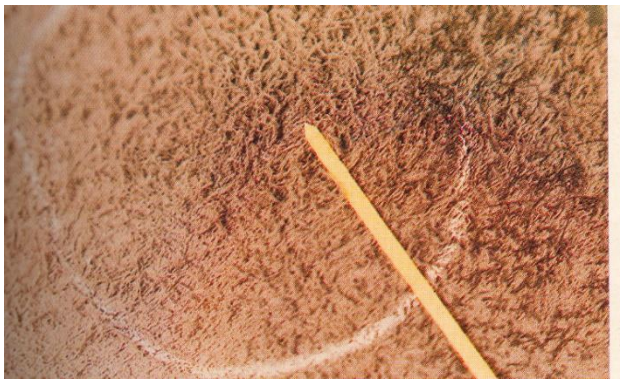

Figure 137 Loose fibers

b) Poor Thickness

Thickness of the leather is measured to ensure skin supplied of the expected thickness**.**

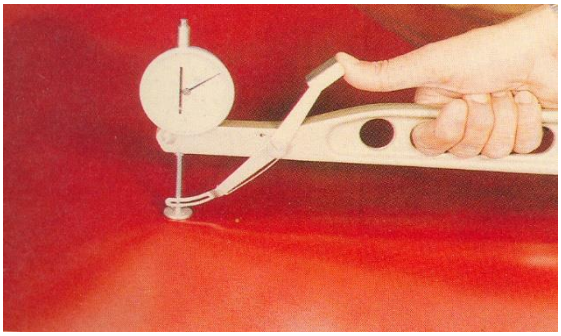

Figure 138 Thickness measuring

c) Pipeness

Figure 139 Pipeness

d) Scratch marks

Figure 140 Scratch marks

e) Scar marks

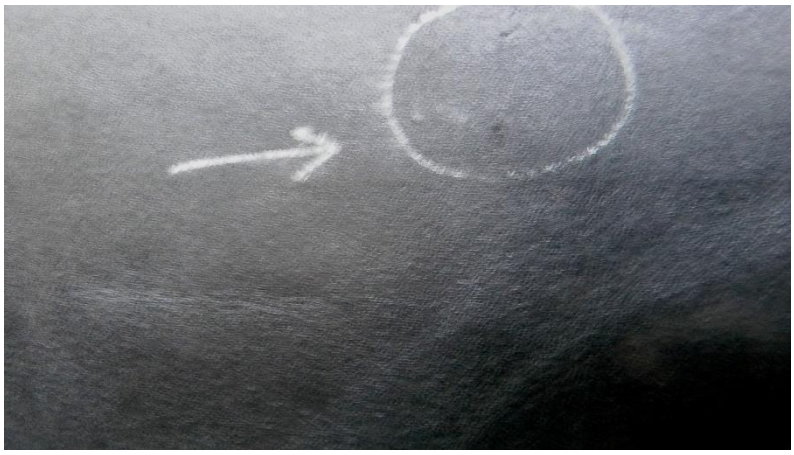

Figure 141 Scar marks

f) Brand marks

Figure 142 Brand marks

g) Flay cuts

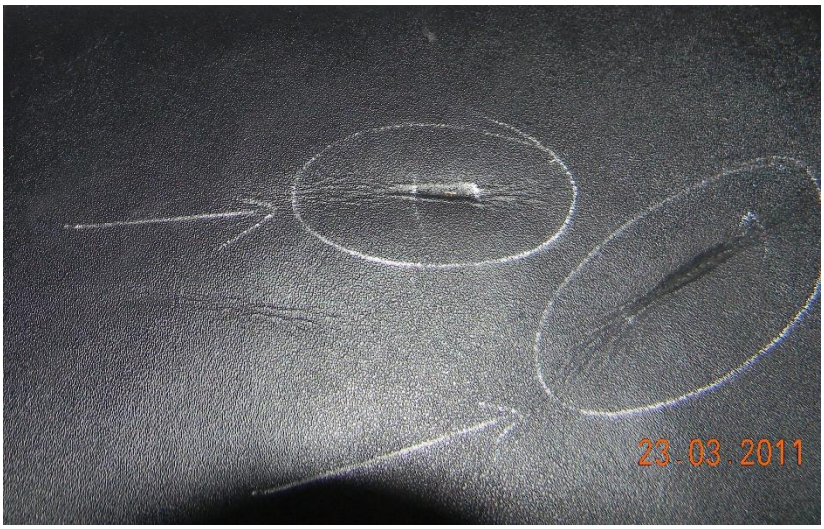

Figure 143 Flay cuts

h) Cracking or Grain Cracking

Double fold leather at least 4 places per hide to see whether there is any tendency of pigment and or grain cracking.

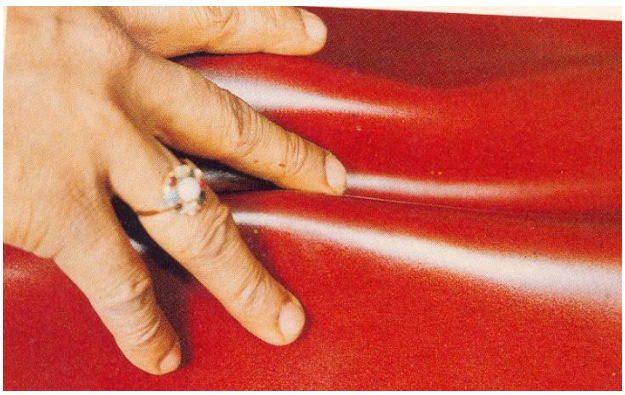

Figure 144 Grain cracking

i) Bleeding

It is the diffusion of uncombined materials from the interior of leather to the grain surface where they may contaminate other materials or mar the appearance of the leather. This usually occurs at elevated temperatures and is commonly designated as staining.

j) Tearing

In the butt region, we make a half inch cut from an edge with a scissor. By holding leather on two sides of cut with thumb and a finger we try to tear it further. If it tears easily the lot is not acceptable. That is, it fails tear strength.

k) Warble hole

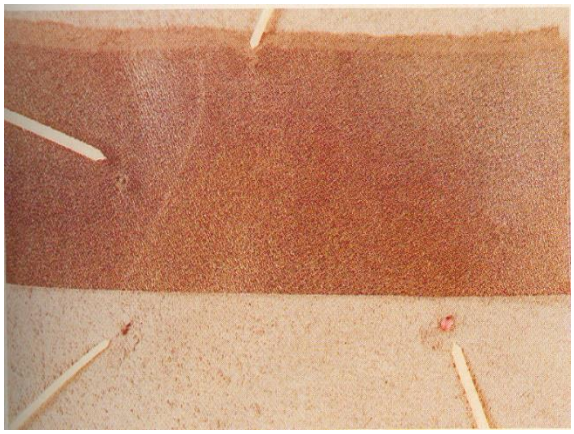

Figure 145 Warble hole

l) Tick mark

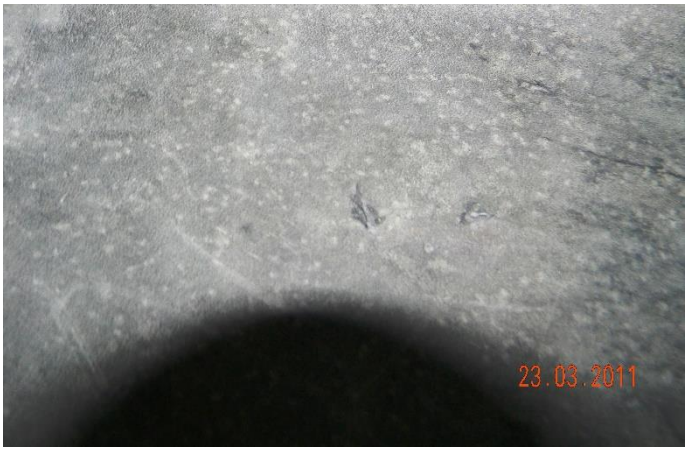

Figure 146 Tick mark

m) Growth marks

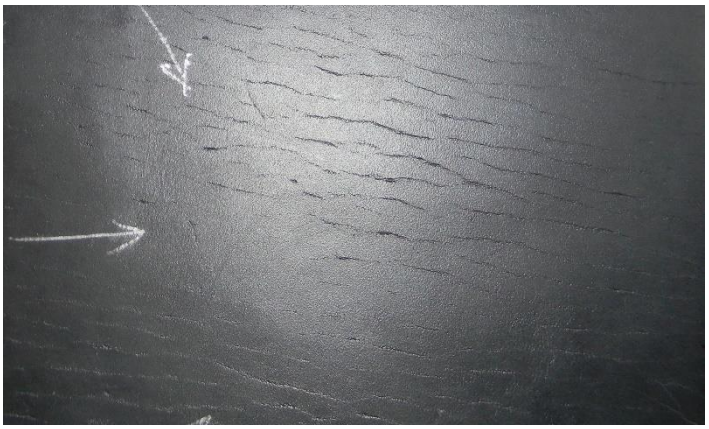

Figure 147 Growth marks

n) Vein marks

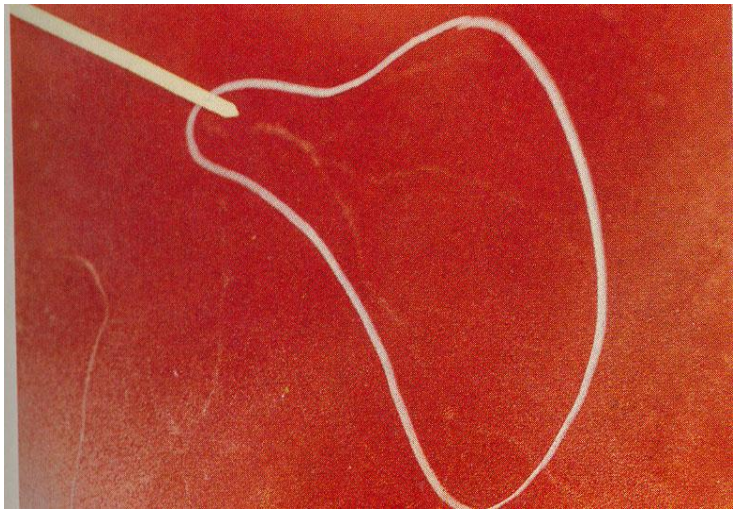

Figure 148 Vein marks

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Test I: Short answer questions: (Total points: 10)

1. What is leather defect? (2 points)
2. What are the two groups of defects that are found in finished leather? (2 points)
3. List the different types of leather defects. (2 points)
4. List natural defects of leather? (2 points)
5. List man-made defects of leather? (2 points)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

Information Sheet 3-Identifying relevant OHS practices

3.1 Identifying relevant OHS practices

Occupational health and safety (OHS) is a discipline, which aims at:-

- The promotion and maintenance of the highest degree of physical, mental, and social well being of workers in all occupations;
- The prevention among workers of adverse effects on health caused by their working condition;
- The protection of the worker in their employment from risks resulting from factors adverse to health;
- The placing and maintenance of workers in an occupational environment adapted to physical and mental needs.

In other words, occupational health and safety encompasses the social, mental and physical well-being of workers, that is the “whole person”

The definition of occupational health and safety given above encompasses both health and safety in their broadest contexts.

Poor working conditions can affect the environment workers live. This means that worker, their families, other people in the community, and the physical environment around the workplace, can all be at risk from exposure to workplace hazards.

In many countries, chemicals are dumped into the environment, often with serious human and environmental consequences. The laws about chemicals disposal in other countries are strict, to protect both people and the environment.

1. Adhesives

Adhesive is a useful material during shoe making but it may be harmful for factory mankind in case of negligence and safety precautions are not taken care during its use. Therefore

we should follow certain safety measures during using the adhesive and checklist has to be made for proper application of such chemical fluids.

For the safety of the operator:

- Wear appropriate footwear and clothing while using it in the workshop.
- Wear a hair band or tie your hair back in case of hair longer than shoulder length.
- Adhesive should not come in the contact of skin, but in case of emergency use hand gloves during manual application of adhesive.
- Avoid wearing loose clothing during machine operation.
- Use proper ventilation/exhaust system near the adhesive application station.

Safety points during machine operation:

- Sit squarely on your chair within reach of the material and m/c controls.
- Your thighs should be parallel to the floor when seated.
- Keep your fingers and yourself away from moving parts of the m/c.
- At a time, one operator in m/c.
- In case of an accident, no matter how minor, report it to your supervisor.
- Know your fire drill.
- Do not try to make your own electrical repairs.
- Do not push the work through your hands; let the m/c feed the work.

For the safety of the m/c:

- Proper cleaning, oiling and covering of the m/c.
- Thorough knowledge of m/c prior to operating them.
- Instructions to be properly followed.
- After finishing off with the work switch off the machine and raise the pressure assembly or put a piece of material beneath it.
- Check for any looseness in the screws of the machine.
- Ensure that proper setting and adjustment of certain parts has been done.
- Check for enough polyamide granules in thermo folding machine.
- In case of spray gun, set it for proper pneumatic pressure and nozzle flow.

As different types of material is being used by footwear industry, resulting various complications during adhesive selection. One should be extra cautious while selecting particular adhesive for particular material. For example water based adhesive is not suitable for oily kind of leather.

A lot of application of adhesive should be avoided during upper closing, therefore it is advisable that one should use less adhesive while attaching the two or more components together. More use of adhesive can lead following question marks:

- Wastage of adhesive.
- Creates problem during making & stitching.
- Makes the upper more stiff & rigid.
- Stiffness affects the flexibility while walking.
- Increases the weight of the shoe.
- Upper surface becomes hard, leads uncomfortable walk.
- Increase the operation & material cost.

2. Primers

Storage of primers

The main purpose of the primers is to help chemically activate that outer layer of the upper material and the sole, where the film of adhesive would be applied and bonded together.

The expected shelf life of primers commonly in use is as follows:

Primer	Shelf Life
Lacsol	6 months
Satreat	3 months unopened.1 month opened
Super Satreat	2 months unopened.1 month opened
SAT EVA Primer	6 months
Isocyanate wipe (SDP 102	1 to 2 weeks

Figure 149 Expected shelf life of primers

The shelf life of any product is that span of time from the date of manufacturing to the date of expiry as indicated by the manufacturer of that product.

Once a stock container has been opened, the shelf life may be reduced. If a primer shows signs of deterioration e.g. sediment or undue discolorations, do not use.

Halogenations primers such as Satreat should be kept in black polythene containers with the caps firmly screwed on to avoid degradation by exposure to sunlight or uptake of moisture.

The physical and the chemical treatment of the sole and the upper material are to be done before the adhesive is applied to either of them. The adhesive applied (shown in the table) should be compatible to both the surfaces. Enough time is then given to each one of them for drying (either in normal conditions or by forced drying). After that proper activation time

and temperature should be given to heat the adhesive film on the upper and the sole so that proper and efficient bonding takes place**.**

Priming of sole:

Florescent chemicals visible in UV light must be added to primers and each pair sole must be checked under UV light sole that it's correctly primed. UV chamber may be used to check correct application of primers.

Small amount of primer should be taken out from the main bottle or container at a time. The container should not allow any light to reach the primer.

Correct amount of powder provided by supplier must be mixed according to instruction. Everyday new primer mixture should be used.

3. Finishing materials

When we address healthy and safety aspects in finishing, it is more related to the use of finishing materials at work place (solvent /chemicals).

The effects of solvents can be acute or chronic depending up on the concentration and length of exposure to the body. More effects are irritation and allergic reaction to skin, eyes and respiratory tract.

Solvents in the work place are major fire and explosion hazards. The improper storage, handling or transport may result in minor fire to major disaster resulting in loss of human life.

Fire in principle needs three elements to survive: fuel, heat and oxygen. To check any fire hazards these elements should be controlled.

In this respect we can classify the chemicals used in finishing department in two categories:

- Water based products: there is no risk of flammability during drying or application but some of the residues may ignite if exposed to a naked flame. Soil deposits must be disposed off correctly.
- Solvent based products: most of them contain low flash point solvents and they will ignite instantly if come in the contact of naked flame or a hot surface. Safety precautions must be respected.

Principle of prevention

The following are basic principles of operational control:

- Eliminate the hazards(replace as far as possible, solvent based chemicals to that of water based)
- Put a distance/shield between the solvent and worker.
- Provide general and local ventilation
- Protect the workers by using personal protective equipment like dust mask respiratory, protective goggles, gloves.
- Spillage, disposal, cleaning. Major spillage of solvent products should be immediately soaked by dust or sand to prevent spreading and in particular to avoid contaminating drains.

Factors Affecting Selection of Adhesives:

1	Safety	Whether flammable/non-inflammable; whether vapors harmful for inhalation, skin protection
2	Application	Hand (brush); machine; roller; spray-gun
3	Drying Time	Quick; Slow
4	Tack Retention Time/Open Time	Time available to make bond after drying
5	Shelf Life	The length of time an unopened package of adhesive can be expected to remain in usable condition under specified conditions of temperature and humidity.
6	Pot Life	Length of time, it can be used after opening of the container
7	Type of Stick	Dry; wet; self adhesive; heat & pressure
8	Compatibility	With materials to be bonded
9	Final Bond Strength	Permanent/Temporary; Flexibility; Resistance to heat/moisture
10	Cost	Low; High
11	Storage	Temperature conditions

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Test I: Short answer questions: **(Total points: 10)**

1. Define OHS (occupational health and safety). (2 points)
2. What will happen if follow poor working condition in working area.(2 points)
3. State safety consideration while using adhesive. (2 points)
4. It is advisable that one should use less adhesive while attaching two or more components together. Why? (2 points)
5. State basic principle of operational control for using finishing materials. (2 points)

Note: Satisfactory rating – 10 points **Unsatisfactory - below 10 points**

LG #22	LO #9. Determine performance of materials for footwear

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Identifying physical properties of materials
- Identifying and describing performance characteristics of materials
- Describing types of surface finishes used on materials

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify physical properties of materials
- Identify and describing performance characteristics of materials
- Describe types of surface finishes used on materials

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks

Information Sheet 1-Identifying physical properties of materials

1.1 Identifying physical properties of materials

For more understanding of this information sheet refer to learning guide on information sheet 2.

Leather

For making footwear, leather is being replaced nowadays by varieties of synthetic materials available in the market due to the cost factor. But leather is still the most suitable material for making footwear and is superior to synthetic leather or any other leather substitutes.

The leather is fibrous in nature and due to this it can perspire giving the feet extra comfort. Also, the leather has got poor thermal conductivity, keeping the wearer cool in the summer heat and warm when it is cold. The elasticity and plasticity of leather allows it to adjust individual foot shape. The tensile strength, bursting strength, tear strength, flexing endurance, shrinkage temperature etc. are also observed to be considerably high when compared to synthetic materials.

Additionally, the leather is repairable and eco-friendly justifying its suitability as the best material. The structure of hides and skins and the tanning methods involved determine the actual properties of the given leather.

Suitability of leather for upper materials is due to its:

- Elasticity and plasticity
- Strength and stretch
- Permeability
- Surface characteristics
- Ease of working and maintenance

Adhesives

For a material to perform as an adhesive it must have four main requirements:

- It must "wet" the surfaces - that is it must flow out over the surfaces that are being bonded, displacing all air and other contaminates that are present.
- It must adhere to the surfaces - That is after flowing over the whole surface area it must start to adhere and stay in position and become "tacky".
- It must develop strength - The material must now change its structure to become strong or non-tacky but still adherent.

Textile

Textile (fabric) is the term describes any woven or non-woven or knitted materials. Textile (fabric) derived from Fibers. Fibers may be of natural or synthetic (man-made) origin e.g. cotton, wool, silk, jute are the natural fibers whereas, nylon, viscose, Orion etc. are the synthetic fibers. Fibers are produced either as staples or filaments.

Fabrics and other man-made materials are now being used more and more in shoemaking. Brocades have been used in footwear for hundreds of years, but today a wide range of fabrics and non-leather materials enters into the construction of all types of footwear. Textiles in all the well-known natural synthetic categories are specially produced to meet the particular needs of the shoe industry.

Steel Shank

The Shank is a metal strip that forms a part of the insole. It maintains the longitudinal arch of the foot. Generally shank is made of high grade carbon steel which is properly tempered in order to impart the required material properties. In ladies high heeled shoes, the shank is shaped in such a way that it extends into the heel. Dimensions of typical shank are 10 mm width x 1 mm thickness and length of 85, 95, 105 mm as per size of footwear. There are various material used for making shank.

Metal: are manufactured from steel. Two thickness of steel are commonly used 1.2 m.m. and 1.42 m.m, the first being the more common. These are available in two widths: 9.5 m.m. and 12.7 m.m. although other widths and thickness are used.

Shank length (m.m.)	Minimum Total Shank Depths (m.m) for:	
	9.5 mm wide shanks	12.7 mm wide shank
Less than 50	2.18	1.22
50-74	2.82	2.18
75-99	3.40	2.82
100 and over	Not recommended	3.45

Figure 150 Steel shank

Wood: wooden shanks are not as strong as steel shank. But they are light in weight. Bamboo shanks are also used for a low heel shoes. In welted footwear a special board wooden shank is used which ultimately covers the space between welt ribs, doing an important job both filler and a shank. Wooden shanks are skived to give a tapered edge at each end and along the side.

Plastic: the plastic shanks are the edition among the shank materials. It is generally used for the PVC unit soles. The shanks are made from polystyrene or polypropylene injection moldings. It is hard plastic but less inflexible than wood or steel shank.

Soling material

The ideal qualities for a soling material are as follows:

- Durability
- Flexibility
- Water proof
- Lightness in Weight
- Slip resistant
- Uniformity/Dimensional stability
- Cement holding
- Temperature resistant
- Stitch / Tack holding

Testing of soling materials

It is obvious that soling material possess some basic requirements in order to make them suitable for soling purposes. Testing is done to evaluate the required properties and to ensure the fitness for use. Very common tests are essential in case of soling materials are:

- General state of soling
- Flex crack resistance
- Abrasion resistance
- Dimensional stability
- Sole adhesion
- Slip resistance

- Durability

General state of soling: Soling materials are to have some basic properties like light weight, flexible, offer adequate strength, water resistance etc. Those are very common responsible factors for selection to solve the purpose as well as to feel comforts. To evaluate them following are very usual tests. (a) Hardness/Softness (b) Density (c) Tensile strength (d) Water proofness (e) Water absorption

Flex crack resistance: The shoe is repeatedly subject to compression forces and flexing deformation at each step during walking. The area gets increased when it is bending during stepping and comes to the normal state when the step is completed. The sole should posses adequate flex resistance to prevent from flexing deformation**.**

Abrasion resistance: The sole as the bottom surface of the shoe is in continuous friction with the ground under body pressure during walking. It can be abraded of gradually by reducing its volume by contact area. Such abrasion may be quiet significant or quiet justify.

Mensional stability: The shoe while in wear is subject of repeated compression forces, which may spread cellular soling material and thus make the sole deformed and ugly. To evaluate this property some sort of testing is carried out which are (a) Compression set (b) Heat shrinkage (c) Shrinkage due to all change in moisture content

Sole adhesion: It is one of the very important properties of the soling materials that it should readily stick on to the upper with a permanent strong bond to avoid bond failure during wear. The sole adhesion and bond strength depend upon various factors like type of material, type of adhesives quantum of pressure, heat reactivation, temperature and preparation of soling upper.

Slip resistance: Slip resistance is expressed as coefficient of friction which is obtained numerically by dividing the horizontal force required to cause slip by a vertical force applied on a material.

Durability: Durability of soling material in a combination of property such as abrasion resistance, hardness, stress applied, and density of the soling material. All these characteristics can influence the tear and wear resistance or as such durability.

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Test I: Short answer questions: (Total points: 8)

1. Write down the physical properties of the following footwear materials. (2 points each)

- Adhesive
- Soling materials

2. List the materials used for shank making. (2 points)
3. Why leather is suitable for upper making purpose. Write down four points. (2 points)

Note: Satisfactory rating – 8 points and above Unsatisfactory - below 8 points

Information Sheet 2- Identifying & describing performance characteristics of materials

2.2 Identifying & describing performance characteristics of materials

Incorrectly, fitting footwear is common in problem and is strongly associated with forefoot pathology and foot pain. Wearing shoes that fit properly and support your feet is vital to avoid sore feet and to prevent or alleviate many common foot problems. Footwear can help sore feet by providing support, such as lace-up boots. Arch supports help distribute weight and remove pressure from the heel and forefoot. High-heeled shoes (high heels) place stress on the body and feet and can cause calluses, bunions, claw toes and corns.

Footwear that fits poorly or is in need of repair also contributes heavily to foot discomfort. Pointed toes and high heels are particularly inappropriate for working footwear.

Prolonged standing, hard flooring and inappropriate footwear are common working conditions. Are there jobs that are safe for feet? Statistics show there are not, really. Among teachers and workers in clerical occupations that belong to "safe" jobs, foot injuries account for from 15 percent to more than 20 percent of all disabling injuries. Not knowing about the need for foot protection in workplaces like schools or offices can play a role in the onset of foot problems.

Some of the effects of poorly made footwear are mentioned as follows.

- shape loss
- Problem in walking
- Foot Injury
- Pain in feet

In designing strategies to protect foot injury, one has to remember the fundamental principle of occupational health and safety: that occupational hazard should be eliminated at the source. The role of personal protective equipment is to minimize exposure to specific occupational hazards, not to eliminate them. Protective footwear does not guarantee total protection.

All workers should wear adequate protection against workplace hazards. For workers exposed to foot hazards, the required protection is protective footwear

All working footwear, for both men and women, whether it is safety wear or not, should provide comfort without compromising protective value. A steel toe cap should cover the whole length of the toes from tips to beyond the natural bend of the foot. A soft pad covering the edge of the toecap increases comfort. If the toecap cuts into the foot, either the size or style of the footwear is incorrect.

Soles come in a variety of thicknesses and materials. They need to be chosen according to the hazards and type(s) of flooring in the workplace.

Uppers of protective footwear come in a variety of materials. Selection should take into account the hazards, and individual characteristics of the worker's foot.

A steel midsole, which protects the foot against penetration by sharp objects, should be flexible enough to allow the foot to bend.

No one type of non-slip footwear can prevent the wearer from slipping on every surface type.

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Test I: Short answer questions: (Total points: 6)

1. Define effects of poorly made footwear. (2 points)
2. Define the causes of poor shoe fitting. (2 points)
3. Discuss the solution for the causes of poorly made foot wear. (2 points)

Note: Satisfactory rating – 6 points and above **Unsatisfactory - below 6 points**

Information Sheet 3-Describing types of surface finishes used on materials

3.1 Describing types of surface finishes used on materials

Introduction

Leather can be classified into different categories based on the origin (type of animal) appearance of grain, sometimes tanning also and finishing. Another very important classification is done on the basis of finishing. The types of surface finishes used on leather are listed as under:

Velvety

Nubuck, suede, split suede and reverse side suede comes under this category. The leather is given a velvety look either on the grain side or flesh side by buffing (rubbing by course emery paper) or snuffing (by fine emery paper). In this process small fibres called naps are raised on the surface which gives a velvety look.

Nubuck

In Nubuck leather, the grain side of the leather is made velvety by snuffing. This leather has got a very good writing effect.

Writing effect is the effect caused due to raised naps on the surface. When we apply our finger on the surface we get finger marks on the leather. This effect is called writing effect.

Note: Buff Nubuck has low writing effect.

Suede: If the grain side is having more deep defects, the flesh it is made velvety by buffing the flesh side. This leather is called Suede.

Split Suede: If the leather is made velvety by buffing the flesh surface in case of split leather, it is called Split suede. The suede effect on split leather can be obtained on both the sides and this leather can be utilized from both the sides.

Glazed

It is type of finish; the glazing effect is obtained by glazing machine. Compactness of grain is required to sustain the high temperature and pressure of the machine.

Oil-pull up

It is carried out on full grain leather (partially snuffed). The pull-up oil (free oil) is well sprayed with the season and finally the oil is sealed inside by top coat permitting the oil to move freely inside, responsible for color change when pulling the leather.

Patent

Basically it is a PU finish in which a special type of curtain coater machine is utilized. The finish film thickness is restricted to be less than 0.15mm. The mirror like appearance is the unique feature if this finish.

Embossed

The leathers are embossed in order to hide some defects or to create a particular appearance and surface effect, such as reptile embossing etc.

This is a type of corrected grain finish, the closed defects are covered by repeated coating of season and pressing on hydraulic press, finally plain plating is done to get smooth finished surface effect.

Film coated

A PU coated leather is a type of leather with a thick film of PU laminated on it. This leather does not have breakability like leather because of thick PU film.

PU film coated leather is either a split or sometimes, a grained leather with a very thin film of PU laminated on it. This leather is made breathable.

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Test I: Short answer questions: (Total points: 12)

1. Define the following types of surfaces finishes on leather. (8 points)
    - Glazed
    - Patent
    - Film coated
    - Embossed
2. Briefly explain what types leathers are come under the velvety category. (2 points)
3. What is the difference tween suede and split suede? (2 point)

Note: Satisfactory rating – 12points **Unsatisfactory - below 12 point**

Reference

1. TTLM of footwear level one on os Version 4January 2012 IND BFP1 TTLM 0212v1
2. Galenleather.com/bog
3. TTLM of footwear level two on (OS)Version 4January 2012 IND FP2 TTLM 0212v1
4. www.geine leather , hhh.leather

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Experts Who Developed this Learning Guide

No	Name	Educational Background	Region	E-mail	Remarks
1	Asnakech Lakew	BSC in Garment Technology	Oromiya, Bishoftu TVET College	asnakech2013@gmail.com	Learning Guide Developers Team Members
2	H/Gebriel Abebe	BSC in Leather and Leather Products Technology	Addis Ababa, Misrak TVET College	haile30@yahoo.com	
3	Kibreab Daniel	BSC in Footwear and Leather Goods Manufacturing Technology	Addis Ababa, Leather Industry Development Institute	12kibreabdaniel@gmail.com	
4	Melaku Abebayehu	BSC in Footwear and Leather Goods Manufacturing Technology		melakuabebayehu12@gmail.com	
5	Shambel Alemayehu	MSC in Footwear Technology		shambelalemayehu@gmail.com	
6	Yonas Tefera	MA in Curriculum and Instruction	Addis Ababa, LIDI	yonast2025@gmail.com	Learning Guide Development Coordinators
7	Romian Anbessie	BSC in Garment Technology	Oromiya, TVET Bureau	romianbesie@gmail.com	
8	Tigist Kebede	MA in TVET leadership and Management	Addis Abeba, Federal TVET Agency	tgkebede27@gmail.com	
9	Fitsum Tilahun	BSC in plant Science		tilahun.fitsum@gmail.com	
10	Workneh Asmamaw	MSC in Food Security and Development		workasmamaw@gmail.com	
11	Muluken Kassahun	Electrical and Electronics		mulak.last@gmail.com	