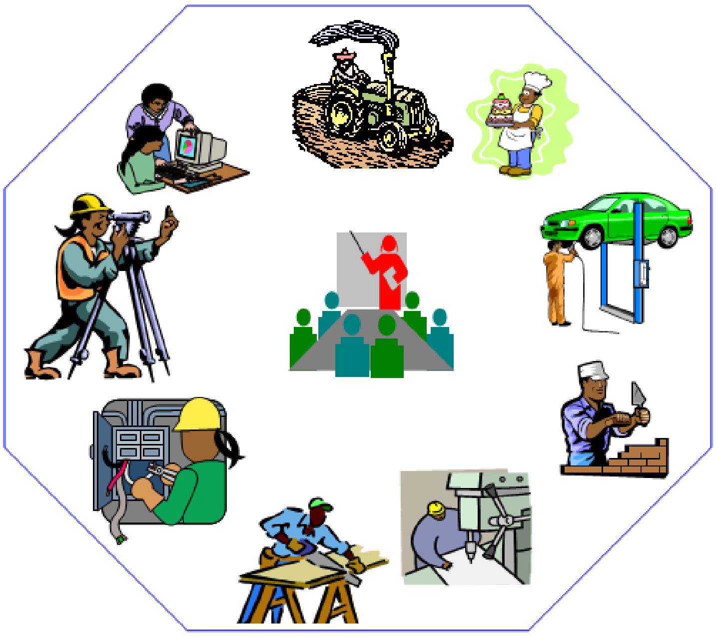
Footwear Production Supervision

Level IV

Based on November 2019, Version 5 Occupational Standards and February 2020 version 1 Curriculum



Module Title: Performing Footwear and Material Testing

LG Code: IND FPS4 M06 LO (1-5) LG (31-35)

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LG #31	LO #1- Identify testing of materials and quality

Instruction sheet

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

- The Fundamentals of the Quality of the Products
- The Purpose & need for the Product Conformity
- The importance of the raw material testing & relationship with the product performance
- Types of Tests Conducted on the different Materials Related to the Footwear
- Importance of Accuracy of the Results

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

- Identify the fundamentals of the quality of the products
- Identify the purpose and need for the product conformity to standard testing manuals
- Describe the importance of raw material testing and establish the relationship with the product performance
- Explain types of tests conducted on the different materials related to the footwear
- Explain importance of the accuracy of the results

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". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished

answering the Self-checks).

6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- The Fundamentals of the Quality of the Products

1.1 Introduction to quality

The dictionary meaning of Quality is "Degree of Excellence". Quality is the totality of the features and characteristics of a product that bear on its ability to satisfy the stated or implied needs.

Quality can simply be defined as "Conformance to Requirements". Quality is not absolute. It is relative to other goods and services.

Quality changes with time and customer's perceptions.

In order to have a requisite quality, a product has to meet the need of the application. The need or requirement when quantified becomes specification of a product.

Quality consistency requires us to concentrate on the process rather than on the product alone.

1.2 Keys to a good quality system:

- Commitment to quality must begin at the top of the organization.
- There should be a clear company vision for quality and its business value.
- It is important to have a clear documented company policy on quality and ensure that this is available to all employees.
- Everyone must know what to check and how to check.
- Make specifications clear to the supplier at the time of ordering material
- Check all inputs materials
- For quality/ quantity do not dilute the quality/quantity do not dilute the standards.
- List major and minor defects and display these.
- When a mistake occurs look for corrective and preventive action
- Corrective Action - Immediate action taken to solve problem
- Preventive Action - Steps taken to prevent a recurrence of the problem.
- Keep a defect file as a learning system.
- Clearly fix responsibility for quality in each department.
- Quality cannot be controlled at the end of line. It must be built into the system.
- Continuous improvement in small steps is the key to success.
- Have a good monitoring system.

- The policy should be to, "Do it right the first time".
- Companies must invest in training, special purpose machines, design and research to improve quality "
- An open mind is essential to build a quality culture.
- In a good organization, each error is part of training and learning. The key to success is to ensure that a mistake is not repeated again in the organization.
- Team work is the key to quality.
- Good housekeeping is important for good quality.

1.3 Inspection

The process of quality checking is inspection. The inspection segregates "Confirming and Non-conforming products". Non-confirming products mean failure to meet supply commitments, leading to customer dissatisfaction and increased cost of production due to rework, scrap.

Inspection is the most common method of attaining standardization, uniformity and quality of the product and workmanship. It is the art of controlling the product quality after comparison with the established standards and specifications. It is a function of quality control. If the said item does not fall within the zone of acceptability it will be rejected and corrective measure will be applied to see that the items in future conform to specified standards.

Inspection is an indispensable tool of modern manufacturing process. It helps to control quality, reduces manufacturing costs, eliminate scrap losses and assignable causes of defective work.

Purpose of Inspection

a) To distinguish good lots from bad lots

b) To distinguish good pieces from bad pieces.

c) To determine if the process is changing.

d) To determine if the process is approaching the specification limits.

e) To rate quality of product.

f) To rate accuracy of inspectors.

g) To measure the precision of the measuring instrument.

h) To secure products – design information.

i) To measure process capability.

Stages of Inspection

1) Inspection of incoming material
2) Inspection of production process
3) Inspection of finished goods.

1.4 Need of Quality Control

1) Quality of the products is a matter of great concern to both buyers and sellers
2) Testing increasing customer satisfaction and confidence
3) Means of safeguarding their reputation in the present competitive scenario.
4) Reduces the risk in receiving poor quality /potentially hazardous products
5) Sub-vendors for raw materials and product components whose quality needs to be assured on first hand basis to the buyers.

Quality Control process consists of observing our activity performance, comparing the performance with some standard and then taking action if the observed performance is significantly different from the standards.

The control process involves a universal sequence of steps as follows:

1) Choose the control subject.
2) Choose a unit of measure.
3) Set a standard value i.e., specify the quality characteristics
4) Choose a sensing device which can measure.
5) Measure actual performance.
6) Interpret the difference between actual and standard.
7) Taking action, if any, on the difference.

Ideally before the product reaches the consumer, it should have been tested to ensure that it meets the quality requirements .the materials used in the product should be checked to prevent break down during manufacture or in wear.

The reasons for poor & inconsistent quality are identified as under:-

1) No means of identifying potential quality problems before they result an unacceptable level of rejects.
2) Insufficient development in new product ranges.
3) Lack of product specifications and quality standards.

4) Inconsistent quality - some consignments are above the required 'standard and some below the standard. The variation is too large and not acceptable to customers.
5) Lack of clear understanding of quality.
6) Tendency to save money on testing
7) Inefficient planning to ensure quality.
8) Lack of top management commitment to quality
9) Tendency to monitor quality at the end of the line instead of in-process quality control.
10) Poor documentation
11) Tendency to take only corrective action, not preventive action.
12) Lack of understanding on how to achieve quality
13) In most factories good quality is only a matter of range.

Quality brings customer loyalty

Good quality results in productivity & higher profit Quality is the key to success & survival in business.

1.5 Reliability

Reliability may be defined as the probability that a product will perform a specified function, without degradation, under agreed conditions of service for a specified period of time, or when called upon to do so. The words 'agreed' and 'specified' implying acceptable conditions between the manufacturer, the designer and the customer. Reliability should be specified by design personnel (i.e. in the Product Design Specification) and where it is claimed by the seller, the basis of the claims should be stated.

Self-Check 1	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

1. What is quality? (1 point)
2. Mention three objective of quality control? (3 points)
3. What are the important points for a good quality system? (5 points)
4. What are objective of inspection? (2 points)
5. Name three stages of inspection? (3 points)
6. Why quality control is needed? (2 point)
7. What do you mean by reliability (2 points)

2.1 Product Conformity

If we take the following two definitions:

Product – a deliverable (Goods, services, activity)

Conformity – Compliance (meeting accepted and known requirements or expectations of end user; regulator; provider)

Then we see that:

Product Conformity – The assurance that the totality of a firm's output satisfies accepted standards.

From a manufacturer's point of view, the requirement for an organization to identify, provide and maintain the facilities it needs to achieve conformity of products (including: work space and associated facilities, Equipment, hard ware and software and supporting services) has now been expanded to include the identification and management of the work environment and in particular to need to consider the human and physical factors required to achieve conformity of product

Placing a product in today's marketplace can be a complex and expensive process. Increasing demands are being placed on suppliers to assure that their products are safe, reliable, and do not have adverse effects on the health and the safety of users or on the environment. These demands may come in the form of contract requirements imposed by customers, or as mandatory government regulations. The supplier is faced with the task of ensuring that the product conforms to all imposed requirements. This article describes some of the methods that are utilized by suppliers to provide assurance that their products conform to requirements.

The term "Product conformity" is more commonly used in relation to determining whether a product meets a given specification or standard.

Dependent upon the specific requirements imposed on a product, some or all of these activities may have to conform. The technical standards or guidelines or government regulations as well as the process of product design and development must also be considered in the comprehensive framework of conformity.

2.2 The purpose & need for the product conformity

Quality needs to be defined firstly in terms of parameters or characteristics, which vary from product to product. For example, for a mechanical or electronic product these are performance, reliability, safety and appearance. For pharmaceutical products, parameters such as physical and chemical characteristics, medicinal effect, toxicity, taste and shelf life may be important. For a food product they will include taste, nutritional properties, texture, and shelf life and so on.

The first step toward ensuring that our product conforms to the specified expected re requirements is fixing the product specification, ensure design and process conformity is there.

2.3 Fixing product specifications

A specification is the minimum requirement according to which a producer or service

Provider makes and delivers the product and service to the customer. In setting specification limits, the following should be considered:

- The user's and/or customer's needs
- Requirements relating to product safety and health hazards provided for in the Statutory and regulatory requirements
- Requirements provided for in national and/or international standards
- The competitor's product specifications, in order to gain marketing advantages

Conformity Level:

The "conformity level" is defined here as the level at which the activity is conducted in performing the actual assessment of the product or service that is the subject of the specification or requirement. Examples are the efforts of testing laboratories, product certifiers or quality system.

Accreditation Level:

The "accreditation level" applies to the evaluation for accreditation of bodies that perform at the conformity level conducted by a third party, such as a laboratory accreditation body, a certification system accreditation body.

Accreditation provides a measure of confidence to the user of bodies operating at the conformity level and serves as a credential for the conformity assessment body.

Recognition Level:

The "recognition level" refers to the assessment of accreditation bodies to determine their conformity with specified criteria, leading to recognition of those that conform. Recognition is typically a function of government or some entity delegated by government.

Not all system for conformity necessarily contain all of the above levels. The complexity of a system is dictated by the severity of the risk posed by the product as discussed below. Naturally, the more complex the system leading to a higher cost of the product.

Role of Standards in product conformity:

Standards play a major role in product conformity. In many cases, requirements or specifications incorporate consensus standards for one or more of the following reasons: to use widely agreed-upon procedures, to avoid re-inventing the wheel, or to promote the use of common standards and reduce the differences between standards, thereby easing the manufacturer's burden of having to make similar products to different standards for different markets (harmonization).

Product Development and Marketing

In addition to determining the marketability of a product, several things usually occur before it is introduced into the marketplace. Specifications to which the product will be produced and expected to function must be developed. These may be developed in-house or be imposed by the customer. Specifications sometimes require the use of consensus standards, such as ASTM technical or guideline documents. Then, a determination must be made as to how the product will affect the health and safety of the user or other segments of the population, as well as what the impact will be on the environment. Depending on the severity of the anticipated risk, this determination may be made voluntarily by a manufacturer, imposed by the purchase/user of the product, or mandated by a government regulatory body.

Once the requirements established the conformity of the product to the requirements must be determined. Depending on the specified requirements different ways for verifying that the product meets the specifications may be utilized.

In low-risk cases, verification that a product meets specifications can be accomplished with little difficulty, possibly through a supplier's declaration. A supplier may simply provide a document or declaration that the product conforms to specifications. An in-house laboratory or an independent laboratory may perform the conformance testing of the product, or evidence may be presented that the supplier has an effective quality management system in place.

In moderate-risk cases, more elaborate procedures may be required to verify that the product meets specifications. This may include third party registration of the supplier’s quality management system, and/or product testing in an independent laboratory accredited by a third party.

Government oversight of the process may in some cases be required. In high-risk cases, a government regulatory body usually sets forth and mandates requirements for the product. In order for the supplier to demonstrate that the product complies with the requirements, a more elaborate system may be necessary. This may entail the same activities as those described for medium risk products, including formal product certification. A product certification system calls for an administrator and conformity testing in an acceptable laboratory, possibly one that has been accredited. It may also invoke periodic inspection of the manufacturing process and records, and may require that the manufacturer have a quality management system with formal registration to a standard such as ISO 9000. For very high risk cases, government recognition of the accreditation or certification functions or some other form of government oversight may be mandated.

In the global arena, trading is even more complex. Not only must a supplier satisfy mandated technical characteristics, but multiple government recognitions or approvals are all too often required. If a supplier's customers are located in many countries, it may be necessary to satisfy many different regulations; a product may have to be manufactured with variations tailored for each separate market.

Design Conformity:

In designing the product, the capacity of processes and machines should be kept in Mind. It is also necessary to maintain a balance between cost and value realization. The clearer the specification, the better the possibility of creating and delivering quality products

Preparing product design

The specifications and drawings produced by the designer should show the quality standard demanded by the customer or marketplace in clear and precise terms. Every dimension should have realistic tolerances and other performance requirements Product quality should have precise limits of acceptability so that the production team can manufacture the product strictly according to specification and drawings.

The overall design of any product is made up of many individual characteristics. For example these may be:

- Dimensions, such as length, diameter, thickness or area;
- Physical properties, such as weight, volume or strength;
- Electrical properties, such as resistance, voltage or current;
- Appearance, such as finish, colour or texture;
- Functional qualities, such as output or kilometer per liter;
- Effects on service, such as taste, feel or noise level.

Manufacturing drawings and specifications are prepared by the designers and these should indicate to the production team precisely what quality is required and what raw materials should be used. In precise, proper technical sheets should be provided.

2.4 Process conformity

Preparation for manufacture

After the design, including the manufacturing drawings, has been reviewed and finalized, it is time to plan for manufacture. This will include the following steps:

(a) Deciding on the method of manufacture

Methods must be devised that permit the operators and processes to make the product in the quickest, easiest and most foolproof way, including preparation of manufacturing instructions, setting up procedures, listing various operations and so on;

(b) Providing the necessary machines, plant, tooling and other equipment.

Everything that is required for manufacture must be selected, taking care that all the elements are capable of achieving the standard of quality demanded;

(c) Obtaining satisfactory raw materials.

No one can make a good product from unsatisfactory raw materials, so every material must have a precise written buying specification so that the purchasing department can buy exactly what is required. Often purchasers are expected to buy from suppliers who have been assessed and approved by them and when supplies arrive the goods should be checked before acceptance into stores. Quality requirements and manufacturing processes should be discussed with the suppliers, as well as the inspection activities to be carried out by the purchaser on the goods on arrival;

(d) Obtaining and training suitable operators.

Operators who are willing and able to do the work in a satisfactory manner must be chosen and given whatever training they need;

(e) Planning inspection and shop floor quality control.

Plans for inspection activities should be prepared, proper workplaces provided for inspection staff, written inspection. Product quality: a guide for small and medium-sized enterprises procedures prepared, inspection equipment provided, checking and calibration of inspection equipment planned for, inspection personnel selected and trained and pre pilot and pilot runs carried out. One should never attempt to solve a quality problem by carrying out more inspections.

2.5 Manufacture

Once the design and planning for manufacture have been completed, the manufacturing can begin. If the planning has been well done, there should not be too many problems. During manufacture the following are the most common factors that can affect quality:

(a) Set-up.

Some processes, such as punching, cutting, printing and labeling, are so consistent that, if the initial set-up is correct, the whole lot will conform to the specifications. However, the initial set-up has to be checked by carrying out first-piece inspection;

(b) Machines and tools.

From time to time changes can occur in machine or tool settings, which can then lead to defects. Processes of this type include machining, resistance welding and filling. Here it is necessary to carry out periodic checks by patrol inspection;

(c) Operator.

There are some processes where the result depends on the skill and attention of the operator, such as welding, hand soldering and painting processes. For such processes it is necessary at the manufacture planning stage for the operator's working methods to be decided upon;

(d) Materials and components.

It is important to ensure the quality of raw materials and components by undertaking regular checks on the suppliers' processes and also where necessary by carrying out incoming inspection.

Correction of quality deficiencies

In spite of all the efforts made, the required quality will sometimes not be attained and one may be faced with a pile of scrap and rework. This means that something has gone wrong during the quality planning and maybe also during the manufacturing process. The reason for the trouble must be located and permanently corrected so that it cannot happen again. The following are obvious possibilities:

- The shop-floor operators had no clear idea what standard of quality was required;
- The method was such that it was very difficult to get the job right, but very easy to get it wrong;
- The machine and equipment were incapable of achieving the tolerances required;
- The incoming materials and components were unsatisfactory;
- The operators were untrained and not up to the job;
- Shop-floor quality control was either not properly planned or not properly executed, or both.

Self-Check 2	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

What do you mean by product conformity? (1 point)

1. What is the purpose of product conformity? (2 points)
2. Define product specification (2 points)
3. What is the design conformity? (1 points)
4. Mention important parameters for design conformity? (4 points)

Information Sheet 3- The importance of the raw material testing & relationship with the product performance

3.1 Various type of raw materials used in footwear:

- Leather
- Soling Material:
- Insoles:
- Heel
- Toe puff and Stiffeners:
- Threads
- Adhesive
- Color
- Dye
- Packing Material
- Finishing Material
- Nails
- Foil paper

3.2 Performance Requirement of Raw Materials

Before the raw materials are used in for the manufacturing of the shoe, there are various tests conducted upon the materials like:

Minimum Performance guideline:

Upper Leather:

Property	Requirement (minimum)
Tear strength	70 N (for light use) 100 N (for medium use) 120 N (for heavy use)
Tensile Strength	15 N/mm^2 for split Leather 21 N/mm^2 for grain Leather
Water Vapour Permeability	0.8 mg/cm^2h for upper 2.0 mg/cm^2h for lining

Water Vapour Coefficient	15 mg/cm^2 for upper
Flexing Resistance (Bally Flexing	100,000 cycles
Lastometer (Grain crack)	Distension: 7 mm Force: 200 N
Ph	3.2 (min)if value is <4 than difference figure shall less than 0.7
Chromium VI	3.0 mg/kg (maximum)

LINING

PROPERTY	REQUIREMENT (Minimum)
Tear strength Leather Textiles & Coated fabric	 30 N 15 N
Tensile Strength	15 N/mm^2
Abrasion Resistance (Martindale Abrasion) Dry 25600 cycles Wet 12800 cycles	 No hole No hole
Colour fastness to veselic rubbing Dry (after 150 cycles) Wet (after 50 cycles)	Grey scale Rating 3 3
Water Vapour Permeability	2.0 mg/cm^{2}h
Water Vapour Coefficient	20 mg/cm^2
pH(if leather)	3.2 (min)if value is <4 than difference figure

	shall less than 0.7
Chromium VI	3.2 mg/kg (Maximum)

Soling Material

PROPERTY	REQUIREMENT (Minimum)
Tensile strength For PU Sole For TPR Sole For Rubber (Vulcanised) For Rubber Sole (Resin Rubber) For PVC	 30 N/mm^2 40 N/mm^2 75 N/mm^2 75 N/mm^2 90-150 N/mm^2
Abrasion Resistance For PU Sole For TPR sole For PVC sole For rubber sole For Resin Rubber (Hardness > 85 Shore A) For EVA (at 5 N Load)	Volume loss (Maximum) 300 mm^3 350mm^3 200 mm^3 400mm^3 160mm^3
Flexing resistance (Bennewart Flexing) Cut Growth after 30,000 cycles	 4 mm cut growth (maximum)
Flexing resistance (Ross Flexing) Cut Growth after 150,000 cycles	 6 mm cut growth (maximum)
Flexing resistance (SATRA/ BATA BELT Flexing) **After** 50,000 cycles	No significant damage/crack observed.

INSOLE:

Flexing test:
Flexing Index ; 2.7 FOR Average quality
Flexing Index ; 3.2 FOR Medium quality
Flexing Index : 3.7 FOR High quality

INSOCK:

Abrasion test *;
For Dry Condition: no hole till 25,600 cycles.
For wet condition: no hole till 6400 cycles.

LACES

Breaking Strength
For Normal Shoes 200 N
For heavy duty shoe 350 N

Lace to Eyelet Abrasion:

Observation : No damage/breaking till 5000 cycles
Lace to Lace Abrasion:
Observation 1.No damage/breaking till 5000 cycles (For Normal Shoes)

2.No damage/breaking till 15000 cycles (For Heavy Duty Shoes)

EYELETS

Eyelet Strength

Requirement 250 N (minimum)

Eyelet/D - Ring attachment Strength

Requirement 120 N (minimum)

Corrosion Resistance of Metallic Eyelets & Trim Material should be corrosion resistant.

3.3 Purpose of testing raw material

Ideally before the product reaches the consumer, it should have been tested to ensure that it meets the quality requirements the material used in the product should be checked to prevent break down during manufacture or in wear.

The first step is to establish performance specification/ Requirement for all raw materials & finished products. Testing is used both in setting these up and in checking that all raw materials match the specification. It is vitally important that the real cost of materials is unduly increased by further processing if they are below the required standard. Make sure that relevant test data is available for all materials to be used.

Control of raw material quality can be achieved by one of the following methods

- Purchasing against agreed specifications
- In house testing / evaluation
- Independent testing/evaluation

In all the above, an understanding of testing is very important to formulate a performance specification against which the product can be judged.

Self-Check 3	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

Match the following (5 points)

1. Bally flexing	Sole
2. Benn wart Flexing	Visual observation
3. Martindale Abrasion	Upper
4 Color fastness to rubbing	Breathability test
5. Water vapor permeability (WVP)	Grey Scale rating

4.1 Tensile Strength and extension at break of Leather:

This method is intended to determine the tensile properties of leather. The method is mainly applicable to footwear upper and lining leathers. But could be also used for sole leathers

Principle:

A dumb bell shaped test specimen of standard thickness is gradually stretching by a tensile testing machine until it fails the tensile strength and extension at break of the specimen is determined.

Apparatus and materials:

A tensile testing machine with

1. A jaw separation rate of 100±10mm/minute.
2. The capability of measuring force up to 5KN to an accuracy of better than 2%.
3. The facility to record the force and test specimen extension throughout the test.
4. A press knife for other means of cutting dumb bell shape test specimen of the dimension shown in given figure. The edge of press knife should be smooth and free of nicks.
5. A dial thickness gauge which applied a pressure of 49±5KPA. Over a circular area of diameter 10±1mm and is capable of measuring thickness to the nearest 0.01mm.
6. A device to measuring distances up to 20mm to the nearest 0.1mm, A graduated optical magnifier is suitable.

Sample preparation

With the grain surface of leather upper must use the press knife to cut six specimen of the dimension specified in given figure. Cut three with their longer is parallel to the back bone or along direction of the leather. And three at 90º to this direction in the cross direction

When testing a cutting of leather of unknown origin, assign the tighter direction as along or principle direction. When the sampling leather footwear assign the head – toe direction as the along or principle direction

Mark the along direction of the material of each of the test specimen

Store the test specimen in a standard controlled environment of either 23±2 ºc/50±5 %RH or 20±2 ºc/65±5 %RH for a minimum of 48 hours. And carry out the test in this atmosphere.

If measurement of tensile stress and extension at grain crack is also required prepared further set of test specimen

Procedure:

Used the thickness gauge to measure the thickness of test specimen in mm to nearest 0.01mm at three points on the longitudinal axis of the narrow section cd record the arithmetic mean of these value as the thickness of the test specimen.

Use the device to measure the width of each specimen of width grain and flesh side. Record the arithmetic mean of six values as the width of the test specimen

Adjust the tensile testing machine so that the jaws are about 50 mm a part. If an extensimeter is not used the jaw separation is the gauge length.

Note: If test specimen of other than the standard size is used the distance between the jaws will need to be adjusted accordingly

Insert 01 and of test specimen in each of the jaws of the tensile testing machine and clamp it centrally, so that the longitudinal center line of the test specimen is parallel to the axis of machine.

Operate the machine so that the jaws separate at the speed of 100±10 mm/minute.

Stop the machine the test specimen failed and examine the position of failure. Reject the results if the specimen has not failed within the narrow section and repeat the test with the fresh test specimen

Record:

[F] The maximum in Newton

[X] The extension at break in mm to nearest 0.2mm. As measured by the extensometer or by the jaw separation

Repeat the above procedure for remaining test specimen

For each test specimen calculate the tensile strength in N/mm² using the formula.

$$TS = \frac{\mathrm{F}}{\mathrm{TxW}}$$

The percentage extension at break to the nearest 1% the using formula

$$X\% = \frac{[\mathrm{X}]\mathrm{x}100}{[\mathrm{G}]}$$

If for either redirection of test the result for the three test specimen is mark different then also record them individually.

Measurement of tensile stress and extension at grain crack:

Measure, mark and clamp the test specimen as per the above given procedure

Immediately cracking of the leather grain is observed, stop the machine.

Additional Note:

Measurement of test specimen width

Experience has shown that the width of the specimen of the top of grain side are very close to width of the cutting knife, but those on the lower or flesh side are usually narrower by up to .6 mm. Consequently to obtained accurate value of tensile strength it is necessary to measure test specimen width and not assume it to be same as width of the cutting knife.

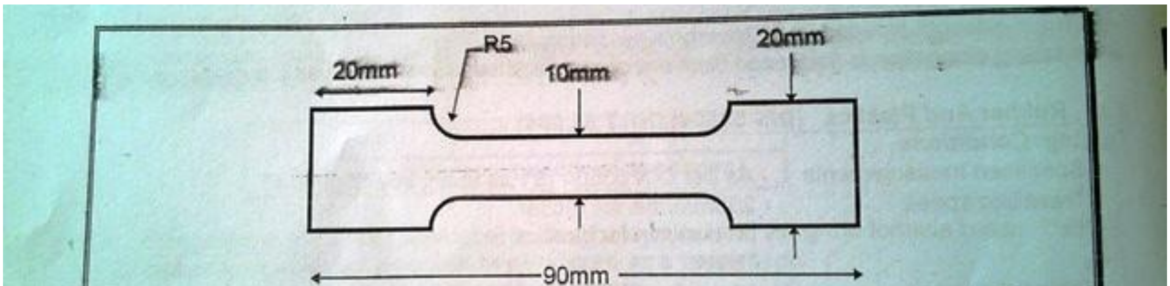


figure 2

4.2 Tear strength of Leather (Baumann tear):

SCOPE

This method is intended to determine the force required to tear a material. The method is applicable to all types of leather.

PRINCIPLE

A wide slot with taper ends is cut in the centre of a rectangular test specimen. The slot is then pulled open by a tensile testing machine causing the material to tear from the tapered ends of the slot see cover photograph. The test is stopped when the tear has propagated to the edge of the test specimen. The maximum force required to propagate the tear and the thickness of the test specimen are recorded.

Apparatus and test material

A jaw separation rate of 100 ± 20 mm/min

A force range appropriate to the specimen under test. This will usually be less than 1 kN for leather.

A pair of Baumann jaw attachments with the dimensions shown in Figure

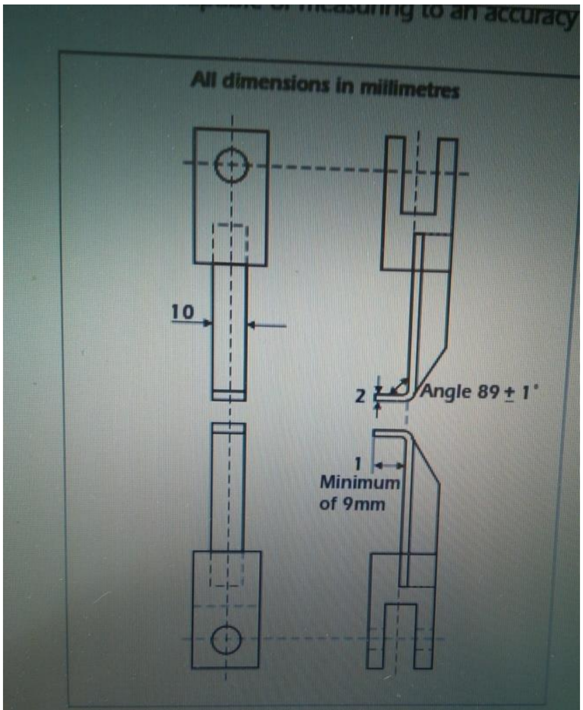
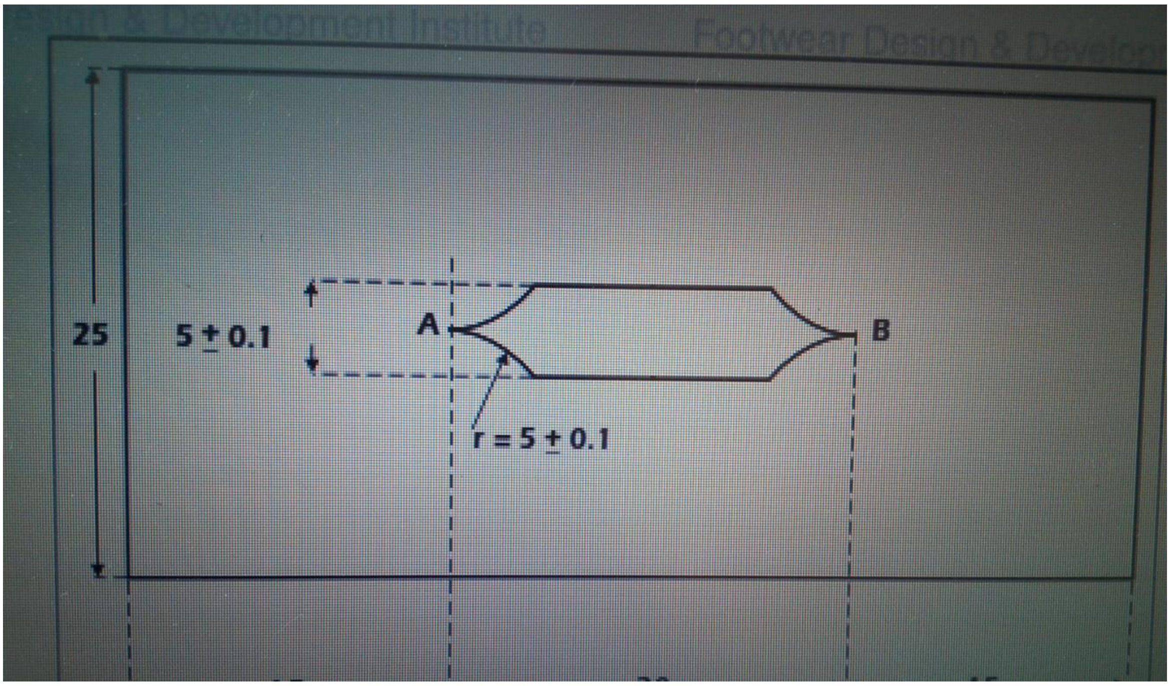


Figure 1 Baumann attachments fitted in jaws of tensile testing machine

Press knife or other cutting device capable of cutting a test specimen with a slot of the dimensions shown in Figure 2. see section 8.1. The pointed ends of the slot, marked A and B in Figure.



4.4 A dial thickness gauge which applies a force of 3.8 ± 0.1N over a circular area of diameter 10.0 ± 0.1mm and is capable of measuring to an accuracy of 0.01mm.

PREPARATION OF TEST SPECIMENS

.1 Cut six test specimens with the dimensions specified in above figure. Three should be cut with their longer edges parallel to the backbone. or along. direction of the material. and three should be cut at to this in the across direction..

When testing a cutting of leather of unknown origin. assign the tighter direction as the "along" or principal direction. When sampling leather footwear: the heel-toe direction should be assigned the I along" or principal direction.

4.3 Flexing test (Benn wart Flexing)

Apparatus

The test piece shall be guided in such a way that on one side it can be bent at an angle of 90° about a mandrel with a radius of 15 mm.

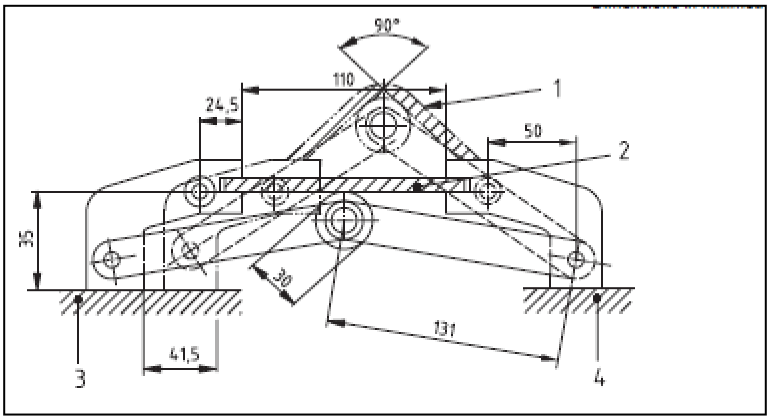


Figure: Testing device for flexing resistance of outsole

Key

a) test piece at maximum flex position
b) test piece at the neutral flex position
c) moveable bearing
d) fixed bearing

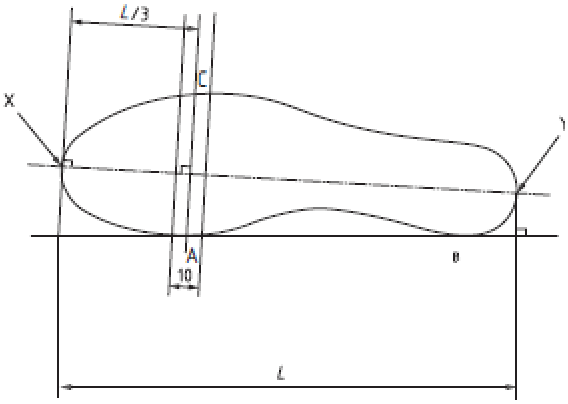
Measuring magnifier (Eye piece), with an accuracy of 0.1mm.

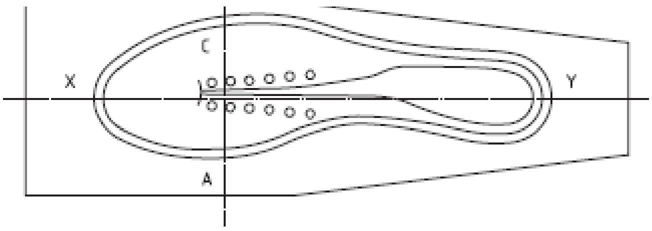
Preparation of the test piece

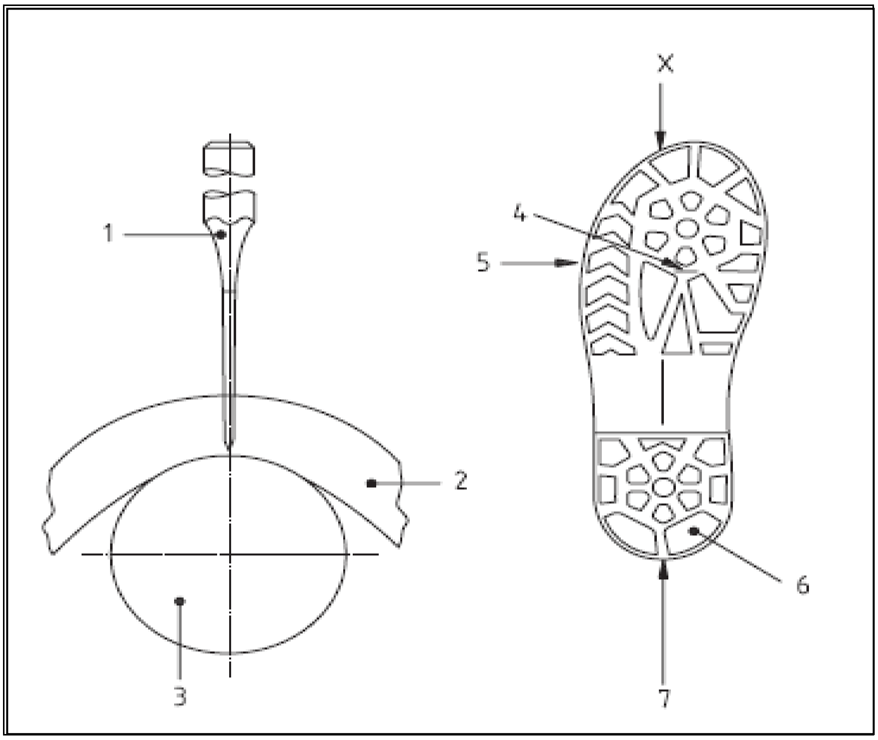
Take the bottom of the footwear with the insole, separated from the upper, as the test piece.

Define the flexing line in accordance

Mark a point, for the later insertion of a cut, as follows:







Key

a) cutting tool
b) test piece
c) mandrel of the test machine, radius 15 mm
d) single incision on the line of maximum stress
e) auxiliary line AC, parallel or on the line of maximum stress
f) cleats
g) longitudinal axis XY

Sole incision

Procedure

Ensure that the testing device is at the neutral flex position (see Figure) and clamp the test piece into the device in such a way that the flexing line AC is parallel with the central roller and the cut position marked is directly above the centre roller. If the sole unit is naturally curved, the clamping procedure shall be carried out so that the sole comes close to the centre roller under no load. Manipulate the machine until the test piece is in the maximum flexed, extended or stretched state. Make a single incision at the pointmarkedin with the blade of the cutting tool parallel to the flexing line AC. The cutting device shall pass through the full thickness of the outsole and into the insole or equivalent layer. If the product contains a penetration resistant insert, only cut until contact with this is made.

If there are several materials constituting the sole, another incision shall be made, but it is necessary to avoid the cut in a region of 15 mm from the edge of the sole.

Measure the initial length of the cut at the surface of the test piece using the measuring magnifier Carry out 30 000 cycles starting from the maximum flexed, extended or stretched state, with the test piece undergoing deformation at a constant rate value between 135 cycles/min and 150 cycles/min.

At completion of the 30,000 cycles, the testing device should not be left in the fully flexed position.

After 30 000 cycles, measure the final length of the cut at the surface of the test piece using the measuring magnifier. The number and dimensions of spontaneous cracks shall be recorded if present.

Cut growth = (final cut length) - (initial cut length).

4.4 ROSS FLEXING TEST - RESISTANCE TO CUT GROWTH ON FLEXING

This method is intended to determine the resistance of a polymeric material to cut growth during repeated flexing. To accelerate the test it is normally conducted at a temperature where the resistance of the material to cut growth is low, which is not necessarily a temperature, the material is expected to experience in wear.

The method is applicable to all types of flexible sheet material and especially those used in footwear soling

1. **SCOPE**

This method is intended to determine the resistance of a polymeric material to cut growth during repeated flexing. To accelerate the test it is normally conducted at a temperature where the resistance of he material to cut growth is low, which is not necessarily a temperature the material is expected to experience in wear.The method is applicable to all types of flexible sheet material and especially those used in footwear solinq

2. **PRINCIPLE**

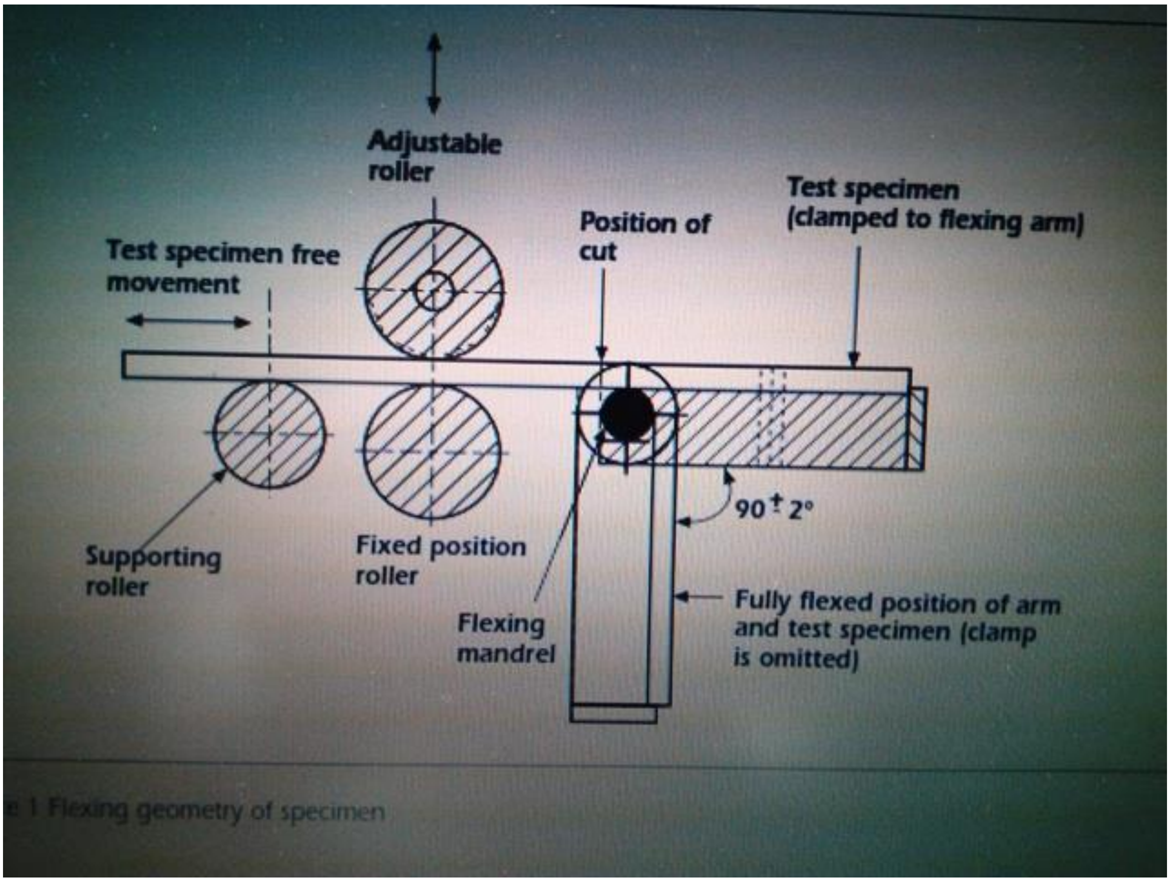
2.1 Method 1 - Standard size test specimens (either cut from sheet material or components; or moulded specially)

Rectangular specimens of the material are either cut from a sheet or a moulded sole or are specially moulded for the test. A narrow cut is made through the full thickness of the specimen in the centre. The specimen is then repeatedly flexed, at the cut position through 90 degree until the length of the cut has grown to a predetermined length. The arithmetic mean cut growth rate per 1000 flexing cycles is then calculated. The thickness of the specimen is critical to the results. And a standard thickness is used. If the material is thinner than the standard thickness. The test is conducted in the same way and a correction formula may be used to predict the result for a specimen of a standard thickness.

2.2 Method 2 - Larger test specimens (such as forepart soles)

The test may also be carried out on larger test specimens such as complete soles or multi- part rnouldinqs to assess the effect of surface patterns on crack initiation and growth. Normally these are tested at full thickness with all the surface pattern remaining but without a narrow cut though the thickness the test is stopped at intervals and the number of cracks and their individual lengths are recorded. The test is terminated when either the longest crack exceeds a length of 6 mm or the specimen has been subjected to a total of 15O000 flex.

If required the test specimens can be subjected to special treatments before testing. See section 8.2.



4. APPARATUS AND MATERIALS

4.1.1 A mandrel of diameter 10.0 ± 0.6 mm around which the specimens are flexed.

4.1.2 A means of holding the specimen so that in the unflexed state the cut is directly in line with the edge of the mandrel [4.1.1] nearest the rollers, see figure 1. One end of the specimen is firmly clamped, and the other end is free to move in a lengthwise direction between rollers. The vertical positions of the upper must be adjustable to the thickness of the test specimen.

4.3 A sharp chisel and to pierce the test specimen the chisel should *have* the dimensions shown in 2. The jig should ensure that the cut is *vertical* and passes through a specified in the uppermost face of the specimen.If possible the chisel should be held by the so as to *give* a 7.5 mm penetration beyond the upper surface of the specimen after It should be possible to *remove* the chisel from the jig to enable specimens are too large to be fitted into the jig to be pierced.test om

4.5 A mandrel of diameter approximately 15 mm to flex the specimen round when measuring the cut length

5. PREPARATION OF TEST SPECIMENS

5.1 Method 1 Standard size test specimens (either cut from sheet material or

components or moulded specially)

5.1.1 Measure the thickness of the sheet material using the thickness gauge (4.4). If the thickness of the sheet material differs from that given below then prepare the materials described in section 8.1. For specimens cut from soles c section 8.4.

• Solid natural rubber, synthetic rubber; men's resin rubber; thermoplastic polyurethane, polyester (Hytrel) and nylon 3.0 ± 0.2 mm

• Micro cellular rubber, EVA and polyurethane 5.0 ± 0.2 mm

• Thermo plastic rubber and PVC 7.0 ± 0.2 mm

•Women's resin rubber 2.7±0.2mm

With PVC test mould in slab form it is recommended to make additional tests on material reduced to 4.5 ± 0.2 mm in order to assess its suitability for soles between 4 and 5 mm thick (for which 7 mm specimens are not appropriate).

?1 .2 With sheet material cut six test specimens25 ± 2 mm wide and 150 ± 5 mm long, three cut so that their longest edges are parallel to the length direction of the sheet (subsequently referred as the 'along' direction), and three cut in the direction at 90° to this (subsequently referd to as the 'across'direction).

With soles,cut three test specimens so that their longer edges are parallel to the heel-toe direction (subsequently referred to as the 'along' direction).

5.2 Method 2 - Large test specimens (such as forepart soles)

If the sole to be tested is from complete footwear it should first be taken off the shoe or boot. Then remove the heel, insole and any bottom filler.

In all cases cut off the heel. If the sole has a raised edge to its upper surface this should be scoured off without removing anything from the centre of the surface so as to produce a level surface. If the foot ear bottom has a completely separate middle sole, remove this before testing.

6. PROCEDURE

6,1 Method 1 - Standard size test specimens (either cut from sheet material or components; or molded specially)

6.1.1 Place each *test* specimen in the chiseling (4.3), with the wearing surface uppermost, and make a cut which lies across the longitudinal centre line of the specimen and is at 90° to it. The cut should be through the whole thickness of the specimen, and should be at a point on the centre line so that when it is loaded into the flexing machine (4.1) the cut will be directly above the edge of the flexing mandrel (4.1.1). In the case of the SATRA testing machines the cut should be 58.7 mm from one end, *see* Figure I, and SATRAjigSTO405 will facilitate this.

6.1.2 Colour the area of the specimen around the cut with a contrasting marking pen or chalk. This colouring assists the visibility of the cut. Bend each specimen through an angle of 45° around the mandrel (4.5) and use the optical magnifier (4.2) to measure the length of the cut to an accuracy of 0.1 mm.

6.1.3 Measure the thickness of each specimen in the vicinity of the cut made in section

6.1.1. Calculate the arithmetic mean thickness of the three specimens cut in the along direction of the sheet and the arithmetic mean thickness of the three specimens cut in the across direction

6.1.4 Ensure that the flexing machine (4.1) is in a temperature controlled environment of:

-5 ± 2°C	Standard test for all materials except TPR
+20 ± 2°C	Thermoplastic rubber
Down to -30°C	Special tests for materials to be worn in low temperatures.

Place all the test specimens in the controlled environment.

6.1.5 load the test specimens into the flexing machine in the unflexed position (4.1) with their wearing surface uppermost and cuts directly in line with the edge of the flexing mandrel (4.1.1). Reset the counters on the machine.

The test specimens should be at right angles to the axis of the flexing mandrel (4.1.1). The upper roller should be set to touch but not grip the test specimen so that the test specimen may move freely between the rollers without pinching or flapping.

3600

6.1.6 when the specimens have been in the temperature controlled environment, as described in section 6.1.4, for at least ten minutes run the flexing machine (4.1) for cycles 360.

6.1.7 Stop the flexing of that the specimens are flexed through an angle of 45°.

Use the steel ruler measure the length of the cut in each specimen to an accuracy of 0.5 mm without removing them from the machine.

6.1.8 Start the flexing machine again and repeat the procedure in section 6.1.7 at intervals that are considered to give sufficient information about the rate of growth of the cut, If it is necessary to interrupt the test before completion, for example if it is not possible to run the flexing machine overnight, or the expected rate of cut growth could give complete cracking overnight, then during this time the specimens should be stored flat. unflexed and at normal room temperature. which means out of the machine for low temperature tests. Follow the procedure In section 6.1.6 for reloading the test specimens in the machine.

6.1.9 Stop the test when either the length of the cut has reached 8 mm (6 mm cut growth) or the specimen has been subjected to a total of 150000 cycles. Remove the specimens from the machine and measure the final cut length to an accuracy of 0.1 mm using the procedure described in section 6.1 .2 and determine the cut growths by subtracting the initial cut lengths measured in 6. 1.2. If the cut is jagged, measure the distance between the two extreme points. Note the occurrence and severity of any spontaneous cracks in the vicinity of the chisel cut. This should include any cracking or cut growth confined to the reverse side of the test specimen.

6.1.10 For each specimen calculate the average rate of growth in the length of the cut in millimeters per thousand flexing cycles (kilocycle). Then calculate the arithmetic mean rate of cut growth for the three specimens cut in the along direction. And the arithmetic mean rate of cut growth in millimetres per kilocycle for the three specimens cut in the across direction. 6.2 Method 2 - Larger test specimens (such as forepart soles)

6.2.1 If a cut in the test specimen is required then use the chisel (4.3) to make the cut. SATRA recommend a suitable jig is used to ensure that the cut is vertical and the chisel penetrates 7.5 mm beyond the surface of the test specimen after piercing. On forepart soles the cut should be made across its width and close to the flex line.

6.2.2 Ensure the test machine is in an environment as defined in section 6.1.4. Fit the test specimen into the test machine (4.1) with the wearing surface uppermost. This may require the end of the test specimen being cut or drilled to fit into the clamp. If the specimen is particularly wide then it may be necessary to clamp the specimen between two adjacent clamps.

6.1.4 If the test specimen has a cut in it. position it so that the cut will lie over the edge of the mandrel when the specimen is clamped.

6.2.5 Having clamped the specimen.check that it will move freely between the rollers when it is fully flexed. If it will not do so because of a prominent cleat pattern. remove the specimen and buff off the cleats in this area until it will.

6.2.6 When the specimens have been in the temperature controlled environment. as described in section 6.1.4 for ten minutes run the flexing machine (4.1) for approximately 3600 cycles.

6.2.7 Stop the flexing machine so that the specimens are flexed through an angle of 45° and examine either the cut if one was made in section 6.2.1. or the surface of the specimen for signs of cracking. Record the number of flexes if spontaneous cracking has developed. Use the steel rule (4.2) to estimate to the nearest millimetre either the length of the cut if one was made in section 6.2.1 or the length of any cracks that are present.

6.2.8 Start the flexing machine again and repeat the procedure in section 6.2.S at intervals that are considered to give sufficient information about the rate of growth of the cracks.

SATRA suggest that the test is stopped at intervals of about 10 000 flexes for the first day. If it is necessary to interrupt the test before completion, for example if it is not possible to run the flexing machine overnight. then during the time the specimens should be stored unflexed and at normal room temperature. which means out of the machine for low temperature tests. Follow the procedure in sections6.2.2. 6.2.3 and 6.2.5 for reloading the test specimens in the machine.

6.2.9 Stop the test when either the longest crack has reached a length of 6 mm or the specimen has been subjected to a total of 150 000 cycles. Alternatively if a cut was made in section 6.2.1 stop the test when either the cut length has reached 8 mm (6 mm cut growth)or the specimen has been subjected to a total of 15O000 cycles. Remove the specimens from the machine and measure the final length of either any cracks or the cut to an accuracy of 0.1 mm using the optical magnifier (4.2). If a cut was made in section

6.2.1 then calculate the cut growths and the mean cut growth rate in millimeters per thousand cycles.

7. TEST REPORT

Include in the test report:

7.1 Reference to this test method SATRA™ 60: 1992.

7.2 The temperature at which the test was conducted.

7.3 Details of the material tested. .

7.4 For method 1 (and method 2 is a cut was made):

- The arithmetic means of specimen thicknesses calculated in section 6.1.3.

- The arithmetic means of cut growth rates calculated in section 6.1.10 expressed in millimetres per 1000 flexes [mrn/kc].
- Number of flexes completed in kilocycles if less than 150.
- 7.5 For method 2 (if no cut was made):
- The number of flexing cycles when spontaneous cracking was first noted as recorded in section 6.2.7.
- The final number of cracks and their individual lengths to an accuracy of 0.1 mm as measured in section 6.2.9.
- 7.6 Any deviations from the standard test method (particularly in shape or thickness of test specimen).

8. **ADDITIONAL NOTES**

8.1 Preparation of the test specimens

If the material, as supplied, is not thick enough to provide the standard test thickness for its type. after preparation as described below. prepare it so as to leave the maximum possible thickness for testing.

Reduce the original material. which may be in the form of sheets. or cut or moulded sales, to its test thickness using either a band knife splitter or a surface grinder. (Information on this equipment and is use is given in British Standard BS5131: Section 2.7 - The preparation of test pieces from soling materials for physical testing). During preparation. check the thickness of the soling with the rubber dial thickness gauge (4.4).

When preparing solid solings with a smooth wearing surface remove all the excess material from the reverse side.If the rubber. as received. is thinner than the test thickness do not remove any material if the wearing surface is smooth.

For solid solings with a surface pattern, first remove this pattern completely and then remove the rest of thei material from the reverse side until the specified thickness is obtained. The surface pattern must still be removed even if the final thickness of the sheet will be below the stan1dardtest thickness.

For cellular soling wit~ a smooth solid surface skin on the wearing surface, remove a layer 0.5 mm thick from this side, or a little more if some of the skin remains. Then remove the rest from the reverse side. If however, the wearing surface is already a split cellular layer; do not remove the 0.5 mm layer. Where the cellular sole has a surface pattern remove this completely before removing the 0.5 mm layer.

For all solings mark the prepared surface which is adjacent to the wearing surface of the soling.

8.2 Special treatments

If required, subject any of the test specimens to special treatments such as immersion in a liquid or accelerated ageing before following the testing procedure in section 6.

8.3 The American Ross flex test

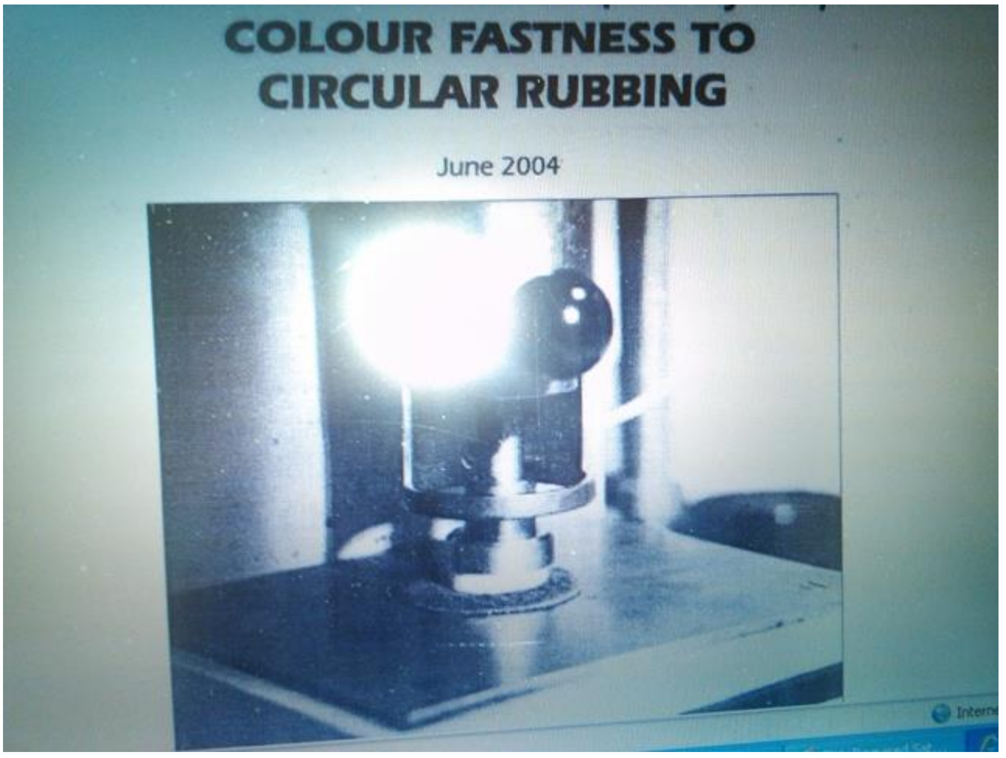
An American version of the Rossflex test is described in ASTMtest method D 1052: 1985. This is the same as SATRATM 60: 1992 Method 1 except that a flexing speed of 100±5cycles/minute and a chisel of different dimensions are used. A suitable chisel is available from SATRAreference STD 405A

8.4 Standard specimens prepared from soles

If standard specimens are to be prepared from soles it may not be possible to satisfy all the standard dimensions. For example, thermoplastic rubber and *PVC* soles may not be 7 mm thick, except at the edges but the edges will not provide a rectangular specimen 25mm by 150mm. In these cases it is permissible and preferable to prepare test specimens which are the correct standard thickness whilst accepting less than standard width and length and perhaps a slightly curved shape [the outline of the sole edge}. In these circumstances the width should not be less than 10mm and the length should not be less than 130mm and the nature of the test specimen should be stated in the report. The outer edge of the sale will usually provide straighter test specimens than the inner edge, and to help improve the straightness the test specimen may include material from the waist of the sale.

8.5 Related tests ISO 4643 .ASTM test method D 1 52 - Measuring rubber deterioration - cut growth using Ross flexing apparatus.

A.4.3 Color fastness to circular Rubbing (Dry & wet)



TEST SPECIMENS

Test specimens should be of a sufficient size to allow them to be fixed firmly to the test platform. When using a SATRA rub fastness tester conveniently sized samples can be either squares of 60 mm x 60 mm, or circles 60 mm diameter; alternatively a 60 mm wide strip can be used for several tests.

PROCEDURE

Dry rub test

Secure the test specimen on to the horizontal platform of the test machine and configure the machine to operate with a fixed force of 24.5 N.

Secure a dry felt pad onto the spindle of the test machine.

Bring the felt pad and the test specimen into contact and run the machine for the required number of revolutions. If necessary, take precautions to avoid thermal Damage.

Lift the felt pad clear of the test specimen surface

Wet rub test

Secure the test specimen onto the horizontal platform of the test machine and configure the machine to operate with a fixed force of 7.1 N.

Immerse the felt pads in cool distilled water and bring to the boil. Continue to boil for 60 seconds, and allow cooling to room temperature. Remove the pads from the water immediately before use but reject any that are excessively swollen or soft. Pads should not be kept in water for more than 24 hours. Unused wet pads should be discarded after 24 hours and fresh wet pads prepared as necessary.

Adjust the amount of liquid in the pad by gently squeezing the excess from it so that when it is fixed to the spindle and lowered onto the test piece a little liquid is squeezed out to form a rim round the pad.

Bring the felt pad and the test specimen into contact and run the machine for the required number of revolutions.

Lift the pad clear of the test specimen surface, dry the felt pad and test specimen as section 8.2 and proceed.

Immediately secure the test specimen over the pad, and configure the machine to operate with a fixed force of 7.1N. Secure a dry felt onto the spindle. Bring the felt pad into contact with the specimen and leave for 60 ± 2 seconds. Run the machine for the required number of revolutions and lift the pad clear of the test specimen.

To make the assessment of color transfer easier it is recommended that each pad is cut in half and is placed against half of an unused pad

Under artificial lighting conditions daylight compare the contrast between tested and non-tested areas with the ratings on the relevant geometric grey scale “Degree of staining" for color transfer and "Change in color" for marring). If the assessment falls between two ratings on the grey scale then quote the lowest number of the two grey scale ratings,i.e the worst case.

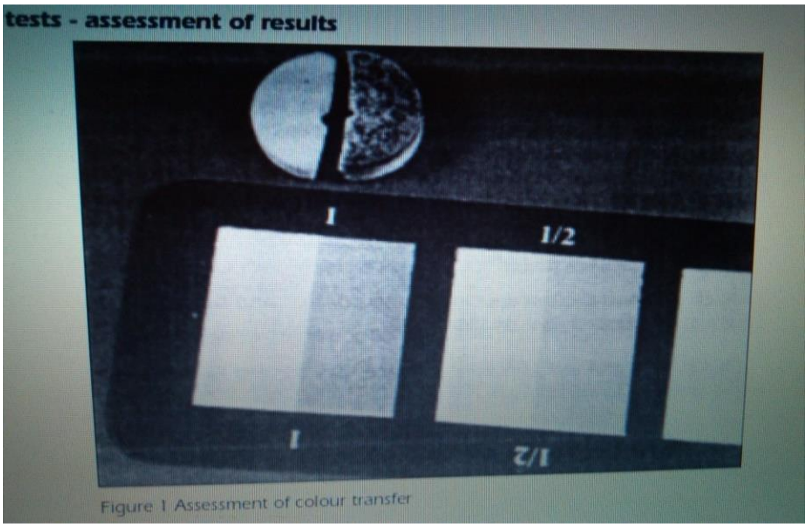


Figure 1 Assessment of colour transfer

Self-Check 4	Written Test

Name: ___________________________ Date: ________________

Q1.State true or false (10 point)

1/Lastometer test should always be conducted on raw material before production

2/Resin rubber is light weight soling material.

3/BALLY flex test is conducted on insoles

4/Water uptake and loss test is conducted on insoles.

5/Synthetics have better cutting value than leathers.

6/It is important to conduct colour fastness to rubbing on the flesh side in unlined shoes.

7/Microcellular rubber is light weight soling material.

8/Flexing index test is done on Upper materials

9/ Ross flex test is recommended on leather soles. .

10/.Leather has an ideal combination of elastic and plastic properties. 5 point

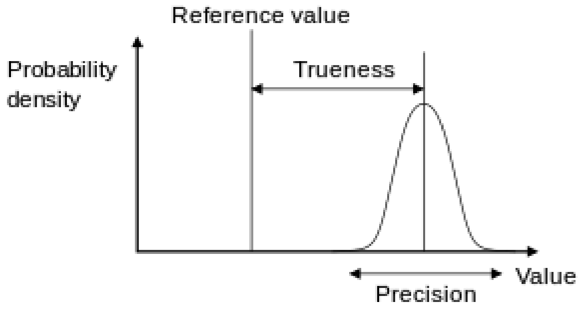
Q2. Match the following

Heat shrinkage	Endurance test of upper
Din Abrasion	Lastometer test
Flexing index	Cellular solings
Bally Flexing	Important test of insoles
Grain crack and burst	Soling material

Information Sheet 5- Importance of Accuracy of the Results

5.1 Accuracy

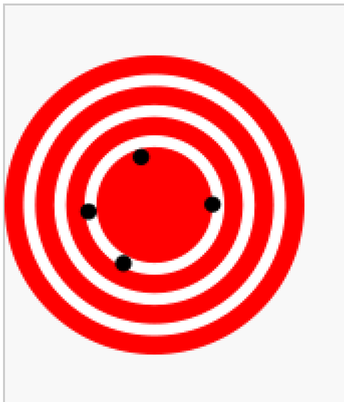
Accuracy is the closeness of agreement between the result of measurement and the true value of the measured.



Accuracy consists of Trueness (proximity of measurement results to the true value) and Precision (repeatability or reproducibility of the measurement)

The terms **trueness** and **precision** are used to describe the **accuracy** of a measurement. Trueness refers to the closeness of the mean of the measurement results to the actual (true) value and precision refers to the closeness of agreement within individual results. Therefore, according to the ISO standard, the term "accuracy" refers to both trueness and precision.

Accuracy



Low accuracy: good trueness, poor precision

Low accuracy: poor trueness, good precision

Example (Accuracy and Precision):

Accuracy refers to the closeness of a measured value to a standard or known value. For example, if in lab you obtain a Thickness measurement of 2.20 mm for a given leather swatch, but the actual or known value is 2.00 mm, then your measurement is not accurate. In this case, your measurement is not close to the known value.

Precision refers to the closeness of two or more measurements to each other. Using the example above, if you measure the thickness of given leather swatch five times, and get 2.20 mm each time, then your measurement is very precise. Precision is independent of accuracy. You can be very precise but inaccurate.

For example, if on average, your measurements for a given leather swatch are close to the known value, but the measurements are far from each other, then you have accuracy without precision.

A good analogy for understanding accuracy and precision is to imagine a basketball player shooting baskets. If the player shoots with accuracy, his aim will always take the ball close to or into the basket. If the player shoots with precision, his aim will always take the ball to the same location which may or may not be close to the basket. A good player will be both accurate and precise by shooting the ball the same way each time and each time making it in the basket.

5.2 Purpose of test result:

When asked to test a shoe material or component, reputable test houses will quickly identify standard properties they think should be tested and carry out the tests. However, it is one thing to produce a test result and quite another thing to be able to understand the purpose and interpret what the result means.

Of course, it is not always necessary to know why something fails. It may simply be enough to know whether a product is satisfactory to be used and place an order or to reject the shipment if it fails. Over time, the guidelines have evolved so that all performance requirements relate to the end-use of the material or product to help identify their fitness-for-purpose. However, a testing expert should be able to interpret the test result. Even if asked to test against a recognized specification, the test expert should be able to comment where it is felt that the result does not tell the whole story and some qualification would be helpful.

The testing of footwear not only serves as a check that the it has been manufactured to an acceptable performance standard, but also gives the supplier, the retailer and the customer peace of mind that there is a level of quality assurance in place.

There are two fundamental purposes of testing: verifying procurement specifications and managing risk. First, testing is about verifying that what was specified is what was delivered: it verifies that the product (system) meets the functional, performance, design, and implementation requirements identified in the procurement specifications. Second, testing is about managing risk for both the acquiring agency and the system's vendor/developer/integrator. The testing program is used to identify when the work has been "completed" so that the contract can be closed, the vendor paid, and the system shifted by the agency into the warranty and maintenance phase of the project.

Importance of testing:

Quality of the products is a matter of great concern to both buyers and sellers

a) Testing increases customer satisfaction and confidence
b) Means of safeguarding their reputation in the present competitive scenario.
c) Reduces the risk in receiving poor quality /potentially hazardous products
d) Sub-vendors for raw materials and product components whose quality needs to be assured on first hand basis to the buyers.

5.3 Deviation in Measurements:

Measurements:

Measurement is a process of determining the numerical value of size of the item to describe its properties in a measurable unit

Measuring Instruments:

Measuring instruments are devices that transform the measured quantity in to an indication or information.

Deviation in measurement

The objective of any measurement is to determine the value of the measure and, that is the specific quantity subject to measurement. A measurement should, therefore, begin with an appropriate specification of the measure and, the identification of the generic method of measurement in the form of a functional model, and a related measurement procedure

Making only one measurement means that a mistake could go completely unnoticed. If you make two measurements and they do not agree, you still may not know which is 'wrong'. But if you make three measurements, and two agree with each other while the third is very different, then you could be suspicious about the third. So, simply to guard against gross mistakes, or operator error, it is wise to make at least measurements. In majority of the test procedures for footwear and allied materials, we will see that the standard defines the no. of samples to be tested.

In general, no measurement or test is performed perfectly and the imperfections in the process will give rise to error in the result. Consequently, the result of a measurement is, at best, only an approximation to the true value of the measurement.

Every time a measurement is taken under nominally the same conditions, random effects from various sources influence the measured value. A series of measurements therefore produces a scatter of values distributed around a mean value. A number of different sources may contribute to variability each time a measurement is taken, and their influence may be continually changing. They cannot be eliminated by the application of correction factors but the uncertainty in the mean value due to their effect may be reduced by increasing the number of observations.

Deviation in measurements (On the same material, in the same laboratory / Inter laboratory) may arise due to the following factors

• Incomplete definition of the test; i.e. the requirement is not clearly described, for example the temperature of a test may be given as "room temperature";

• Imperfect realization of the definition of the test procedure; even when the test conditions are clearly defined it may not be possible to produce the required conditions;

• Inadequate knowledge of the effects of errors in the environmental conditions on the measurement process;

• Imperfect measurement of the environmental conditions;

• Sampling; the sample may not be truly representative;

The material by its own inherent nature (For e.g., leather being a natural material) may not give consistent readings.

The test itself (for example- Bonding strength between sole and upper) in complete footwear may not give consistent readings.)

• Personal bias in reading analogue instruments; parallax errors;

• Instrument resolution, or the discrimination threshold, or errors in the graduation of the scale;

• Values assigned to measurement standards (both reference and working) and reference materials;

• Changes in the characteristics or performance of a measuring instrument since its last calibration; incidence of drift;

• Errors in values of constants, corrections and other parameters used in data evaluation;

• Approximations and assumptions incorporated in the measurement method and procedure;

•Variations in repeated observations made under apparently identical conditions; such random effects may be caused, for example, by short-term fluctuations in local environment, e.g. temperature, humidity and air pressure, or by variability in the performance of the tester.

5.4 Fundamental of Calibration

Calibration is a comparison of measuring equipment against a standard instrument of higher accuracy to detect, correlate, adjust, rectify and document the accuracy of the instrument being compared. Typically, calibration of an instrument is checked at several points throughout the calibration range of the instrument. The calibration range is defined as “the region between the limits within which a quantity is measured, received or transmitted, expressed by stating the lower and upper range values.”

Why Is Calibration Required?

It makes sense that calibration is required for a new instrument. We want to make sure the instrument is providing accurate indication or output signal when it is installed. But why can’t we just leave it alone as long as the instrument is operating properly and continues to provide the indication we expect?

Instrument error can occur due to a variety of factors: drift, environment, electrical supply, addition of components to the output loop, process changes, etc. Since a calibration is performed by comparing or applying a known signal to the instrument under test, errors are detected by performing a calibration. An error is the algebraic difference between the indication and the actual value of the measured variable.

To detect and correct instrument error, periodic calibrations are performed. Even if a periodic calibration reveals the instrument is perfect and no adjustment is required, we would not have known that unless we performed the calibration. And even if adjustments are not required for several consecutive calibrations, we will still perform the calibration check at the next scheduled due date. Periodic calibrations to specified tolerances using approved procedures are an important element of any quality system.

All calibrations should be performed traceable to a nationally or internationally recognized standard. For example, the United States, the National Institute of Standards and Technology (NIST), formerly National Bureau of Standards (NBS), maintains the nationally recognized standards. Traceability is defined as “the property of a result of a measurement whereby it can be related to appropriate standards, generally national or international standards, through an unbroken chain of comparisons.” Note this does not mean a calibration shop needs to have its standards calibrated with a primary standard. It means that the calibrations performed are traceable to NIST through all the standards used to calibrate the standards, no matter how many levels exist between the shop and NIST.

Self-Check 5	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

1. What is measurement (1 point)
2. What do you mean by accuracy in measurement (2 point)
3. Why it is important to do testing (2point)
4. Define purpose of calibration (2 point)
5. State the methods by which we can control the quality of Raw Material (point 3)

LG #32	LO #2- Perform sampling of the test pieces

Instruction sheet

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

- Test required on the material or the footwear
- Numbers of test pieces
- Test pieces
- Cut the pieces from the standard sample test material
- Mark the test pieces and allocate and recording test numbers
- List the left out piece of the material and allocate corresponding test number
- Carrying out conditioning of the test piece

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

- Determine the test required on the material or the footwear
- Determine numbers of test pieces
- Select the test pieces
- Cut the pieces from the standard sample test material
- Mark the test pieces and allocate and recording test numbers
- List the left out piece of the material and allocate corresponding test number
- Carry out the conditioning of the test piece

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished

answering the Self-checks).

6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Test required on the material or the footwear

1.1 Introduction to Standards:

Standards are documented, voluntary agreements which establish important criteria for products, services and processes. Standards, therefore, help to make sure that products and services are fit for their purpose and are comparable and compatible.

Some of the important International standards for shoes testing are:

- Shoes and Allied Trades Research Association (SATRA)
- European Norms
- International Organization for Standardization (ISO Norms)
- Deutsche Institute fur Normung (DIN Norms)
- Australian and Canadian Norms for Safety Shoes Testing
- American Society for Testing and materials (ASTM)
- American Association of Textile Chemists & Colorists (AATCC)
- Bureau of Indian Standards (BIS)

1.1.1 SATRA (Shoe and Allied Trades Research Association)

SATRA Technology Centre (SATRA) is a research and technology centre. Founded as the British Boot, Shoe and Allied Trades Research Association in 1919, it has since extended its expertise to cover other consumer product industry sectors including furniture, safety products, clothing, floor coverings, leather goods, home ware, and cleaning technology. It is partly funded through membership, which includes 1,600 companies in over 70 countries.

SATRA is also a Notified Body for EU Directives on personal protective equipment, toys and construction products

SATRA is one of the most reputed institutions in the field of footwear testing and technology. SATRA has comprehensive facilities for testing

All types of materials including leathers, textiles, rubbers, plastics, metals and ceramics.

Consumer products including footwear, clothing, personal protective equipment, sportswear, furniture, upholstery and bedding, floor coverings, household textiles and home ware.

Other types of products include automotive, medical and construction products.

SATRA is the originator of:

- Test equipment

- Performance guidelines
- Retail specifications

SATRA is accredited by UKAS to ISO 17025 standard. SATRA has developed more than 250 test methods for testing various physical and mechanical properties along with its own performance guidelines. SATRA can test to national, European and international standards. For most materials and products they have their own unique fitness-for-purpose performance guidelines. The guidelines

Much of the test equipment used in SATRA's laboratories has been designed and constructed in-house by its commercial Test Equipment Division.

A SATRA test report is accepted worldwide.

Backed by 80 years' experience in testing materials and products for a variety of markets, SATRA has international recognition. SATRA assists a huge number of companies throughout the global supply chain. These companies who export to the USA and European Union use SATRA's accreditation awards to assure their customers that they have reached and can maintain internationally-recognized standards of design and manufacture.

Some of the SATRA Test methods (TM) are:

SATRA TM1	Nov 04	Thickness of leather and insole materials
SATRA TM2	May 95	Tensile properties of insole materials
SATRA TM3	Mar 99	Flexing index
SATRA TM8	Jun 04	Colour fastness to circular rubbing
SATRA TM29	Nov 92	Breaking strength and extension at break
SATRA TM30	Sep 95	Tear strength - trouser leg method
SATRA TM31	Apr 03 (2005)	Abrasion resistance - Martindale method
SATRA TM43	Jun 00	Tensile strength and extension at break of leather
SATRA TM48	Aug 96	Determination of grain crack index for sole leathers
SATRA TM60	Jul 92	Ross flex test - resistance to cut growth on flexing
SATRA TM64	Jan 96	Compression set - constant stress method
SATRA TM65	May 92	Split tear strength
SATRA TM68	Nov 92	Density of cellular materials
SATRA TM 173		Colour fatness to rubbing (Reciprocating method)
SATRA TM 174		Sole Abrasion
SATRA TM 137		Tensile strength & % elongation (Rubber and Plastic)

1.1.2 ISO (International Organization for Standardization)

ISO standards are developed by a technical committee and supported worldwide.

ISO (International Organization for Standardization) is the world's largest developer of voluntary International Standards. International Standards give state of the art specifications for products, services and good practice, helping to make industry more efficient and effective. Developed through global consensus, they help to break down barriers to international trade.

Purpose

ISO develops International Standards. ISO was founded in 1947, and since then have published more than 19 500 International Standards covering almost all aspects of technology and business. From food safety to computers, and agriculture to healthcare, ISO International Standards impact all our lives.

ISO Is network of national standards bodies. These national standards bodies make up the ISO membership and they represent ISO in their country.

Functioning of ISO:

ISO is an independent, non-governmental organization made up of members from the national standards bodies of 161 countries. it has a Central Secretariat in Geneva, Switzerland, that coordinates the system.

The ISO began in 1946 when delegates from 25 countries met at the Institute of Civil Engineers in London and decided to create a new international organization 'to facilitate the international coordination and unification of industrial standards'. In February 1947 the new organization, ISO, officially began operations.

Since then, it has published over 19 500 International Standards covering almost all aspects of technology and manufacturing.

Benefits of ISO International Standards:

ISO International Standards ensure that products and services are safe, reliable and of good quality. For business, they are strategic tools that reduce costs by minimizing waste and errors and increasing productivity. They help companies to access new markets, level the playing field for developing countries and facilitate free and fair global trade.

The ISO standards are developed by the people that need them, through a consensus process. Experts from all over the world develop the standards that are required by their sector. This means they reflect a wealth of international experience and knowledge

1.1.3 European standards (EN)

European standards are developed when there is a significant industry, market or public need. For example, industry could need a standard to ensure the interoperability of a product or service. The market might use a standard to make sure that competition was fair. The public would benefit from a standard which improved the quality and safety of a product or service. European standards are also developed to help people comply with European legislation on policies such as the single market.

In fact, most standards are developed for a combination of reasons and give many different benefits to a variety of stakeholders.

Development of EN:

In theory, requests for new standards can come from anywhere and anyone. Once a request has been formally made, it finds its way through the different procedures and is given to the most appropriate committee. It is there that the decision is taken on whether a standard should, and could, be developed.

Self-Check 1	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

Fill in the Blanks:

1. ISO stand for ------------
2. SATRA stand for ---------
3. EN originates from---------

Short answer questions:

1. What are objective of inspection? (4 points)
2. Name three stages of inspection? (3 points)
3. Why quality control is needed? (2 point)
4. What do you mean by quality and reliability (5 points)

Information Sheet 2- Number of test pieces

2.1 Sampling:

Sampling is a defined procedure whereby a part of a substance, material or product is taken to provide for testing of a representative sample of the whole. Sampling may also be required by the appropriate specification for which the substance, material or product is to be tested.

2.1.1 Sampling Methods:

The sampling method may be one of the most critical aspects of the entire testing procedure and may be a major contributor to the overall uncertainty of measurement.

The laboratory must be assured that the samples for testing have been taken by a skilled person following approved sampling procedures and a formal sampling plan

If the laboratory is not directly responsible for sampling or has no assurance that samples truly representative of the bulk of product to be assessed, the laboratory must protect itself thus:

Each test report shall carry a statement such as:

"Result relate only to the sample as received"

Sampling procedure:

- Identification of the person who performed sampling
- Environmental condition of sampling
- Identifying the sampling location
- Statistics the sampling procedures are based on
- Customer sampling deviation recorded and reported on test report.

When the customer requires deviation, additions, or exclusions from the documented sampling procedure, they must be recorded in details with appropriate sampling data and included on all documents containing test results and communicated to appropriate personnel.

2.1.2 Sampling requirement under different test:

a. Tensile strength test of Leather:

Sampling method, Requirement & determination of test piece:

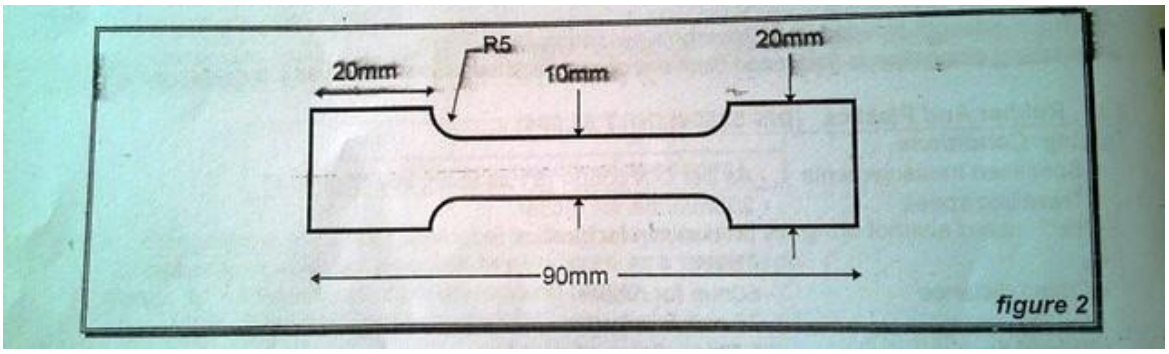
With the grain surface of leather uppermost use the press knife to cut the six test specimens as per the given dimensions cut three with their longer edges parallel to the backbone, or along direction of the leather and three at 90 degree to this direction, in the across direction.

When testing a cutting of leather of unknown origin, assign the tighter direction as along or principal direction. When sampling leather footwear; assign the heel-toe direction as the along or principal direction.

Mark "along" direction of material on each of the test specimens

If measurement of tensile stress or extension at a grain crack is also required prepare a further set of test specimens as per the procedure mentioned.

Determination of Test Piece:



b. Color fastness to circular Rubbing (Dry & wet)

Test Specimens

Test specimens should be of a sufficient size to allow them to be fixed firmly to the test platform. When using a SATRA rub fastness tester conveniently sized samples can be either squares of 60 mm x 60 mm, or circles 60 mm diameter; alternatively a 60 mm wide strip can be used for several tests.

Procedure

Dry rub test

Secure the test specimen on to the horizontal platform of the test machine and configure the machine to operate with a fixed force of 24.5 N.

Secure a dry felt pad onto the spindle of the test machine.

Bring the felt pad and the test specimen into contact and run the machine for the required number of revolutions. If necessary, take precautions to avoid thermal. Lift the felt pad clear of the test specimen surface

Wet rub test

Secure the test specimen onto the horizontal platform of the test machine and configure the machine to operate with a fixed force of 7.1 N.

Immerse the felt pads in cool distilled water and bring to the boil. Continue to boil for 60 seconds, and allow cooling to room temperature. Remove the pads from the water immediately before use but reject any that are excessively swollen or soft. Pads should not be kept in water for more than 24 hours. Unused wet pads should be discarded after 24 hours and fresh wet pads prepared as necessary.

Adjust the amount of liquid in the pad by gently squeezing the excess from it so that when it is fixed to the spindle and lowered onto the test piece a little liquid is squeezed out to form a rim round the pad.

Bring the felt pad and the test specimen into contact and run the machine for the required number of revolutions**.**

Lift the pad clear of the test specimen surface, dry the felt pad and test specimen as section 8.2 and proceed.

Perspiration rub test

Set up the test machine as described in section 6.3.1 and wet the pad as described

Gently squeeze the excess water from the felt pad and immediately immerse it in the synthetic perspiration solution as described in section 4.5 for five minutes. Remove the felt pads from the perspiration solution, reject any that are excessively swollen and proceed as in sections 6.3.3 - 6.3.5.

White spirit rub test

Set up the test machine as described

Immerse a felt pad in white spirit for thirty seconds. Reject any felt pads that are excessively swollen

Dry rub test after wetting from the back with organic solvent

Place the plate on the test machine platform fit a dry felt pad into the hole in the plate and wet it evenly with 2.5 ± 0.1 cm3 of the organic solvent

Immediately secure the test specimen over the pad, and configure the machine to operate with a fixed force of 7.1N. Secure a dry felt onto the spindle. Bring the felt pad into contact with the specimen and leave for 60 ± 2 seconds. Run the machine for the required number of revolutions and lift the pad clear of the test specimen.

To make the assessment of color transfer easier it is recommended that each pad is cut in half and is placed against half of an unused pad

Under artificial lighting conditions daylight compare the contrast between tested and non-tested areas with the ratings on the relevant geometric grey scale “Degree of staining" for color transfer and "Change in color" for marring). If the assessment falls between two ratings on the grey scale then quote the lowest number of the two grey scale ratings, i.e the worst case.

c. Upper/outsole Bond strength

Principle

The force required to separate the upper from the outsole, or to separate adjacent layers of the outsole, or to cause tear failure of the upper or the sole is measured. The test is not applicable when the bond has been made by grindery (using e.g. nails or screws) or stitching.

NOTE: In all cases the objective should be to test the bond strength nearest to the edge of the assembly.

Apparatus

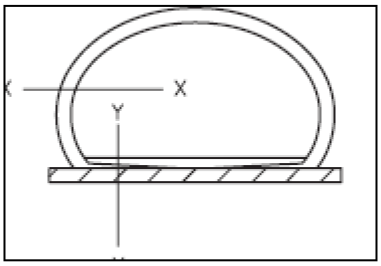
Tensile machine, a means of continuously recording load, with a jaw separation rate of (100 ± 20)mm/min and a force range of 0N to 600N. The machine shall be fitted with either pincers or flat jaws (depending on the construction of the test sample), (27,5± 2,5)mm wide, capable of firmly gripping the test pieces.

Preparation of test pieces

- Method 1: For constructions where the sole edge projects sufficiently beyond the side of the upper to provide a portion which can be gripped during the test.The test specimen is cut across the lasted margin.
- • Method 2: For other constructions the specimen is cut parallel to the edge of the sole. Each specimen is then peeled using a tensile testing machine and the force required to separate the upper from the sole is measured. In all cases the objective is to test tile bond strength nearest to the edge of the assembly which Will be exposed to wear.

Sole/upper bond strength: construction type

Take a test piece from either the inner or the outer joint region.



Method-1

Make cuts at X-X and Y-Y at right angles to the edge of the sole, insole or outsole to produce a test piece about 25 mm wide. The length of the upper and sole shall be about 15 mm measured from the feather line Remove the insole.

Sole/upper bond strength: construction

Take a test piece from either the inner or outer joint region.

Cut the upper and sole at X-X and Y-Y to produce a test piece with a width of about 10 mm and a length of not less than 50 mm. Remove the insole.

Separate the upper from the sole for a length of about 10 mm by inserting a hot knife in the adhesive layer.

Measurement of bond strength

Before carrying out the test, measure the width of the test piece to the nearest mm at several points using a calibrated steel rule and calculate the average value to the nearest mm. Then measure the bond strength on a minimum length of 30 mm in one of the following ways.

For sole/upper bond strength clamp the test piece into the jaws of the tensile machine, using a pincer jaw to grip the short edge of the sole and record the load/deformation graph at a jaw separation speed of (100 ± 20) mm/min.

For sole/upper bond strength and sole interlayer bond strength clamp the separated ends of the test piece in the flat jaws and record the load/deformation graph at a jaw separation speed of (100 ± 20) mm/min.

Calculation and expression of results

Determine, from the load/deformation graph, the average peeling load in Newton and divide by the average width to give the bond strength in N/mm.

d. Sole Flexing test (Bennewart Flexing)

Apparatus

Testing device, as illustrated in Figure, The test piece shall be guided in such a way that on one side it can be bent at an angle of 90° about a mandrel with a radius of 15 mm.

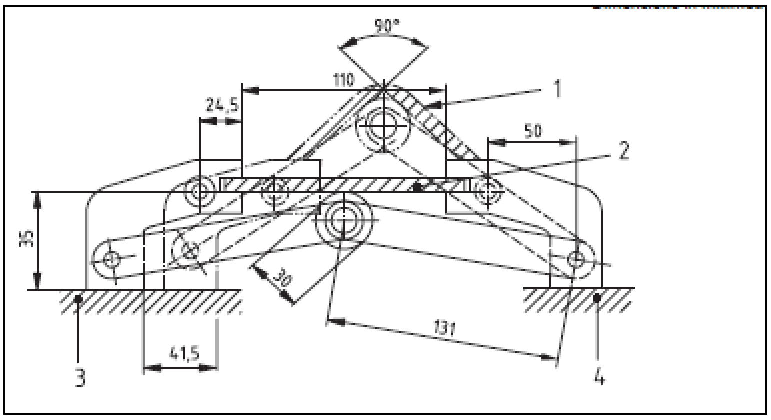


Figure Testing device for flexing resistance of outsole

Key

1. test piece at maximum flex position
2. test piece at the neutral flex position
3. moveable bearing
4. fixed bearing

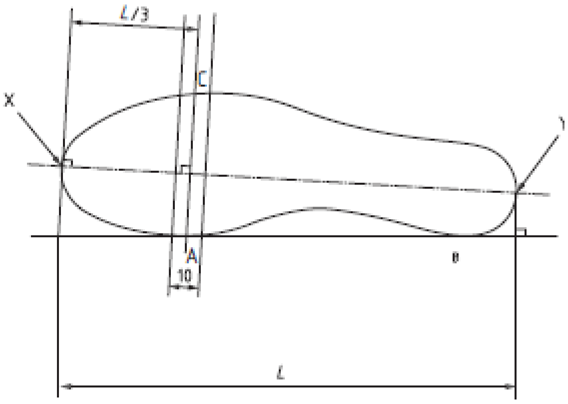
Measuring magnifier (Eye piece), with an accuracy of 0,1 mm.

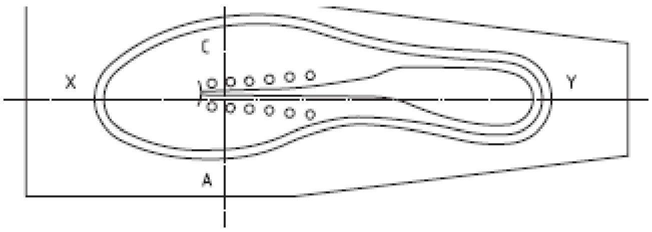
Preparation of the test piece

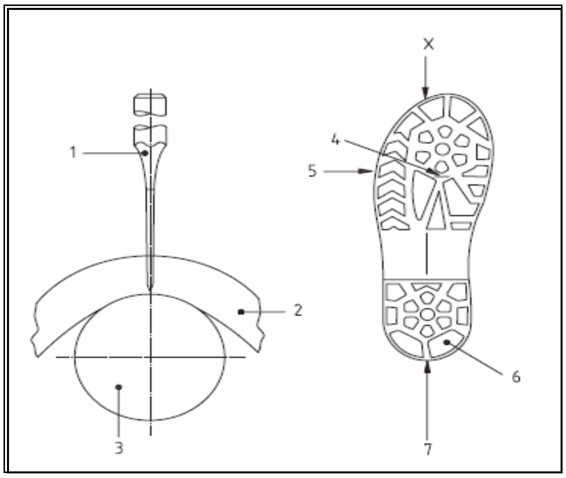
Take the bottom of the footwear with the insole, separated from the upper, as the test piece.

Define the flexing line in accordance

Mark a point, for the later insertion of a cut, as follows:







Key

1. cutting tool
2. test piece
3. mandrel of the test machine, radius 15 mm
4. single incision on the line of maximum stress

5. auxiliary line AC, parallel or on the line of maximum stress
6. cleats
7. longitudinal axis XY

e. Sole incision

Procedure

Ensure that the testing device is at the neutral flex position (see Figure) and clamp the test piece into the device in such a way that the flexing line AC is parallel with the central roller and the cut position marked is directly above the centre roller. If the sole unit is naturally curved, the clamping procedure shall be carried out so that the sole comes close to the centre roller under no load. Manipulate the machine until the test piece is in the maximum flexed, extended or stretched state. Make a single incision at the point marked in with the blade of the cutting tool parallel to the flexing line AC. The cutting device shall pass through the full thickness of the outsole and into the insole or equivalent layer. If the product contains a penetration resistant insert, only cut until contact with this is made.

If there are several materials constituting the sole, another incision shall be made, but it is necessary to avoid the cut in a region of 15 mm from the edge of the sole.

Measure the initial length of the cut at the surface of the test piece using the measuring magnifier Carry out 30 000 cycles starting from the maximum flexed, extended or stretched state, with the test piece undergoing deformation at a constant rate value between 135 cycles/min and 150 cycles/min.

At completion of the 30,000 cycles, the testing device should not be left in the fully flexed position.

After 30 000 cycles, measure the final length of the cut at the surface of the test piece using the measuring magnifier. The number and dimensions of spontaneous cracks shall be recorded if present.

Cut growth = (final cut length) - (initial cut length).

Self-Check 2	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

1. What are the key points for sampling procedure (2 point?)
2. What is the principal direction in leather footwear for tensile strength test (1 point?)
3. How to evaluate grain crack and bursting in lactometer test? (2 point)
4. Why it is necessary to measure width of sample in sole bond peel strength test (2 point)
5. What is the speed of Benn wart flexing machine (1point?)
6. Find the tensile strength of leather for given maximum force 40 kgf and cross section area 0.12 cm^2? (2 points)

Information Sheet 3- Test pieces

The test piece is selected accordance to the Procedure listed in the international standard.

Please refer to the information sheet 2.2 of learning guide #2.

Information Sheet 4- Cut the pieces from the standard sample test material

Refer to: Basic Footwear Production Operations Level 1

Module Title: Operating Footwear Cutting M/c

Information Sheet 5- Mark the test pieces and allocate and recording test numbers

The test piece are marked and test numbers are allocated and recorded

Please refer to the information sheet 5.1 of learning guide #5.

Information Sheet 6- List the left out piece of the material and allocate corresponding test number

6.1 Storage system of left out pieces:

Laboratory should have system for the, receipt, handling, protection, storage, retention and/or disposal of test items, including all provisions necessary to protect the integrity of the test item, and to protect the interests of the laboratory and the customer.

The laboratory should have a system for identifying test items. The identification shall be retained throughout the life of the item in the laboratory. The system shall be designed and operated so as to ensure that items cannot be confused physically or when referred to in records or other documents. The system shall, if appropriate, accommodate a sub-division of groups of items and the transfer of items within and from the laboratory.

Upon receipt of the test item, abnormalities or departures from normal or specified conditions, as described in the test method, shall be recorded. When there is doubt as to the suitability of an item for test, or when an item does not conform to the description provided, or the test required is not specified in sufficient detail, the laboratory shall consult the customer for further instructions before proceeding and shall record the discussion.

The laboratory shall have procedures and appropriate facilities for avoiding deterioration, loss or damage to the test or calibration item during storage, handling and preparation. Handling instructions provided with the item shall be followed. When items have to be stored or conditioned under specified environmental conditions, these conditions shall be maintained, monitored and recorded. Where a test item or a portion of an item is to be held secure, the laboratory shall have arrangements for storage and security that protect the condition and integrity of the secured items or portions concerned.

Where test items are to be returned into service after testing, special care is required to ensure that they are not damaged or injured during the handling, testing or storing/waiting processes.

Reasons for keeping a test item secure can be for reasons of record, safety or value, or to enable complementary tests to be performed later.

6.2 Retention Period:

The tested items should be retained as per the defined period. for example minimum of three months with proper identification in such a way sample can be easily traceable (sample number, month and year)

6.3 Traceability:

Property of the result of a measurement of the value of a standard whereby it can be related to stated reference usually national or international standard through an unbroken chain of comparisons all having stated uncertainties

Self-Check 6	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

1. Why it is necessary to maintain a proper storage system (2 points)
2. What should be the minimum retention period ---------------- (2 points?)
3. What is traceability? (2 points)
4. How to identify the preserved sample (2 points)
5. What precautions should be taken after test items are brought in service? (2 points)

Information Sheet 7- Carrying out conditioning of the test piece

7.1 Need of conditioning of samples:

The properties of materials and behavior of equipment under test are influenced by atmospheric conditions, such as the temperature, the relative humidity and the pressure of the ambient air at the time of the test. For comparison of test results obtained by different test laboratories/testing centres, it becomes necessary to specify standard atmospheric conditions and conditioning procedures, under which the test should be carried out or at which specimen should be conditioned before the test.

The principal considerations that would justify the adoption of a set of conditions may be enumerated in short as follows:

a) Temperature and humidity conditions specified should be suited to a majority of tests requiring standard atmospheric conditions;

b) Equipment required to maintain the standard conditions should be economical to install and easy to maintain; and

c) The standard conditions should be within the comfort zone for workers.

Although the necessity for having an internationally agreed set of standard atmospheric conditions for test is realized, the wide divergence of the atmospheric conditions in the temperate and tropical or sub-tropical regions indicates that the same test conditions may not be suitable for all the zones. This aspect was examined in great detail by the several technical committees of ISO and IEC, and the Co-ordinating Committee on Atmospheric

Conditions for Testing (ATCO) of ISO, in collaboration with IEC, has recommended the following three sets of standard atmospheric conditions from which the individual countries could choose whichever is most suitable to them:

a) 20°C with 65 percent relative humidity

b) 23°C with 50 percent relative humidity

c) 27°C with 65 percent relative humidity

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a) 20°C with 65 percent relative humidity

b) 23°C with 50 percent relative humidity

c) 27°C with 65 percent relative humidity

In many cases, measurements are necessarily made at ambient conditions in an uncontrolled atmosphere, for example, electric motors, generators, transformers, switchgear, etc, are tested in the atmospheric conditions existing at the time and at the place where measurement are made and no question of controlled atmosphere arises in such cases.

In most industrial testing, it is seldom necessary to control the atmospheric pressure as is done in the case of temperature and humidity. Tests are normally carried out at the prevailing atmospheric pressure. Tolerance limits for pressure, therefore, have different significance in different cases depending on the pressure sensitivity of the characteristic to be measured.

7.2 Effect of sample conditioning:

Effect of Temperature & humidity: Temperature & Humidity affects many properties of air, and of materials in contact with air. Water vapour is key agent in both weather and climate. A huge variety of manufacturing, storage and testing process are temperature & humidity-critical. These measurements are used wherever there is a need to prevent condensation, corrosion, mould, warping or other spoilage of products. This is highly relevant in testing of Leather Product, chemicals, fuels, wood, paper, and many other products.

Temperature & humidity is one of the most important parameters in monitoring or managing processes in science, technology and industry. For example, if the temperature and humidity of a leather testing laboratory is not as per the standard, the result obtained may not be accurate (eg; Water vapour permeability, water vapour absorption Tensile, Tear strength etc.)

The natural fibers of leather will break down with the passage of time. Acidic leathers are particularly vulnerable to red rot, which causes powdering of the surface and a change in consistency.

Exposure to long periods of low relative humidities (below 40%) can cause leather to become desiccated, irreversibly changing the fibrous structure of the leather. Chemical damage can also occur from exposure to environmental factors, including ultraviolet light, ozone, acid from sulfurous and nitrous pollutants in the air, or through a chemical action following any treatment with tallow or oil compounds. Both oxidation and chemical damage occur faster at higher temperatures.

Self-Check 7	Written Test

Name: ________________________ Date: ______________

1. Why samples are required conditioning before testing (2 points)

2. What are the ambient temperature and humidity to be maintained in Lab (2 points)

3. Give name of tests for which the result may not accurate if sample is being not conditioned (2 points)

4. Explain briefly effect of Temperature and humidity on natural fiber. (2 points)

5. Explain briefly change in appearance of sample by changing Temp and Humidity. (2 points)

LG #33	LO #3- Determine the Condition of Test Equipment

Instruction sheet

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

- Determine the condition for the testing
- Identify the tools and equipment required for testing
- Verify the machines for the accuracy of the result
- Checking the least count of the machine
- Checking the testing condition of the machines such as temperature and humidity
- Checking the gauges for accuracy

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

- Determine the condition for the testing
- Identify the tools and equipment required for testing
- Verify the machines for the accuracy of the result
- Check the least count of the machine
- Check the testing condition of the machines such as temperature and humidity
- Check the gauges for the accuracy

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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Determination of Condition of Testing

1.1 Conditioning Methods:

A laboratory is any place where measurements, test, calibrations are carried out.

The laboratory facilities for testing or calibration shall be such as to facilitate correct performance for test and/or calibrations. The laboratory shall ensure that the environment does not invalidate the results or adversely affect the required quality of any measurement.

The environment is the set of conditions that may influence the test and/ or measurement result. Considering Temperature and humidity

The laboratory must be equipped with the appropriate accommodation and environment conditions

The laboratory with specific requirement must have monitor, control, and record condition as required.

Testing must be stopped when the testing conditions jeopardize the test results.

There must be effective separation between neighboring areas where activities there in are incompatible.

Restricted area must be labeled as such and controlled to prohibit unauthorized access.

Laboratory must document the measures taken to ensure good house keeping

Terms and definitions

Atmosphere

Ambient conditions define by the parameter temperature and RH

Standard atmosphere

Atmosphere maintained within prescribed tolerance. In which attest piece is kept for a given period of time. Before being subjected to testing, the air should be free moving to ensure to uniformity of atmosphere.

Conditioning:

Standard Atmosphere

The standard atmosphere and tolerance

Designation	Temperature Degree centigrade	Relative humidity%
20/65	20±2	65±5
An alternative but not equivalent set up conditions may be used.		
23/50	23±2	50±5

Conditioning of sample:

All test pieces shall be conditioned in a standard atmosphere as mentioned below minimum for 48hrs before testing unless otherwise stated in test method

Standard Atmosphere

The standard atmosphere and tolerance

Designation	Temperature Degree centigrade	Relative humidity%
20/65	20±2	65±5
An alternative but not equivalent set up conditions may be used.		
23/50	23±2	50±5

The maximum time which is elapse between removal from the conditioning atmosphere and the start of testing shall not been greater than 10 minutes unless otherwise stated in test method

Testing:

Carry out the testing in same standard atmosphere as that in which the test piece was conditioned unless otherwise specified in the individual test method.

1.2 Measurements of the parameters

The term metrology covers the science of measuring i.e knowledge and experience . Measuring is the experimental procedure where by a special value of physical quantity or a multiple or fraction of such unit is determined. This physical quantity is the measured quantity. The measured value is the special value of the measured quantity to be determined and is expressed as a numerical value and a unit. Processing the data to the measuring results is also part of measuring. In metrology measuring is often termed as determination or in case of comparing standards, termed as “linking”

Further there are two more terms, which are also significant in the area of metrology. These are calibration and adjusting. Calibration is the determination of relationship between output quantity and input quantity. The indication error of scale is determined by calibration. On the other hand adjusting a measuring instrument means setting the devices so that the display deviates as less as possible from the correct value or the errors are kept within prescribed limits. Thus adjustment generally requires some alteration to the measuring instrument.

Temperature and humidity conditions inside the testing or calibration laboratory must be regularly monitored and recorded.

I. Temperature gauge:

Temperature is one of the most common types of physical measurements. You can measure temperature in various environments . Depending on the desired accuracy, range, and expense, you have several sensor options for measuring temperature.

Thermometers:

A thermometer is a device in which a property that changes with temperature is measured and used to indicate the value of the temperature.

In a mercury thermometer the liquid expands as the temperature increases, so changing the length of the mercury column in the capillary glass stem. The temperature is indicated by a scale marked on the glass, in degrees.

In an electrical thermometer a measurement is made of a resistance or a voltage which depends on temperature, and a conversion algorithm enables the temperature to be displayed. A radiation thermometer senses the heat radiated and, again, an electrical signal is processed in order to display the temperature.

To be useful, the thermometer must have some other properties. It must be

• *Repeatable*, so that the measured property of the device has the same value (or very nearly so) whenever the temperature is the same. In particular, the device should withstand exposure to temperatures within its range of use

•*Sensitive* to temperature but *insensitive to things other than temperature*, so the measurement should not depend on factors such as the humidity or pressure

• *calibrated*, so the measured property (length, resistance, etc) can be reliably converted to temperature. If the instrument reads directly in temperature, the calibration shows how accurate the reading is *convenient to use*. Factors such as size, ruggedness, speed of response, immunity to electrical interference, etc, and cost, will be important to varying degrees in different applications.

The majority of scientific and industrial temperature measurements use resistance thermometers, thermocouples or radiation thermometers, and the measurements are often automated. They can be used at very low or very high temperatures with good accuracy and the instrumentation can be very sophisticated, with multiple measurement channels and feedback for process control, etc. The next section and Section 4 are concerned with contact thermometers; non-contact radiation thermometers are treated in Section 3.

Hygrometer

A hair tension dials hygrometer with a nonlinear scale

A **hygrometer** is an instrument used for measuring the moisture content in the atmosphere. Humidity measurement instruments usually rely on measurements of some other quantity such as temperature, pressure, mass or a mechanical or electrical change in a substance as moisture is absorbed. By calibration and calculation, these measured quantities can lead to a measurement of humidity. Modern electronic devices use temperature of condensation or changes in electrical capacitance or resistance to measure humidity differences.

Temperature & Humidity Data Recording:

In Life Science facilities, Metrology/testing/Calibration labs and Electronics manufacturing environments, temperature and humidity often need to be displayed for monitoring and alarmed 24/7 to safeguard products and processes. In monitored environments, reporting on real-time data to ensure conditions are "in-spec" is critical.

In cases where certain personnel are accountable for ensuring temperature or humidity remain within appropriate parameters; an alarm notification is also necessary to ensure people aren’t chained to a PC that is displaying current readings. Ideally, the alarm system should come to where you are; pagers, email and cell phones should all be able to relay an alert.

Additionally, historical records, which are easily compiled and stored, are requisite for quality reviews and audits, as well as meeting regulatory and accreditation requisites. Ensuring that this data is free of gaps can be a challenge when most systems are both power and network dependent. If there is a power outage, the data will not be collected; likewise, if your Network fails temporarily.

Although most buildings are equipped with centralized systems for heating and air conditioning, most of these systems can't fulfill accurate, industry-specific monitoring, recording and reporting requirements. Depending on the needs of the application, the choices come down to one or more of three methods: Manual penand- paper systems, chart recorders, or a secondary centralized hard-wired system.

Each of these methods offers various advantages and disadvantages that depend on how they are being used. Consequently, facility managers often have to make difficult compromises to get the temperature monitoring system that fits both their needs and their budget.

While systems that are based on a network or mechanical devices like chart recorders come with the inherent risks of lost and inaccurate data, it is possible to assemble a monitoring system that combines all the advantages of other methods with none of the downsides. Such a system would take all the elements of a centralized monitoring system that save time and money, while sacrificing nothing in terms of accuracy or data integrity. In order to understand the benefits and risks of each monitoring and alarm method, it will be helpful to look at each method separately.

The Simplest System: Manual Data Collection

Surprisingly, manual humidity and temperature data collection methods are still in wide use today. Manual collection involves one or more operators recording initialed readings on a regular basis from a fixed read-out device (such as a digital thermometer or hygrometer). These readings are usually entered on a prominently displayed chart next to the area of interest, such as a refrigerator, freezer, or chamber. Recording temperature and humidity readings in this manner has some obvious advantages; there is minimal equipment to purchase and there is next to nothing to maintain.

However, manual systems are inherently time-consuming to operate and error prone, making them unsuitable for most critical environments. One hospital estimated labor costs of 3,000 hours per year were taken up performing routine checks on monitored environments. Typically, the personnel required to manually record temperature were nurses concurrently tasked with patient care. The same hospital frequently had to deal with missing data that impacted their need to meet regulatory requirements. Worse: critical products were at risk because of an unreliable, error-prone system.

When the system was audited, it was found that the risks to product increased during off-hours, when limited resources resulted in missed temperature checks.

Problems could easily go undetected for days, resulting in serious damage or loss.

One Step Up: Chart Recorders

Chart recorders are one of the most popular ways to automatically collect and locally display data. They record and display operating data on paper charts which are then changed regularly and archived, usually on a weekly basis. Chart recorders are relatively easy to deploy, power wiring is usually all that's required and they have often been included as a built-in feature of various equipment.

Although expensive, chart recorders are simple to operate and provide local display of real-time and short-term historical data. Many of the issues with manual collection are eliminated by chart recorders.

But for all their advantages, chart recorders are still dependent on manual processes to function properly. Charts and pens must be changed regularly or else valuable information is lost. Being mechanical devices, they cannot provide the kind of measurement accuracy that critical monitored environments require. Chart recorders are prone to periodic mechanical failures and require frequent recalibration.

In addition, in today's increasingly networked world, the inherent inability of chart recorders is quickly making them obsolete. Isolated devices that cannot be monitored remotely or access a variety of communications vehicles (email, pagers, cells) make retrieving data—required when the auditors arrive—a time-consuming and tedious process.

Wired Back to a Central Location: CM Systems

Centralized monitoring (CM) systems for temperature and humidity consist of a network of remote sensors that are literally wired back to distributed or centralized input panels. Not to be confused with Building Automation Systems, a CM system is an auxiliary system tailored to the specific monitoring and reporting requirements of a particular industry.

CM systems offer many advantages including remote temperature monitoring, alarming, and reporting. By avoiding the need for manual data collection and chart replacement, such systems are a significant time-saving alternative to chart recorders and manual methods.

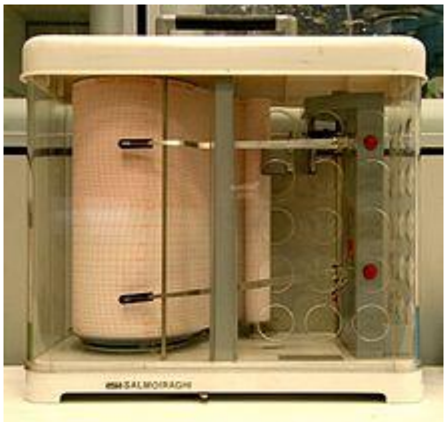
The main drawback to these systems is that they are costly, vulnerable to system wide failures and limited in their ability to display localized information. A typical

CM system requires expensive data acquisition equipment as well as a proprietary hard-wired network. Installation and wiring costs can often be prohibitive, particularly in older buildings. The large capital expense of such systems can also lead to a protracted budget approval process.

Centralized systems are also prone to global failures that can result in missed records and unreliable reporting. For example, system viruses, computer crashes, network failures, power outages, or operator errors can interrupt the data collection process throughout the whole system.

An oft overlooked issue with CM systems is their inability to display data on a localized basis, a key requirement in many industries. Instead, data can only be viewed or retrieved at one central location.

1.2 Method of recording the parameter:



A thermo-hygrograph

A Thermo-Hygrograph is a chart recorder that measures and records both temperature and humidity (or dew point). Similar devices that record only one parameter are a thermograph for temperature and hygrograph for humidity. Uses a bi-metallic strip for temperature and one human hair bundle for humidity Includes one red and blue felt–tipped pen to record the reading

A thermograph is usually configured with a pen that records temperature on a revolving cylinder. The pen is at the end of a lever that is controlled by a bi-metal strip of temperature-sensitive metal which bends as the temperature changes.

1.3 Accuracy of the Measuring instruments:

a) Accuracy in Humidity Measurement

There is often great confusion about accuracy in humidity measurement. People in the industry talk about accuracy and uncertainty. But what is the difference between these terms? Even more confusing is the use of such phrases as calibration accuracy, operational accuracy, repeatability, traceability, and long-term accuracy. This article explains what accuracy you can expect in actual operation of a humidity sensor or instrument.

Definitions

Perhaps, some of the confusion over accuracy in humidity measurement can be cleared up by defining some of the terms often used by the industry. Two of the terms used to describe sensor or instrument performance are accuracy and uncertainty.

The Importance of Calibration

A calibration report does not guarantee satisfactory performance under actual operating conditions, but it is an important starting point, and it tells a lot about the quality of a sensor. An essential part of humidity and moisture measurements is the calibration against a standard.

The most fundamental standard that is used by national calibration laboratories is the so-called gravimetric hygrometer. Using this method, a certain amount of dry gas is weighed and compared with the weight of the test gas in the same volume. From this, the amount of water is determined, and vapor pressure calculated. The method can provide the most accurate measurements possible, but the system is cumbersome, expensive, and time consuming to use.

Some national laboratories-such as the National Institute for Standards Testing (NIST) in the U.S., the National Physics Laboratory (NPL) in the UK, and the National Research Laboratory of Metrology (NRLM) in Japan-have access to gravimetric hygrometers. However, these laboratories use the system only to calibrate other, slightly less accurate, standards that are easier and faster to use for day-to-day calibrations, such as the two-pressure humidity generator, a precision chilled mirror hygrometer, or a carefully designed psychrometer.

Traceability to National Standards:

Many commercial humidity measurement instruments are supplied with a calibration report that shows the unit's accuracy at the time of manufacture or shipment from the factory. Traceability means that the instrument has been calibrated against a primary or transfer standard. An instrument calibrated against such a standard is called NIST-traceable in the U.S. or NPL-traceable in the UK. The calibrations are conducted under controlled laboratory conditions and in most cases do not reflect the way the instrument will perform in the field.

Calibration Standards:

With regard to humidity measurements, it's commonly accepted that a standard is a system or device that either can produce a gas stream of known humidity by reference to fundamental base units (e.g., temperature, mass, and pressure) or is an instrument that can measure humidity in a gas in a fundamental way, using similar base units. There are established standards for humidity in many countries, operating on various principles, such as gravimetric systems and two-pressure generators. Some of these national standards and the approximate ranges they are capable of covering are shown in Table 1.

Standards used to calibrate humidity instruments fall into three classifications: primary standards, transfer standards, and secondary devices.

Primary Standards: These systems rely on fundamental principles and base units of measurement. A gravimetric hygrometer is such a device. This method is very accurate but difficult and laborious to use. A gravimetric hygrometer is expensive to build, and at low humidity levels, the device can require many hours of operation to obtain a large enough sample. It is not a practical system for day-to-day use. At a lower level and at somewhat lower accuracies, two-pressure generators, two-temperature generators, and some other systems are customarily used as primary standards.

Transfer Standards: Instruments in this category operate on fundamental principles and can provide good, stable, and repeatable results, but if they are not properly used, the instruments can give incorrect results. Examples of commonly used instruments include:

- **Chilled Mirror Hygrometer:** This is probably the most widely used transfer standard. A mirrored surface in contact with the gas stream to be monitored is cooled until condensation forms. The temperature at which condensation is formed is known as the dew point or frost point of the gas, and this temperature directly relates to the saturation water vapor pressure of the sample. From these data, any hygrometric equivalent parameter can be calculated, provided that other information (e.g., gas temperature and pressure) are also known.

- **Electrolytic Hygrometer:** This instrument operates on the principles of Faraday's laws of electrolysis to determine the amount of moisture in a gas stream. The water vapor in the gas stream is passed through the instrument's measurement cell, which electrolyzes the water molecules into their component parts (H2 and O2). The current consumed in this process is directly related to the amount of water electrolyzed. Provided the cell converts all the water in the gas stream into its component parts, the measurement of current represents an absolute measure of the moisture content.
- **Psychrometer:** In a dry/wet bulb psychrometer, pure water is evaporated from a wick surrounding a temperature probe placed in the gas stream that passes over the wick at a proper velocity. The evaporation lowers the wet bulb's temperature. Under ideal conditions, the wet bulb's temperature is directly related to the relative humidity of the gas at the prevailing gas temperature, which is measured with the dry bulb thermometer. If all measurement parameters are known, the temperature difference (depression) is related fundamentally to the heat of evaporation of water. Hence, an absolute determination of the water vapor pressure of the gas can be made.

  This technique was widely used in the past but is now considered to be the least desirable because of the large number of variables that can affect measurement results and must be controlled. The psychrometer also requires skilled operators to make accurate measurements.

Secondary devices

These devices are non-fundamental and must be calibrated against a transfer standard or other fundamental system. To obtain accurate data from them, you must recalibrate the device frequently. Secondary systems are rarely used for laboratory calibration but have many applications in industry and in commercial buildings (e.g., for air conditioning).

An example of a secondary humidity analyzer is an impedance hygrometer. These ceramic-, aluminum oxide, and silicon oxide based sensors rely on a change in electrical properties (capacitance, resistance, or impedance) of a porous layer. The change in electrical properties is processed by simple electronics to give an output calibrated in a suitable hygrometric unit. Properly manufactured, calibrated, and operated, these devices can provide good on-line service for many years. However, calibration is required on a regular basis, and adjustments are often needed. In most applications, the accuracy of these devices is modest and much lower than that provided by transfer standardtype instruments.

Polymer film RH sensors are another example of secondary humidity analyzers and are similar in principle to impedance hygrometer sensors. Polymer film RH sensors are constructed from polymer material with a hygroscopic dielectric and are designed to provide an electrical response corresponding to relative humidity. In recent years, significant improvements have been made, and these devices can now provide excellent low-cost service, particularly in normal ambients, and sometimes at high temperatures (see Table 1).

Field Applications

In real-time applications of humidity measurement instruments, specifications of a manufacturer and calibration data of a standards laboratory lose some, and often much, of their significance. Operation of instrumentation under less-than-ideal conditions introduces variables likely to affect even the most reliable and accurate systems in some way. These variables include temperature, electronics, pressure, flow, and contaminants.

Temperature Effects: Most hygrometers are calibrated at a fixed ambient temperature. This may vary from manufacturer to manufacturer, but the temperature is usually around 25°C ±1°C. Variations from the ambient temperature can easily affect measurement results and accuracy.

Sensor temperature coefficients in impedance-type sensors, like the capacitors and resistors they are derived from, exhibit temperature dependency. Many systems compensate for this either by using electronic compensation or by controlling the sensor temperature to negate the effect. Temperature coefficients of 0.1 to 0.2 are not uncommon, even in compensated systems, and result from non-uniformity of sensors and electronic components used in the compensation systems. Sensor temperature effects in chilled mirror hygrometers are usually negligible. However, variations in temperature can cause changes in the measurement range.

Electronics: Modern electronic instrumentation is usually temperature insensitive over a normal ambient temperature range. However, large temperature swings in exposed locations can cause performance errors in many electronic components. Instrument suppliers usually report the temperature range over which electronic performance is unaffected, and if these limits are adhered to, the temperature effects can be ignored.

However, if the operating temperature exceeds these limits, you can expect errors and, in some cases, failure.

Pressure: Pressure effects are much easier to quantify-and therefore easier to correct-than temperature effects. Variations in pressure have an effect only on the actual water vapor pressure of the gas being measured. Therefore, knowledge of the pressure at the measurement point will allow the effect to be fully compensated, provided that the nature of the gas and its behavior under pressure are known.

Flow: In theory, flow rate should have no direct effect on the measured moisture level in a gas system, but in practice, the flow rate of a gas can affect the system's accuracy. Excessive flow rates in piping systems can introduce pressure gradients. Care should be taken to ensure that the sampling system can accommodate the required flow rate for the measurement instrument. An inadequate flow rate can result in errors caused by several side effects:

- Back diffusion--If an open-ended sampling system is used, ambient air can flow back into the system.
- Ineffective purging of the sampling system--In a complex system, inadequate flow can allow pockets of undisturbed wet gas to remain in the sampling system or sensor, which will gradually be released into the sample flow. In worst-case conditions, liquid water may exist for long periods in moisture traps in the sampling handling system. This can happen after hydraulic testing or after a high-moisture fault condition.
- Low flow rate--This condition will accentuate adsorption and desorption effects in the volume of gas passing through the sampling system. This will become more significant as flow rates are lowered.

Contaminants: Humidity measurement instruments are susceptible to errors caused by contamination. The full list of contaminants is almost endless, but here are a few of the most common substances that can affect the performance of your system:

- Particulates eventually cause a chilled mirror hygrometer to go out of control, clog the porous structure of impedance and polymer film sensors, and potentially inflict physical damage on the sensing surface by impingement. Particulates can also reduce the evaporation rate of a psychrometer wet wick, and they will clog an electrolytic cell.
- Inorganic salts can affect the accuracy of chilled mirror systems and psychrometers by modifying the saturation vapor pressure of liquid water on the surface of each

type of device. Most salts are hygroscopic, and when they are deposited in the porous structure of an impedance or RH device, the salts can modify the device's characteristics. In fact, older types of such sensors relied on a salt dopant to give the required electrical respons\to moisture changes. Salts deposited on an electrolytic cell can change the coulomb metric relationship and cause damage to the cell.

- Although organic compounds tend not to have a direct interference with water vapor, the compounds can condense on a mirror surface at a higher temperature than water or can evaporate from a psychrometer wick, causing additional evaporative cooling. It is possible for organics to damage secondary sensors if glues or epoxies are used in their manufacture. To eradicate or at least minimize these problems, conditions should be evaluated and steps taken to properly remove all or most contaminants from the gas stream by a suitable filtration method.

Methods of Calibration

Calibration of instruments used in the field can be carried out at any level, from a full evaluation against a transfer standard to a one-point check against an assumed humidity level. Calibration against a standard (usually a national standard) represents the highest level of calibration. The national standard used may be the gravimetric train or an easier-to-use method, such as a two-temperature or two-pressure system. In the U.S., many laboratories perform calibrations using NIST-certified transfer standards, usually with a chilled mirror hygrometer.

It's possible to provide calibration information on field instruments in situ, either by reference against a gas stream of known humidity (generator or certified compressed gas cylinder) or by comparison with a portable transfer standard device. This can be useful in assessing the performance of an instrument in its normal operating conditions, but because of the departure from ideal laboratory conditions, the calibration can be less accurate. Generally this type of evaluation is used to give a close estimate of the performance of an instrument to assess whether it must be removed from service for a more rigorous examination.

Summary

Considerable misunderstandings can exist when defining the accuracy of humidity sensors. Each manufacturer has its own way of measuring and specifying accuracy, and the user is often left confused. Although most manufacturers are not deliberately misstating accuracy claims, competition forces them to specify accuracy of their instruments in the most favorable way, sometimes only over a narrow range, at a fixed temperature, or under ideal laboratory conditions.

The following considerations should be kept in mind when using humidity instrumentation:

- What calibration standard was used to calibrate the instrument?
- Over what range was the instrument calibrated? It is much easier to obtain high accuracy at one point or over a narrow range than, for example, from 5%100% RH or from 60°C to 90°C dew point.
- At what ambient temperature was the instrument calibrated? Most sensors are temperature dependent. If the calibration is defined at only one temperature, the accuracy will be better than if it were defined over a range of temperatures (e.g., from 20°C to 75°C).
- How long ago was the instrument calibrated? Some sensors exhibit aging and are less accurate if calibrated many months before their use.
- What contaminants exist? This is perhaps the most important consideration. All known humidity sensors are affected by chemical and/or particulate contamination. If calibrated in a clean laboratory environment and subsequently used in a contaminated factory environment or outdoors in the presence of air pollutants, the sensor will perform at a lower accuracy, especially over time.

Fundamental of Calibration:

- All instruments that are used for inspection, measurement and test are subjected to drift over a time and with use over an extended period of time. This drift is inherent in any instrument as the different component that are used in the manufacture of the instruments, age with time or they may get worn out and the instrument would not show the correct reading . However, if the product being manufactured by any organization should be consistent quality. It is necessary that the instruments read correctly. Wherever there is an error in the measurement made by an instrument the quality of the products also deteriorates accordingly. To obviate such situation, it is necessary that the instruments used should be calibrated.
- Calibration is the process of checking machines and making sure that values used in measurements remain at standard points. It is the process of verifying a machines work and performance within a set of specifications.

When done the right way, calibration can make your life easier and better. It allows for faster processes and of course with lesser errors and mistakes. During calibration, it is also important to make sure that the measurements taken during the period is also valid.

Remember that whatever values that you have gotten during the calibration process are the values that are accepted to be the most accurate and precise.

Problems however arise when the calibration service is not done correctly. This is frequently what happens when a low cost service is purchased. It is important that you get a good service especially if your company is operating under a standardized quality system like that of the ISO 9000.

The implementation in fact of the ISO 9000 became one of the primary reasons why calibration software is so popular. In order to operate within the set standards, one need to regularly check the machines and networks that are being used.

Calibration is based on the data that has been collated and gathered by experts in the fields. Often, these data came from experiments, studies and projects which required calibration. The many data supporting the process is the reason why calibrating standards have long been established.

When calibrated, a machine or a system is compared against another machine whose values have already been standardized and established. The larger the base that was used in the calibration, the better and wider will be the chances of the inaccurate values to be replaced and readjusted. The introduction of newer and more sophisticated models only serve to refine the standard.

Purpose of instrument Calibration:

There are three main reasons for having instruments calibrated:

- To ensure readings from an instrument are consistent with other measurements.
- To determine the accuracy of the instrument readings
- To establish the reliability of the instrument i.e. that it can be trusted.

When an instrument is not calibrated it would indicated a value but this value would not be the correct value of quantity being measured. Whenever a decision wheather to accept a product or not is taken on the basis of this value indicated , this would be a incorrect decision. The value indicated by an instrument which has been calibrated would lead to a correct decision regarding acceptance or otherwise of a product.

Thereafter through the process of a number of calibrations the value of quantity to be measured is disseminated down to shop floor.

In more modern and scientific language, calibration is referred to the natural process of transition that is used to measure accuracy and comparison of a measuring instrument that has a standard to determine the possible errors in a specific scale.

Today, calibration is basically used for the process of manufacturing so less and less possible mistakes and errors can be made. This process or measuring apparatus is also used to lower the cost of manufacture or possible production by determining or ensuring the quality.

Calibration is also ideal in minimizing possible errors because it uses scientific method to determine impending miscalculations while doing something to correct the errors if there were any. Calibration becomes more and more popular to companies because the method aims to economize time, labor, and other resources in any production by means of accurate verification.

If there were one industry that benefits a lot in the discovery and utilization of calibration, that would be the numerous laboratories all over the world that conduct seemingly endless and continuous research. The researcher or the tasked observer usually uses this measuring apparatus to refine his or her work.

Calibration is also greatly beneficial to a researcher is he or she doesn't the time to develop his/her own apparatus due to lack of time and he/she needs a set of methods for accurate testing.

Aside from the field of research laboratories, calibration is also extremely beneficial because it makes the construction of instruments that are capable of measuring with sufficient precision and lesser probability to ensure correction.

Considered as the actual accuracy of a scale or balance, calibration is widely used in testing the products to get their accurate weight. In the United States alone, an agency called National Institute of Standards and Technology that is tasked to maintain standards for values of SI units and industrial standards, calibration has become a helpful tool in providing the traceability of their subjects of study by adhering to the basic standards of calibration.

Verification of accuracy:

- Accuracy:
- Accuracy is the closeness of agreement between the result of measurement and the true value of the measured.

- One of the wonders that people have discovered in the world of science and measurements is calibration. Often referred to as the process of verifying and determining the relationship between the output and the response of measuring instrument to the value of the input quantity, calibration is known as a measurement standard.
- For non-specialized use, calibration involves the entire process of adjusting the output/result or the indication on a measurement instrument to correlate with the value of the applied standard within the boundary of specific accuracy.
- For an example the calibration of an outside micrometer may be performed with help of “00” or “0” grade slip gauges whose accuracy is higher than the accuracy of outside micrometer. The slip gauge set used would have been calibrated against the reference standard (A reference material is a material, or substance, one or more of whose property values are sufficiently homogeneous and well established to be used of a measurement method or for assigning values to material.) available and the calibration would be valid at the time of calibration of micrometer. A slip gauge blocks of different sizes are place in between the anvil and spindle of the micrometer and the readings on micrometer are compared with used slip gauge block. If the deviation is not within the specified limit the micrometer requires to be adjusted to be brought down to indicated the correct value,
- As any manufacturer is aware, it is essential to carry out checks of product both during and after manufacture. These can range from something as simple as measuring the thickness of a material before it is used, to full laboratory testing to assess the durability of a product or material under simulated conditions of use.
- Whichever is the case, to be confident that the results are accurate and reliable, the equipment used to carry out these checks and tests must be calibrated. Important commercial decisions are made based on these results and, if an item of test or measuring equipment is giving misleading information and perhaps failing to identify poor quality material, the consequences can be very costly.
- What aspects need to be calibrated?
- For some equipment, calibration will involve finding how accurately the equipment displays the required data. For example, does a balance read correctly to the nearest gram or ten grams? Is a rule correct to one millimetre or five millimetres? Comparing the equipment against a correct reference will give this information.

- However, for some complicated machines – including many types of footwear test equipment – it may not be clear which aspects require calibration, or to what accuracy they must operate. Here, the characteristics that need calibration must be defined, and this is usually specified by the test method for which the equipment is designed. At first glance, the required checks may seem relatively simple. For example, if a thickness gauge is used, then it is important that the accuracy of the gauge reading needs to be checked. However, there are often a number of other less obvious factors that may also need to be investigated, since these will also have an effect on the measured thickness. For instance, the pressure that the gauge applies to the test material and the degree of parallelism between the presser foot and the anvil will both affect the result obtained.

  Parameters for machine calibration should be closely specified in test methods, since slight differences between machines used by each laboratory can lead to significantly different test results. Acceptable tolerances should always be given, but some methods may state only a nominal value for a parameter, with no tolerance. Where none is given, must the value measured agree precisely with this nominal value, or will a close result be satisfactory? Also, what does 'close' mean? Clearly, nominal values for parameters do not help users of machines to understand if they are suitable or not where no tolerance is given, users of machines must draw their own conclusions as to its suitability.

- Calibration of new equipment
- It is essential that all new items of equipment are calibrated before use and at regular intervals thereafter, to make sure that the machine's parameters remain within tolerance. Parameters can change over time, due to negligent maintenance, incorrect use and even general wear and tear. It is often incorrectly assumed that new equipment is always supplied calibrated, but this is not always the case. Whilst the required engineering tolerances of the machine may be achieved during production, the precise measurements that are needed for a particular test method may not have been carried out. It is also a common problem that the supplier of a machine may not be fully aware of which test methods the laboratory intends to use, and so the machine may conform to an entirely different specification. Given the many different national or company test methods which may exist for a given test routine, it is no surprise that a machine set up for one method may not conform to the requirements of another. It is recommended that a purchaser requests that full calibration is carried out on any new machine and, if relevant, that it meets the requirements of a specific test procedure.

- Frequency of calibration
- The frequency of calibration depends upon the parameter being measured, how often the machine is used, and how critical the measurement is to the application or product. Equipment that is in constant use (or that is known to suffer significant wear in operation) will require more frequent calibration than more robust or seldom-used items. Also, some parameters on a complex machine may require more frequent calibration than others. For example, machines with moving parts, such as abrasion or flexing machines require at least an annual calibration of these parts, whereas the dimensions or mass of solid metal parts that are not exposed to any wear in use may not need to be re-measured for five years or more following initial calibration.
- Calibration tools must also be calibrated
- Many test machines are complex and require the use of a varied range of measuring equipment in order to carry out the calibration. It is quite common for measurements of length, mass, force, angle, time and temperature to be carried out on each machine. To purchase the necessary calibration equipment may require a considerable investment.
- However, these tools must then be regularly calibrated to ensure they remain of acceptable accuracy. Traceability to national standards is essential, and is a requirement of ISO 17025 (the international management system for testing and calibration laboratories) and the ISO 9000 series of quality standards. Given the initial purchase price of checking tools and the cost of ongoing calibration, it is common for calibration services to be bought in – both for production measuring equipment and for laboratory test equipment.

Self-Check 1	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

1 Mentioned two different standard atmospheres in lab with respect to temperature and humidity? (2 points)

2. What do you mean by environment of Lab? (2 points)

3. What is minimum conditioning time for a leather sample? (1 point)

4. Mention some important properties of thermometer? (3 points)

5. What do you mean by reference material? (2 points)

Information Sheet 2- Identify the tools and equipment required for testing

cc

Information Sheet 3- Verify the machines for the accuracy of the result

3.1 The machine is verified for the validity of calibration:

a) The equipment used for testing/calibration must be capable of achieving the accuracy required and must comply with the specifications relevant to the test concerned.
b) The calibration of equipment must take into account key quantities or values of the instrument where these properties have a significant effect on the results.
c) Before being placed into service equipment must be calibrated or check to establish it meets the required specifications and complies with the relevant standard specification.
d) All equipment must be checked and/or calibration before use to ensure that it meets the requirements for use.
e) All equipment must be subjected to regular and scheduled maintenance and calibration verification process according to a standard procedure.

Frequency of calibration

The frequency of calibration depends upon the parameter being measured, how often the machine is used, and how critical the measurement is to the application or product. Equipment that is in constant use (or that is known to suffer significant wear in operation) will require more frequent calibration than more robust or seldom-used items. Also, some parameters on a complex machine may require more frequent calibration than others. For example, machines with moving parts, such as abrasion or flexing machines require at least an annual calibration of these parts, whereas the dimensions or mass of solid metal parts that are not exposed to any wear in use may not need to be re-measured for five years or more following initial calibration.

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However, these tools must then be regularly calibrated to ensure they remain of acceptable accuracy. Traceability to national standards is essential, and is a requirement of ISO 17025 (the international management system for testing and calibration laboratories) and the ISO 9000 series of quality standards.

Given the initial purchase price of checking tools and the cost of ongoing calibration, it is common for calibration services to be bought in both for production measuring equipment and for laboratory test equipment.

Information Sheet 4- Checking the least count of the machine

Least count is the highest degree of accuracy of measurement that can be achieved. For example the least count of a Micrometer is 0.01 mm the formula is - Range/number of divisions.

Every measuring instrument has error when readings are taken. The least count, uncertainty or maximum possible error characterizes such errors.

Instruments' errors can be compared by calculating the percentage of uncertainty of their readings. The instrument with the least uncertainty is taken to measure objects, as all measurements consider accuracy. The percentage uncertainty is calculated with the following formula:

(Maximum Possible error/Measurement of the Object in question) *100

The smaller the measurement, the larger the percentage uncertainty. The least count of an instrument is inversely proportional to the precision of the instrument.

Least count error

The smallest value that can be measured by the measuring instrument is called its least count. Measured values are good only up to this value. The **least count error** is the error associated with the resolution of the instrument.

For example, a digital vernier caliper's least count is 0.01 mm while a dial micrometer may have also least count of 0.01,spherometer may have a least count of 0.002 mm. Least count error belongs to the category of random errors but within a limited scale; it occurs with both systematic and random errors. If we use a meter scale for measurement of length, it may have graduations at 1 mm division scale spacing or interval.

Instruments of higher precision, improving experimental techniques, etc., can reduce the least count error. Repeating the observations and taking the arithmetic mean of the result, the mean value would be very close to the true value of the measured quantity.-

Least count is the least unit that a measuring instrument can measure. It is given by value of smallest division on main scale divided by total number of divisions on vernier scale=Value of 1 main scale div / total vernier scale div

Least count of screw gauge=pitch / total no of div in head scale
pitch = (distance move along the pitch scale when a fixed no of rotations are given to head scale) / no of rotations

[if 10 rotations are given to the head scale ,and then S distance is moved along the head scale then pitch of the screw=p=S/10]

The error made in an instrument can be compared with another by calculating the percentage uncertainty of each of the readings obtained. The one with the least uncertainty is always taken to measure objects, as all measurements are required with accuracy in mind. The percentage uncertainty is calculated with the following formula: (Maximum Possible error/Measurement of the Object in question) *100
The smaller the measurement, the larger the percentage uncertainty

3.3.2 Measurement of the least count of the machine

Accuracy is the closeness of agreement between the result of measurement and the true value of the measured.

Resolution:

Resolution is the smallest difference between indications of a displaying device that can be meaningful distinguished.

Ideally an instrument should have the following relationship

Resolution= Measuring accuracy

However, there are few measuring instruments which satisfy this relationship and in general:

Resolution<Measuring accuracy

This is because of the following reasons:

Small dimensions are also measured with instrument with large range.

Resolution is too high for the large measuring range.

MEASUREMENTS OF LENGTH; VERNIER SCALES AND MICROMETER SCREWS

For most measurements with a rules scale, it is desirable to estimate fractions of the smallest division on the scale. Two common scale attachments that increase the accuracy of these estimates are the vernier scale and the micrometer screw. Because of the difficulty of holding a linear scale against a curved surface or against a narrow width, calipers are used. A *caliper* is an instrument with two jaws, straight or curved, used to determine the diameters of objects or the distances between two surfaces. A caliper with a vernier scale is called a *vernier caliper*; a caliper with a micrometer screw is called a *micrometer caliper*.

The Vernier Principle

The vernier is an auxiliary scale, invented by Pierre Vernier in 1631, which has graduations that are of different length from those on the main scale but that bear a simple relation to them. The vernier scale of 10 divisions that correspond in length to 9 divisions on the main scale. Each vernier division is therefore shorter than a main-scale division by 1/10 of a main-scale division. The zero mark of the vernier scale coincides with the zero mark of the main scale. The first vernier division is

1/10 main-scale division short of a mark on the main scale, the second division in 2/10 short of the next mark on the main scale, and so on until the tenth vernier division is 10/10, or a whole division, short of a mark on the main scale. It therefore coincides with a mark on the main scale.

If the vernier scale is moved to the right until one mark that coincides with *som*e mark of the main scale the number of tenths of a main-scale division that the vernier scale is moved is the number of the vernier division that coincides with *any* main scale division. (It does not matter with which main-scale mark it coincides.) The sixth vernier division coincides with a main-scale mark in Fig 3.2 therefore the vernier scale has moved 6/10 of a main-scale division to the right of its zero position. The vernier scale thus tells the fraction of a main-scale division that the zero of the vernier scale has moved beyond any main-scale mark. In Fig. 3.3 the zero is to the right of the second mark on the main scale and the fourth mark of the vernier scale coincides with a main-scale mark. The reading is 2.0 divisions (obtained from the main scale up to the vernier zero) and 0.4 division (obtained from the vernier coincidence), or 2.4 divisions.

The foregoing example illustrates the simplest and commonest type of vernier scale. Instruments are manufactured with many different vernier-scales to main scale ratios. The essential principle of all vernier scales is, however, the same, and the student who masters the fundamental idea can easily learn by himself to read any special type.

The term *least count* is applied to the smallest value that can be read directly from a vernier scale. It is equal to the difference between a main-scale and a vernier division.

When you have occasion to use a new type of vernier scale, first determine the least count of the instrument. In order to make a measurement with the instrument, read the number of divisions on the main scale before the zero of the vernier scale and note which vernier division coincides with a mark of the main scale. Multiply the number of the coinciding vernier mark by the least count to obtain the fractional part of a main-scale division to be added to the main-scale reading.

Self-Check 4	Written Test

Name: __________________________ Date: _______________

Directions: Answer all the questions listed below.

Fill in the Blanks:

1. Least count is the ------------ of accuracy of measurement (1 point)
2. Least count of machine is inversely proportional to the -------- of the Instrument (1point)
3. Smaller the measurement ---------- larger the percentage uncertainty (1point)
4. Least count of digital vernier caliper is ------ mm (1 points)
5. Least count error associated with ------ of instrument 1 point)
6. Spherometer having least count ------ mm (1 point)
7. Least count belongs to category of ------ and ----- error (1 point)
8. Least count = ------ (1 point)
9. Least count of screw gauge = ------ (1 point)
10. Type A Uncertainty = ------ (1 point)

Information Sheet 5- Checking the testing condition of the machines such as temperature and humidity

5.1 Different instrument used for measurement of temperature & Humidity

Thermometer: It is an instrument used for measuring temperature.

Dial thermometers such as the dial face shown in the photograph at the top of this page are inexpensive (typically less than $10.00) and very simple instruments which combine a bimetallic spring, a dial face, and a stainless steel probe which can be inserted into A/C systems at key points (below) or in some cases simply held in an air stream. The thermometer can take a couple of minutes to stabilize, so you should keep it in position until the dial indicator stops changing. Dial thermometers vary in accuracy but can easily be calibrated (using boiling water).

Digital thermometers work much like a dial thermometer but include a digital display of temperature (and require a battery). .

Air flow thermometers are electronic devices similar to a the temperature probes above, but their probe ends in a loop through which air passes to provide a more rapid readout of air temperature. However these devices are not easily inserted into duct work as a larger probe opening will be required.

Infrared temperature measurement devices have the feature of being able to measure surface temperatures from a distance but are not used to make direct measurements of air temperatures

Data logger

A data logger (also data logger or data recorder) is an electronic device that records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors. Increasingly, but not entirely, they are based on a digital processor (or computer). They generally are small, battery powered, portable, and equipped with a microprocessor, internal memory for data storage, and sensors. Some data loggers interface with a personal computer and utilize software to activate the data logger and view and analyze the collected data, while others have a local interface device (keypad, LCD) and can be used as a stand-alone device.

Data loggers vary between general purpose types for a range of measurement applications to very specific devices for measuring in one environment or application type only. It is common for general purpose types to be programmable; however, many remain as static machines with only a limited number or no changeable parameters. Electronic data loggers have replaced chart recorders in many applications.

One of the primary benefits of using data loggers is the ability to automatically collect data on a 24-hour basis. Upon activation, data loggers are typically deployed and left unattended to measure and record information for the duration of the monitoring period. This allows for a comprehensive, accurate picture of the environmental conditions being monitored, such as air temperature and relative humidity.

Data Logger with USB

This data logger measures and stores up to 16,382 relative humidity and 16,382 temperature readings over 0 to 100%RH and -35 to +80°C (-31 to +176°F) measurement ranges. The user can easily set up the logging rate and start time,

[Data Logger with USB and LCD Display](#)

This standalone data logger measures and stores up to 16,379 relative humidity and 16,379 temperature readings over 0 to 100%RH and -35 to +80°C (-31 to +176°F) measurement ranges. The user can easily set up the logger.

[Data Logger with USB Replacement Battery](#)

This 3.6V 1/2AA replacement battery has a one-year shelf life and was designed to power our Data Logger with USB and Data Logger with USB and LCD Display.

Thermo hygrometer

Self-Check 5	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below.

1. What do you mean by Thermometer and Hygrometer (2 points)
2. Name different type of thermometer (2 points)
3. Name different type of Hygrometer (2 points)
4. Least different type of Thermo hygrometer being used in laboratory (2 points)
5. What is data logger and its advantage? (2 points)

Information Sheet 6- Checking the gauges for accuracy

Please refer 3.3.2 of Information sheet 3 for checking the accuracy of gauge (Vernier caliper and micrometer)

LG #34	LO #4- Conduct Test on the Machine

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topic– • Clamping the test piece on the machine • Setting the initial reading of the machine on zero or at the initial level • Procedure for conducting the test under standard condition • Recording the initial reading related to the test condition • Recording the reading variables during the performance of the test This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to: • Clamp the test piece on the machine • Set the initial reading of the machine on zero or at the initial level • Determine the procedure for conducting the test under standard condition • Record the initial reading related to the test condition • Record the reading variables during the performance of the test
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”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Clamping the test piece on the machine

Bb

Information Sheet 2- Setting the initial reading of the machine on zero or at the initial level

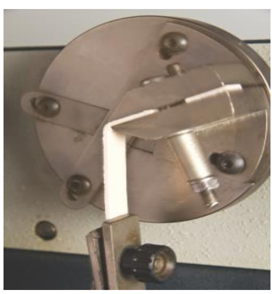
Bbb

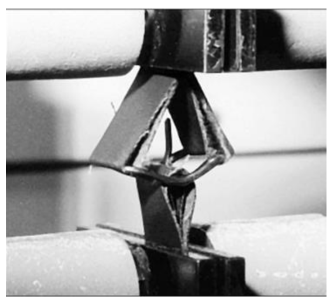
Information Sheet 3- Procedure for conducting the test under standard condition

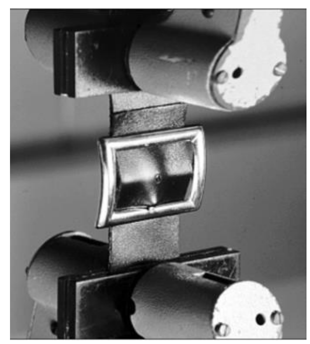
3.1 The test piece is clamped on the machine:

Based on the test sample, fixtures and type of test the sample will be clamped on the machine after passing the sampling, preparation of sample and conditioning stages. In footwear testing there are different types of fixtures and test methods detail the requirements of test fixtures in the text of the document. Some fixtures employ clamps, wedge grips and pincer grips. Further types of construction are eccentric roller fixtures, thread grips and button head grips as well as rope grips. Mechanical holding apparatus provide the clamping force via arms, wedges or eccentric wheel to the jaws. In addition there are pneumatic and hydraulic fixtures for tensile testing that do allow very fast clamping procedures and very high clamping forces.

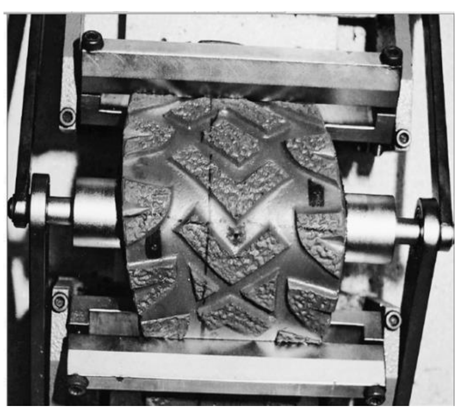
Some fixtures are shown below:







Flex index test of insole – grip pneumatic grip for buckle test

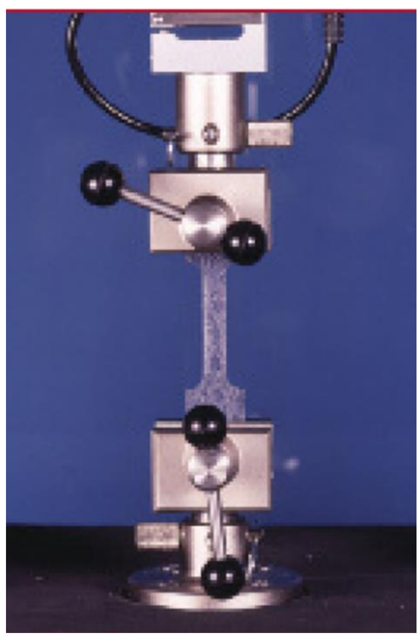


Whole sole flexing test grip Double edge tear test grip of leather

Based on the type of sample and test different clamping steps are followed. While clamping it is vital to follow the proper mounting technique so as to get the proper result. Improper mounting of samples might lead to erroneous results.

Sole bond test grip test

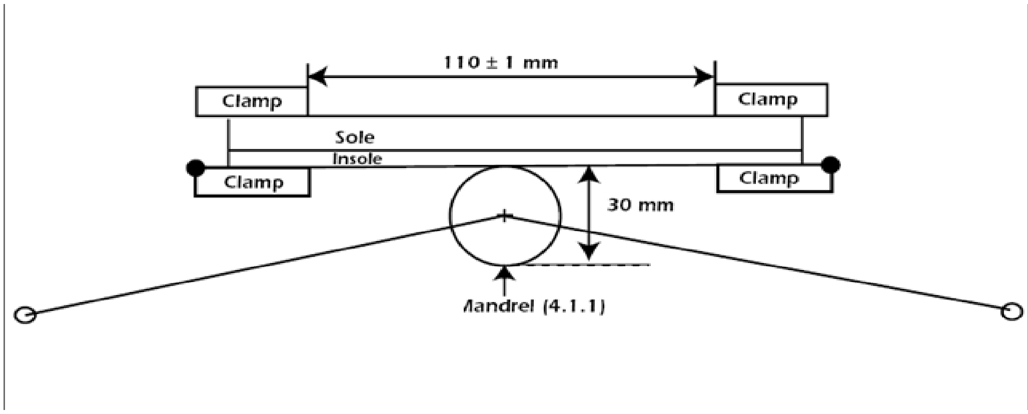
Insole pin holding strength



Tensile strength test grip

While clamping test specimen the following care must be taken.

a) One should adjust the machine at a convenient position so as to clamp the sample. For example for a whole sole flexing machine the mandrel (cylindrical road found in the middle) must be in plain position with the two clamps. Please see figure below.



Example of sole specimen in an unflexed position

In some tests proper spacing length between to clamping jaws is necessary to mount the sample. (For example space between upper and lower jaws in tensile strength tests of leather material).

b) After proper adjustment of the machine clamp position is made it is necessary to ensure that the sample is firmly clamped on both edges, especially if screws are used to tighten the samples.

c) If additional re-enforcement is needed while mounting, use appropriate material as per specified on the test method.

d) If any prior test condition is needed before starting the test, adjust the appropriate test condition using the adjustments available on the instrument as per the test method. Example: Temperature for flexing test of sole using ross flexing method.

3.2 Setting initial reading

After properly mounting the test specimen it is necessary to take any initial reading or adjust the machine counter to a zero/initial reading before starting the test. If any marking of initial position is needed for a finial assessment, use proper markers to easily distinguish any change or deviation from initial reading.

3.3 Use of appropriate procedure

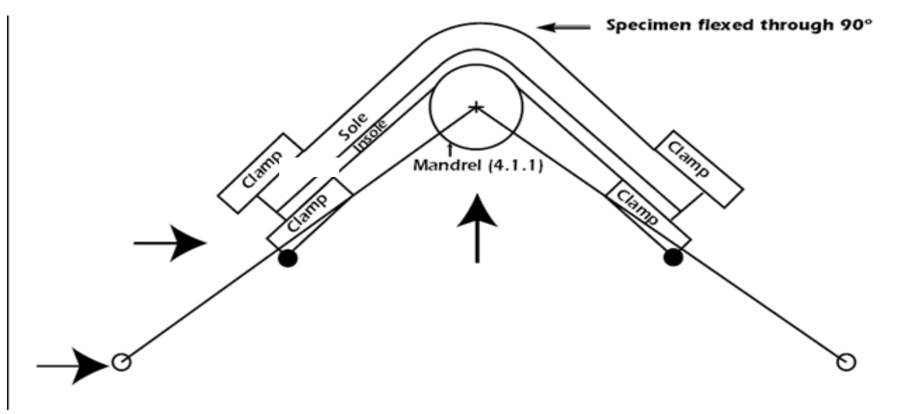
While conducting test on machine it is important to use appropriate procedure. It is necessary to confirm the validity and edition of the test method used. If the procedure is internally developed or institutional there should be a documented evidence to confirm the validation of the test method in order to conduct the test under standard condition. The validation can made by inter – laboratory comparison, proficiency test or through repeatability and reproducibility of test result. For international test methods check the correct edition.

3.4 Initial reading related to the test condition

If any initial measurement is needed use appropriate devise to measure. Devices can be calipers, magnifiers (preferable with graduated scale), thickness gauges, weighing balance (with appropriate decimal place), etc and record it on appropriate worksheet. Make sure that all the measuring devices are calibrated and due date has not passed.

3.5 Recording reading variables during performance of the test

If any intermediate recording is needed one need to **stop** the machine and conduct appropriate measurement. It is inappropriate to make any measurement while running the machine. Note the measurable values as per the test method and record on worksheet. If removing the sample is needed to make intermediate checking remove the sample from the machine and use appropriate reinforcement (where applicable) while measuring. If sample is not removed then make sure the proper positioning of the sample is made. See the figure below as example to adjust the sole in whole sole flexing test while intermediate checking.



Fully flexed test sole specimen for measurement

Self-Check 3	Written Test

Name: _________________________ Date: _______________

Directions: Answer all the questions listed below.

1. What are the adjustments needed before running the test sample? (2 points)
2. List the devices used to make initial measurement of samples? (2 points)
3. What is advantage of Pneumatic and Hydraulic fixtures? (2 points)
4. What is effect of doing improper mounting of samples? (2 points)
5. What care should be taken while clamping test specimen (2 points)

LG #35	LO #5- Record and interpret result

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topic– • Recording the results of the tests • Checking the condition of the piece against the standard reference material • Analyzing the data related to the test and using mathematical model • Verifying the limits of the test data and comparison against standard • Conclusion of the result of the data This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to: • Record the results of the tests • Check the condition of the piece against the standard reference material • Analyze the data related to the test and use mathematical model for checking the result • Verify the limits of the test data against standard and recording the deviations • Conclude the result of the data as per the interpretation of the standard
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". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to "Operation sheets
7. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet 1- Recording the results of the tests

The results of a test conducted must be recorded in appropriate work sheet and must be transferred to a test report. The worksheet can be used to make analysis and data interpretation while the test report depicts the final result of the test. Make sure to follow the correct reporting format and the relevant information needed to be reported on the test report as per the valid test method.

Include in the test report but not limited to

a) Reference to the test method used
b) A full description of the material
c) The average or final result with the appropriate unit as specified on the test method
d) Number of cycles where applicable
e) Environmental condition where applicable
f) Customer name and address where needed
g) Test date
h) Laboratory and customer designation code
i) Sampling method used
j) Equipment used for testing
k) Personnel conducting, checking and approving the test where appropriate
l) Address of the testing organization
m) The date of the receipt of the test item where this is critical to the validity or application of the results

After completion of any test it is important to remove the test piece and place it for any reference labeled and coded as per the laboratory designation code. There should be appropriate retention time of the sample (usually 3 – 4 months) for future reference in case customer complaint or any claim arises for rechecking and confirmation of test result. It is important to note that the test result reported on the test report relate only to the item tested. Any claims that arise after the retention time may not be handled for any reason.

Information Sheet 2- Checking the condition of the piece against the standard reference material

The validation of test result test methods can be made by using reference materials. For example in sole abrasion test by rotating drum method a standard rubber material is used to check the abrasion intensity of the abradant before testing the test piece. This is important in order to check whether the result in the standard range.

In another example of color fastness test of upper material, there should be a reference felt pad (material used to check the staining and color change) after conducting the test so as to compare it with a standard gray scale (scale used to visualize color change and stain). The standard materials must be kept in an appropriate room and must be clearly labeled.

Information Sheet 3- Analyzing the data related to the test and using mathematical model

Practices used in reporting and interpretation of test results include (1) averaging and (2) outlier tests.

1. Averaging

There are both appropriate and inappropriate uses of averaging test data during original testing and during an investigation:

a. Appropriate uses

Averaging data can be a valid approach, but its use depends upon the sample and its purpose. For example, in tensile test, several discrete measurements are taken from horizontal and vertical direction to the back bone of a finished skin and averaged to determine the tensile strength for a sample, and this average is reported as the test result. While averaging proper statistical tool must be utilized to check if the data collected is in a confidence interval.

Standard methods with repeatability and riproducibiilty indexes

For the STANDARD test methods with precision evaluations through a repeatability and reproducibility index, one can verify the capability to perform the method with repeatability tests. In particular, the typical gap of internal repeatability S_i is determined:

$$S_i = \sqrt{\frac{\sum_{1}^{n_i} (x_i - \bar{x})^2}{(n_i - 1)}}$$

n_i = number of performed tests

$\bar{x}$ = obtained average value

x_i = result of the *i*-nth test

The determination of S_i occurs by carrying out 3-10 tests and controlling the compatibility of the repeatability of the test with that reported in the method (σ_m).

Standard methods with out repeatability and Riproducibiilty indexes

When the test method does not report any repeatability and reproducibility data, for the best estimation of the expected values, all the different phases constituting the analytical process are taken into consideration, by identifying all the entry sizes and, for each of them, the contribution to uncertainty, such as to express a mathematical relationship between the measured or exit size *y* and the entry sizes x_i.

The set of sizes x_i may be estimated on the base of a series of observations as experimental intermediate repeatability or by other methods resulting from the calibrations and technical data of the equipment utilized for the test.

The typical gap σ is obtained from the average $u(\bar{x})$

$$\sigma = \sqrt{\frac{\sum_{1}^{n_i} (x_i - \bar{x})^2}{(n_i - 1)}} \qquad\qquad u(\bar{x}) = \frac{\sigma}{\sqrt{n_i}}$$

If the sample can be assumed to be single sample, (for example whole sole flexing test), individual sample is taken and averaging is not applicable.

This is a distinct difference from the analysis of different portions from a lot, intended to determine variability within the lot, and from multiple full analyses of the same homogenous sample. The use of replicates to arrive at a single reportable result, and the specific number of replicates used, should be specified in the written, approved test method. Acceptance limits for variability among the replicates should also be specified in the method. Unexpected variation in replicate determinations should trigger remedial action. If acceptance limits for replicate variability are not met, the test results should not be used.

2. Outlier Tests

The regulations require that statistically valid quality control criteria include appropriate acceptance and/or rejection levels. On rare occasions, a value may be obtained that is markedly different from the others in a series obtained using a validated method. Such a value may qualify as a statistical outlier. An outlier may result from a deviation from prescribed test methods, or it may be the result of variability in the sample. It should never be assumed that the reason for an outlier is error in the testing procedure, rather than inherent variability in the sample being tested.

Outlier testing is a statistical procedure for identifying from an array those data that are extreme. The possible use of outlier tests should be determined in advance. This should be written into standard operating procedure (SOPs) for data interpretation and be well documented. The SOPs should include the specific outlier test to be applied with relevant parameters specified in advance. The SOPs should specify the minimum number of results required to obtain a statistically significant assessment from the specified outlier test.

Information Sheet 4- Verifying the limits of the test data and comparison against standard

It is important to compare the test results with the national standard set for the test item tested. The Ethiopian Standard Agency has developed and adopted international standards for different footwear, accessories and components. It is important to refer these standards and depict them on the test report along the test results for comparison. This standards are derived mainly form customer requirements and from repeated test and or research results. See the reference stated on LO2.

If there is a deviation from the standard set it might be either due to the quality of the test item or due to the test method followed. One should make sure to strictly follow the standard test method or else report any deviation from thereof so as to avoid any error in the interpretation of test result.

Information Sheet 5- Conclusion of the result of the data

After comparing the test result with the standard set on can indicate a pass/fail report or any recommendation regarding the result obtained. Any failure may be due to the different quality parameters that characterize the product while manufacturing process. In order to give appropriate consultation regarding test result it is highly important to have experience, skill and knowledge of the state of the art processes deployed in the production of the test item. If any of this caliber is missing the consultation may led to substandard products that does not fulfill customer requirements.

Self-Check	Written Test

Name: _________________________ Date: _______________

Directions: Answer all the questions listed below.

1. What is need for indicating the environmental condition on the test report?
2. What do you thing the advantage of stating that the result on a test report relate to the item tested only?
3. A tensile test was conducted on a sample used for shoe upper and the following result was obtained. Calculate the confidence interval and the tensile strength.

Sample no.	Thickness (mm)	Width (mm)	Load (N)
1.	1.2	10	231
2.	1.02	10	215
3.	1.1	10	213
4.	1.2	10	220
5.	1.1	10	205
6.	1.05	10	210

Reference Materials

Book:

1. Erik Oberg, Franklin D. Jones, Holbrook L. Horton, and Henry H. Ryffel, "Machinery's Handbook", 27th Edition, Industrial Press, Inc., New York, NY, 2004

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