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Footwear — Sizing — Measurement of last dimensions

Chaussures — Pointures — Mesurage des dimensions de la forme

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 137, *Footwear sizing designations and marking systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

A shoe last is the form on which a shoe is constructed. The size and shape of the last is vital and contributes to the size and shape of the finished product. The shoe last determines the toe shape and heel height as well as the curvature of the shoe. Good fit is a key factor in a customer's choice of footwear. The footwear design and manufacturing processes also contributes to a well-constructed shoe. A standard method of measuring a last will guide the industry on correct shoe sizing based on the last dimensions and will reduce discrepancies and disputes.

Footwear — Sizing — Measurement of last dimensions

1 Scope

This document specifies methods to measure the basic last dimensions. Last dimensions can be measured physically using a real last or virtually on a digital 3D model using suitable software to make equivalent measurements.

These test methods are applicable to all types of lasts.

NOTE The specified last dimensions do not necessarily correspond with anatomical foot positions and foot dimensions.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 19407:2015, *Footwear — Sizing — Conversion of sizing systems*

ISO/TS 19408:2015, *Footwear — Sizing — Vocabulary and terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 19408:2015 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
geodesic
line on a curved surface such that at all points on the line, the normal to the line is also the normal to the curved surface (identical to the normal curvature)

3.2
continuous geodesic
geodesic (3.1) that returns to its starting point and then continues on the same path as for the first circuit when passing around the surface of an object

3.3
convexity
maximum of last bottom curvature

4 Principle

The different dimensions of the last are measured physically at the real last or virtually at the digital last. The measurements are taken at the described places at the last. Find the point, distance or girth at the last and measure the dimension using the described method.

5 Apparatus

5.1 Accuracy

Accuracy of all measurements shall be ±0,5 mm

5.2 Measuring tape, Calibrated measuring tape, thin, flexible, inelastic, with mm scale, maximum 8 mm wide.

5.3 Right angled device in mm (see Figure 1).

Dimensions in millimetres

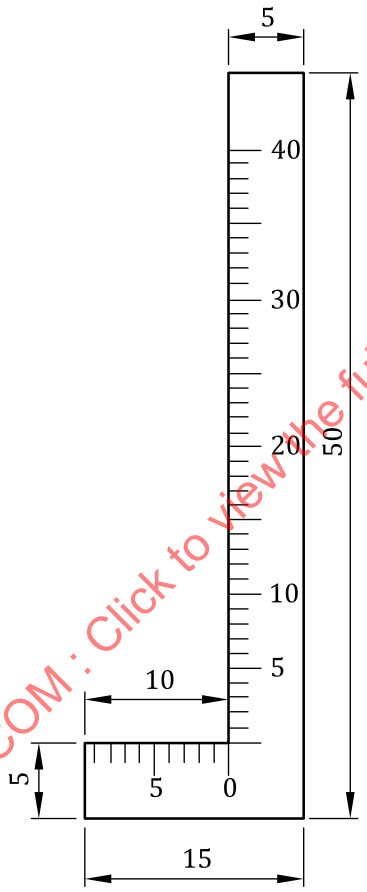
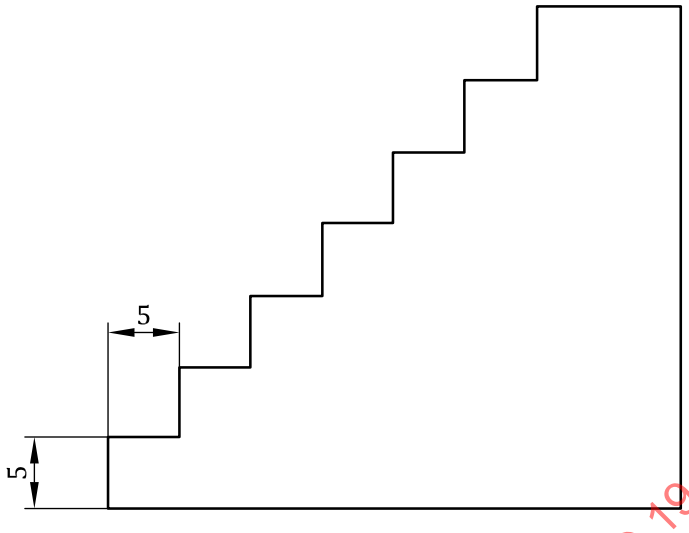


Figure 1 — Example of right-angled device

5.4 Calibrated rule, in mm, of length at least 50 mm.

5.5 Measuring stairs for heel height, a means of supporting the heel seat at the heel height of last (see Figure 2).

Dimensions in millimetres



NOTE Dimensions of the stairs, tolerance ±0,5 mm.

Figure 2 — Example of measuring stairs

5.6 Toe spring gauge, to measure the toe spring as given in ISO/TS 19408:2015, 2.2.13. The scale of the gauge is marked in mm (see Figure 3).

Dimensions in millimetres

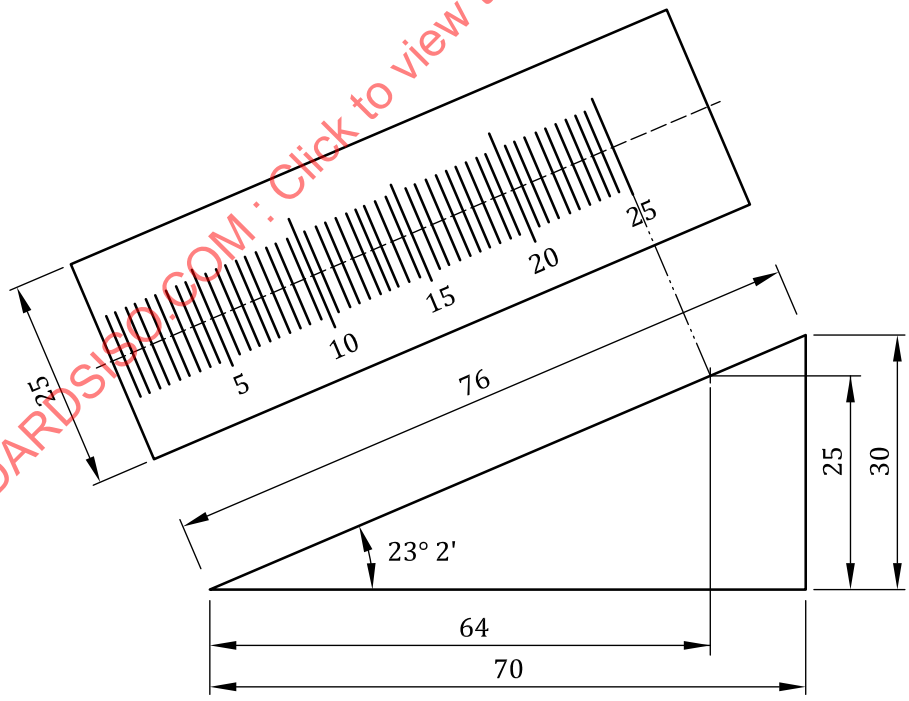
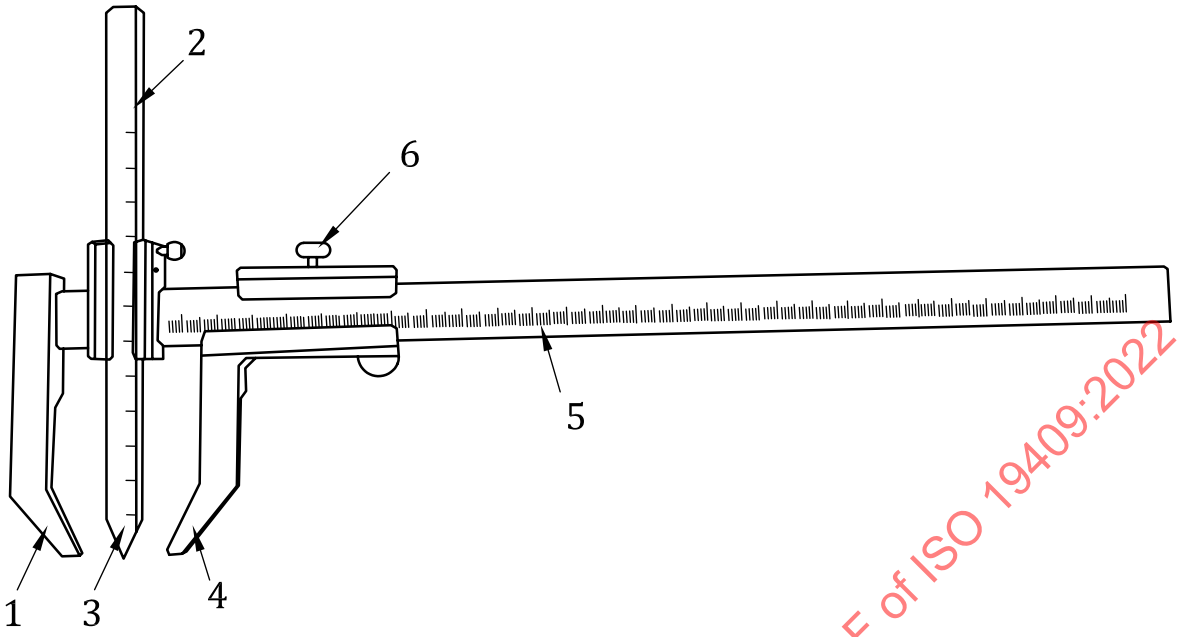


Figure 3 — Example of toe spring gauge

5.7 Vernier calliper (in mm), accuracy of 0,1 mm, of length approximately 100 mm for measurement of toe height, width of ball and heel as given in ISO/TS 19408:2015, 2.2.12, 2.1.15 and 2.2.8.

5.8 Cylinders of modelling clay, diameter 25 mm ± 2 mm with different heights.

5.9 Device to measure convexity (see Figure 4).



Key

1 fixed clamp
2 vice ruler
3 convexity/concavity sensor
4 measuring clamp
5 main ruler
6 screw

Figure 4 — Example of device to measure convexity

6 Sampling

A physical last may be used, such as a model or shoemaking last. Alternatively, a virtual assessment may be carried out using a suitable digital 3D model.

The following information are required from the last designer/maker:

a) heel height of last;

b) toe spring of last.

If only one parameter is stated by the last maker, then the other parameter can be determined by measurement.

7 Procedure

7.1 General

This procedure describes the physical methods to measure last dimensions. The virtual method measures the same dimensions using the digital tools of computer system.

7.2 Last length measurement

Mark the central line in accordance with ISO/TS 19408:2015, 2.2.2 at the last bottom and measure this length *d* (see ISO/TS 19408:2015, 2.2.1) using the measuring tape (5.1).

7.2.1 Heel curve

Use the right-angled device (5.2) to measure the maximum of heel curve (see l_1 ISO/TS 19408:2015, Figure A.6). Place the short arm of the right-angled device at the heel point of feather line, following the increase of the last points of the last bottom. The long arm of the device shall touch the maximum of the heel curve, see Figure 5. Read the value of the maximum curvature (convex) of the heel curve, see Figure 5, a, l_1 from the scale of the short arm of the device. Read the value of the height to the maximum of the heel curve, see Figure 5, b from the scale of the long arm of the device.

Key

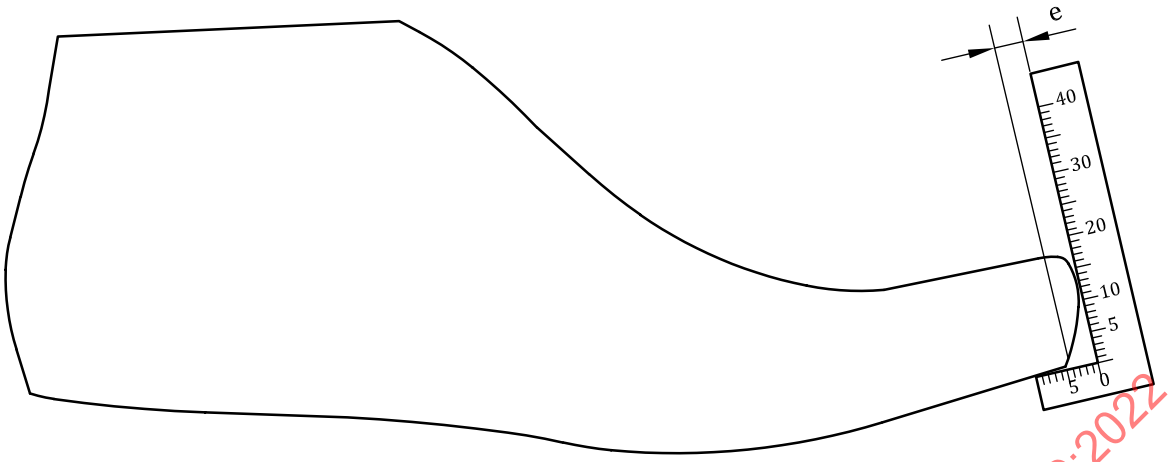
a maximum of heel curve (convex curvature)

b height of maximum of heel curve

Figure 5 — Measurement of the maximum of heel curve

7.2.2 Hang over of the last top

Use the right-angled device (5.2) to measure the last top overhang (see for example distance "e" in accordance with ISO/TS 19408:2015, Figure A.6. Place the short arm of the right-angled device at the prominent point of feather line, following the increase of the last points of the last bottom. The long arm of the device shall touch the maximum of the prominent point of the last (see Figure 6). Read the value of the distance of the maximum of the prominent point of the last top "e" from the scale of the short arm of the device.



Key

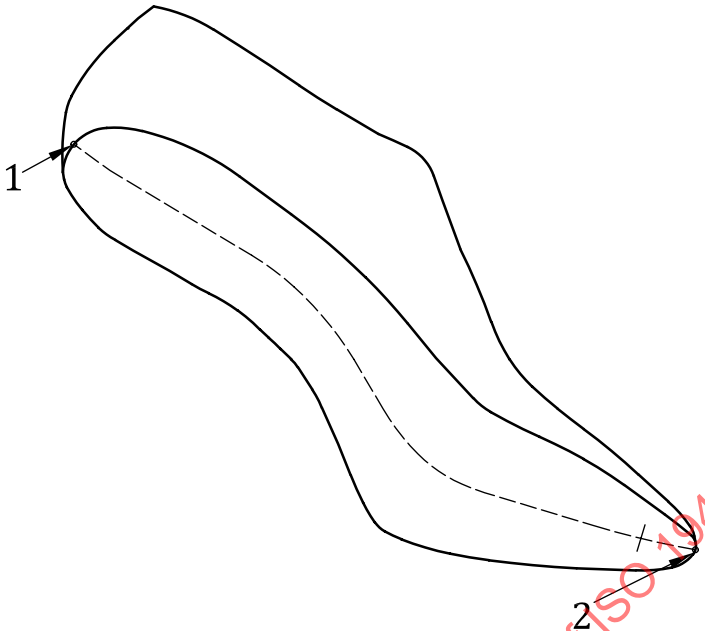
e hang over of the last top

Figure 6 — Measurement of the hang over of the last top

7.3 Effective last length measurement

It is necessary to know the marked size or to assume a size to provide a starting point (it can be found that it is an incorrect size and the process repeated until the correct size is determined).

Select from the conversion table as given in ISO/TS 19407:2015, tables 1 to 3, the foot length of the marked size. Subtract from this value the measured distance of "a" maximum of heel curve in accordance with ISO/TS 19408:2015, Figure A.6 and add the value of toe allowance (defined by the last or shoemaker). Mark this value at the central line of the last bottom, beginning at the heel point of feather line (see Figure 7).



Key

1 heel point of feather line

2 end point of effective last length

NOTE The effective last length is the central dotted line of foot or last that connects the centre of the back of the heel (1) and a point in the forefoot area (2), at the end of the second toe

Figure 7 — Marking of effective last length

7.4 Ball girth measurement

7.4.1 General

Select one of the methods 7.4.2 to 7.4.4 to measure the ball girth in accordance with the definition given in ISO/TS 19408.

NOTE The three methods can give different results.

7.4.2 Ball girth method 1

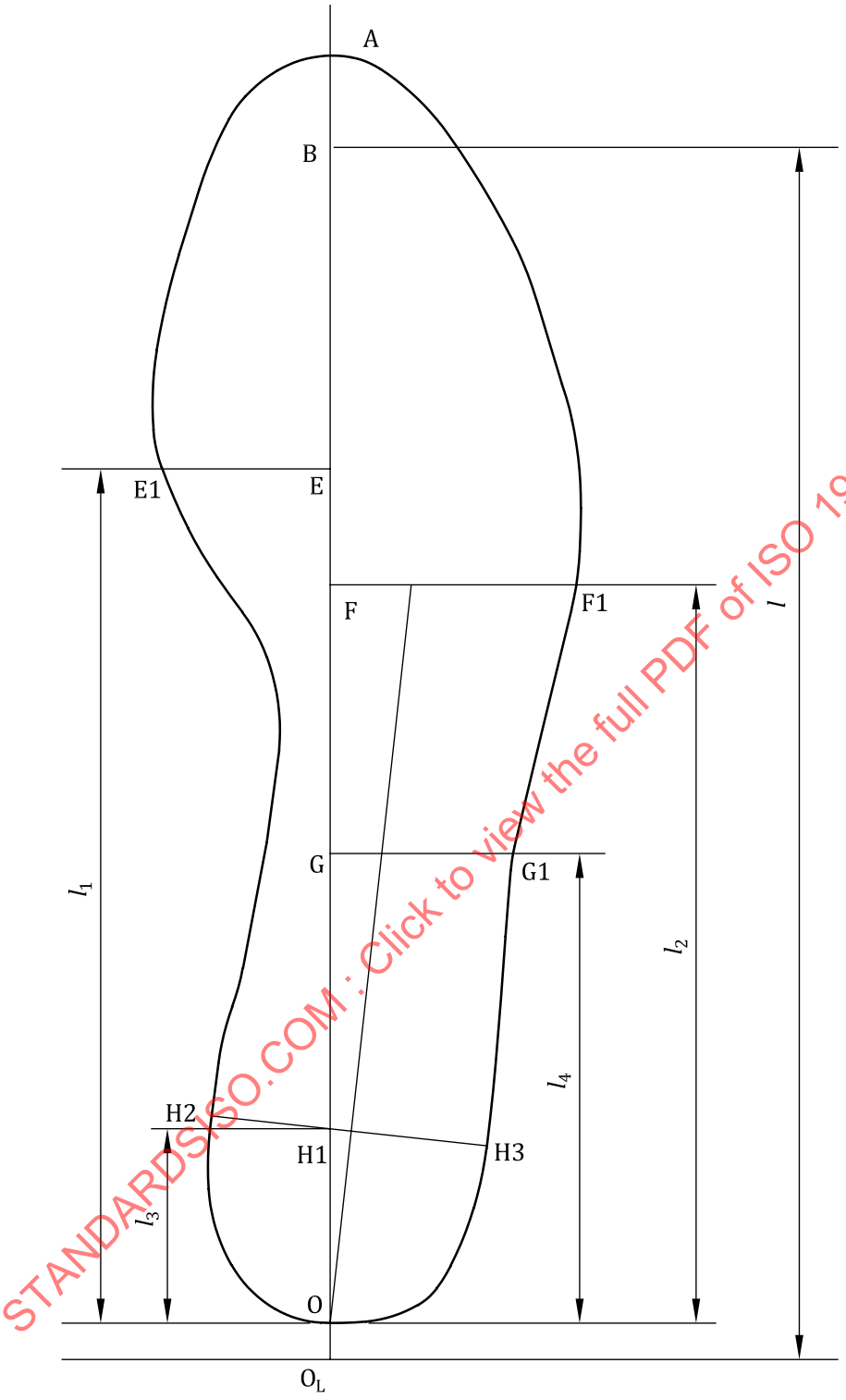
First, working on the last bottom or on a last bottom pattern, mark the central line through the middle of the heel seat as follows:

a) Mark the centre of the back of the heel as judged by eye (point O).

b) Next mark a point (H1) 18 % of the foot length corresponding to the last, and equidistant between the inside (point H2) and outside (point H3) of the heel seat.

c) Draw a line through the two points O and H1.

Draw a second line at an angle inside to the first line (O and H1), and passing through point O. The value of the angle depends on the type of footwear being made and typically ranges from 6 degrees to 8 degrees but may range between 0 degrees and 20 degrees. This is the central line O to A (Figure 8).



Key

A l is equal to 100 % of l (foot length)

B l_1 is equal to 72,5 % of l minus the distance O to O_L (O to O_L is equal to "a" which is the maximum of heel curve (see figure 12))

C l_2 is equal to 63,5 % of l minus the distance O to O_L

D l_3 is equal to 18 % of l minus the distance O to O_L

E l_4 is equal to 41 % of l minus the distance O to O_L

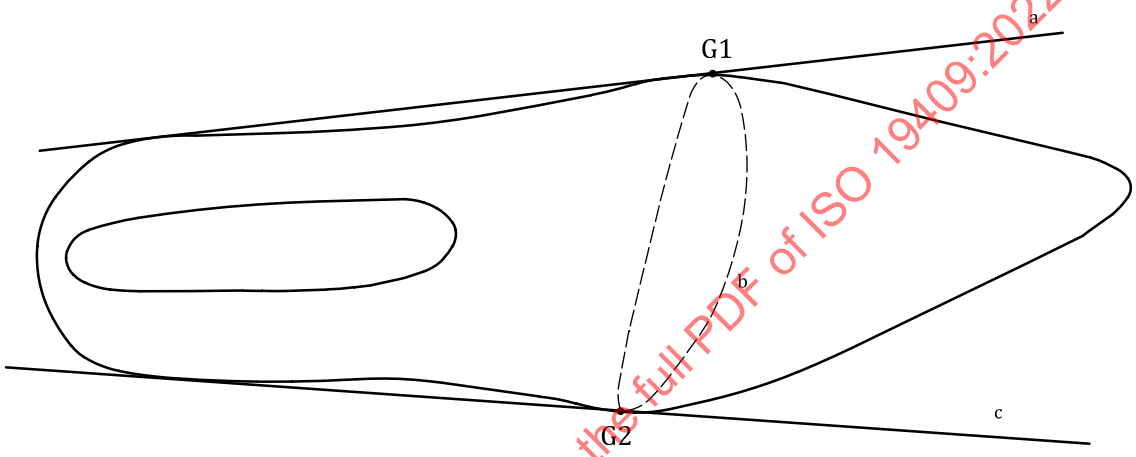
F O to A is the central line

Figure 8 — Method 1 to define the ball points E1 and F1 for the measurement of ball girth

Measure the circumference in mm of the ball girth with the tape (5.1) lying flat on the last. Measure around the last starting from point F1 across the bottom of the last to point E1, returning to F1 over the top of the last. E1 and F1 are shown in Figure 8 and are derived from the central line.

7.4.3 Ball girth method 2

First, mark the metatarsal tangent points G1 and G2 on the last as follows (see Figure 9).



Key

G1 medial contact point of tangent t at the position of 1st metatarsal
G2 lateral contact point of tangent r at the position of 5th metatarsal
a inside tangent line
b last ball girth
c outside tangent line

Figure 9 — Ball girth measurement method 2

The last ball girth "b" is the circumference of the section passing through the metatarsal tangent points G1 and G2, following the shortest surface path. Measure the circumference in mm of the ball girth with the tape (5.1) lying flat on the last.

7.4.4 Ball girth method 3

Measure the continuous geodesic joint girth by wrapping the measuring tape (5.1) around the last in the approximate region of the joint (visually the widest position of the last in the forepart region). Then adjust its position until at all points, the measuring tape lies flat on the surface of the last. The second circuit around the last the tape shall follow exactly the first circuit. Record the measurement of the first circuit.

7.4.5 Technical ball girth method 4

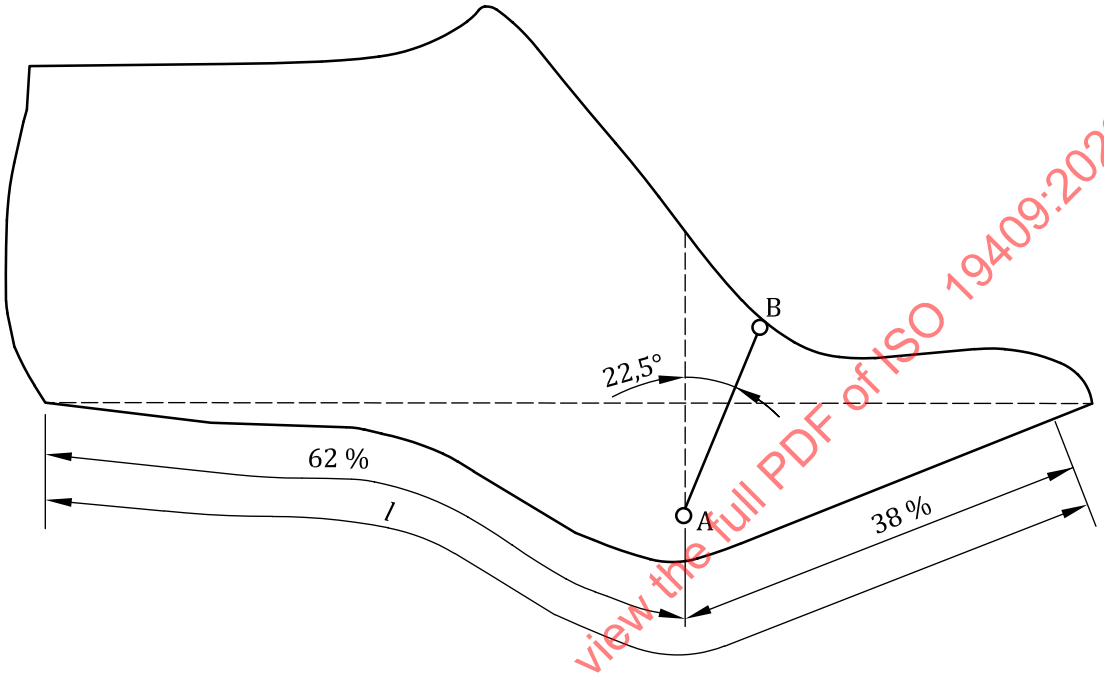
This method uses the golden section to find the measuring points as follows.

The dotted line in Figure 10 is a horizontal line between the heel point and the toe spring point of the feather line to get the orientation of the last. Mark the central line at the last bottom in accordance with ISO/TS 19408:2015, 2.2.2, method 1. Measure 62 % of the foot length minus "a" (in accordance with ISO/TS 19408:2015, Figure A.6 and Figure 10 of this document) along the central line. Draw a vertical

line to the central line in this point around the last. Measure 8 mm from the feather line following the vertical line. Mark point A medial and lateral of the last. Measure an angle of 22,5° with the centre in A. Mark point B at the central line in the upper part of the last.

Take the tape (5.1) and clad it over the last. Fix the tape around the last, crossing the three marked ball points. Read the ball girth in mm from the scale of the tape.

NOTE This ball girth is smaller than the ball girths of method 1, 2 and 3.



Key

l foot length minus "a" (see figure 12) maximum of heel curve is the last length

A ball point at the medial and lateral points of the last

B ball point at the highest point in the middle of the last

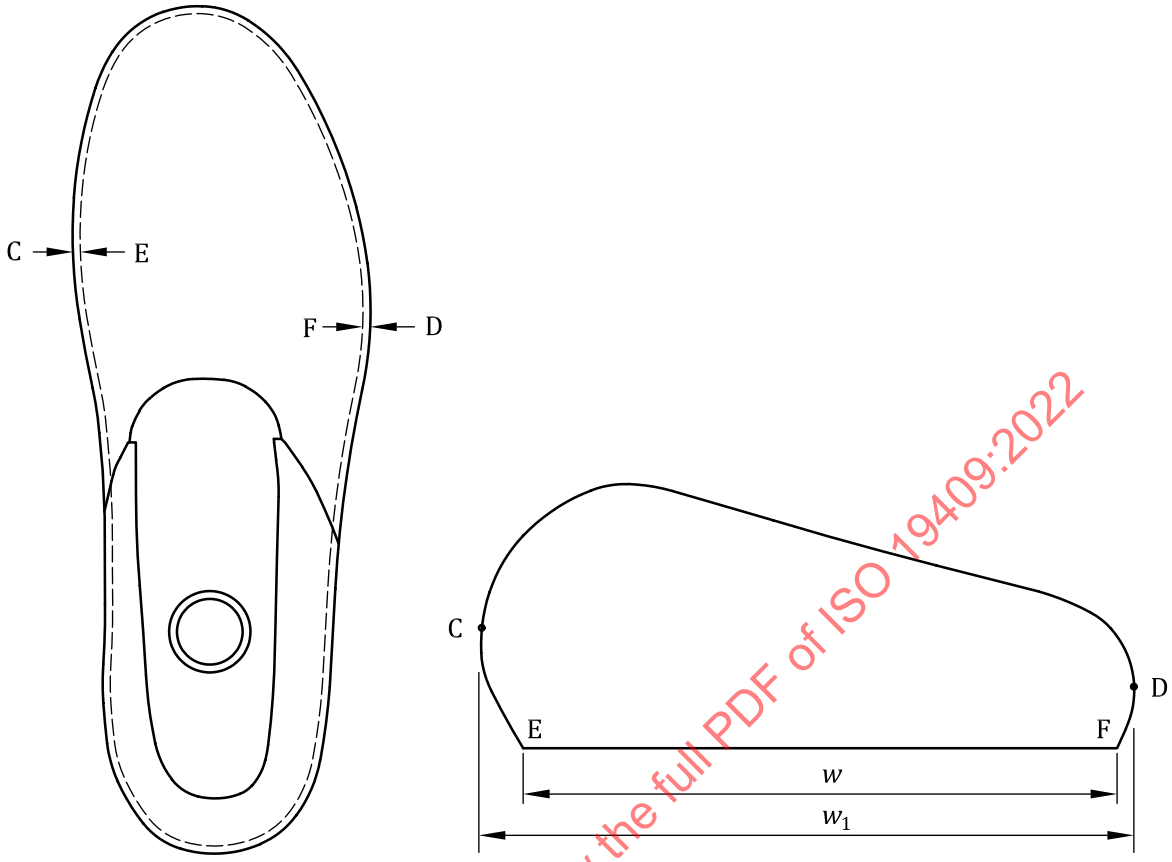
Figure 10 — Position of the 3 ball points to measure the technical ball girth

The heel point shall be horizontally level to the toe spring indicated with a dotted line in Figure 10.

7.5 Linear ball width of last

Mark the maximum of the convex contour in the big ball area (medial) as a point of the last surface (point C in Figure 11). Mark the maximum convex contour of the little ball area (lateral) as a point of the last surface (point D in Figure 11). Points C and D will usually be above the feather line. Measure the distance between C and D using the Vernier calliper (5.8).

NOTE See ISO/TS 19408:2015, 2.1.10.



Key

C	point of the maximum of convex contour in the big ball area of the last surface
D	point of the maximum of convex contour in the little ball area of the last surface
E	point of the maximum of convex contour in the big ball area of the last feather line
F	point of the maximum of convex contour in the little ball area of the last feather line
w	tread width of ball area
w_1	linear ball width of last
– – – –	feather line of the last.

Figure 11 — Ball points

7.6 Tread width of ball area

Method A

Mark the maximum of the convex contour of the feather line (see dotted line in Figure 11) in the big ball area (see point E in Figure 11). Mark the maximum of the convex contour of the feather line in the little ball area (see point F in Figure 11). Measure the distance between these two points [possible with the Vernier calliper (see 5.8)].

Method B

For method 1 in 7.3, add the distances EE1 and FF1 to give the total linear ball width.

NOTE See ISO/TS 19408:2015, 2.2.17.

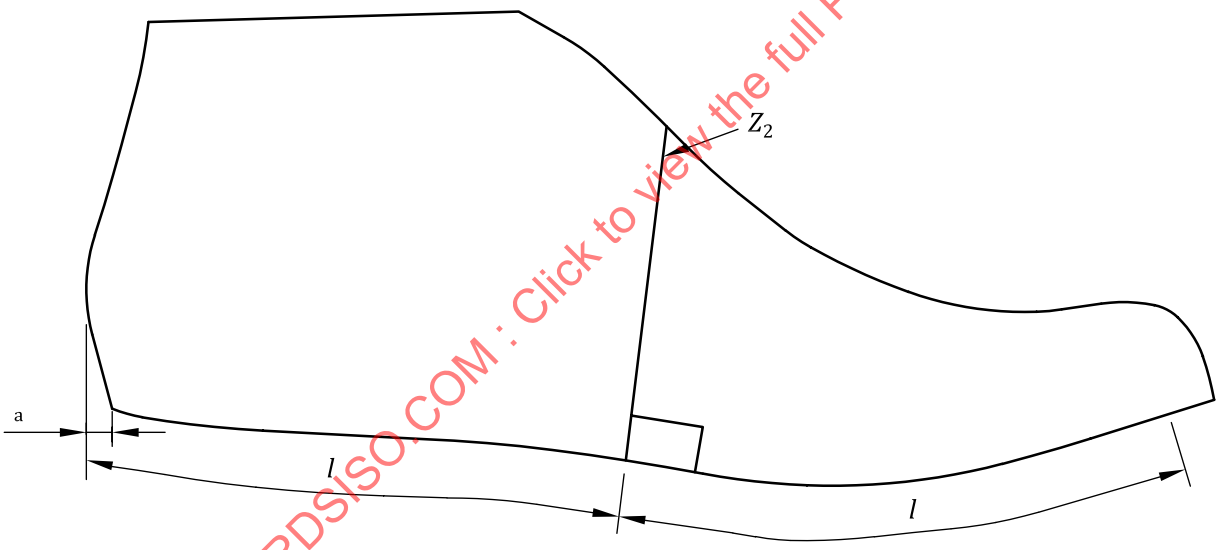
7.7 Instep girth

7.7.1 Instep girth (method 1)

The instep girth "Z_2" shall be measured at a distance of 41 % of foot length from the middle of the feather line in the heel part back. Mark the central line at the last bottom in accordance with ISO/TS 19408:2015, method 2. Calculate 41 % of the foot length obtained in accordance with ISO/TS 19407. Subtract from this value the measured distance of "a" maximum of heel curve (see Figure 8). Mark this value (see point G of Figure 8) at the central line of the last bottom from heel point of feather line. Mark in point G vertical to the central line point G1 as a point of feather line (see Figure 8). Place the measuring tape (5.1) flat around the last, crossing the marked points G and G1.

7.7.2 Instep girth (method 2)

The instep girth "Z_2" shall be measured by a distance of 50 % of foot length. Mark the central line at the last bottom in accordance with ISO/TS 19408:2015, clause 2.2.2. Select from the conversion table of ISO/TS 19407 the foot length, *l*, of the marked shoe size. Calculate 50 % (½) of this length. Subtract from this value the measured distance of "a" maximum of heel curve (see Figure 12). Mark this value "x" (see Figure 13) at the central line of the last bottom from heel point of feather line. Draw a line perpendicular to the central line until the lateral and medial feather line. Place a tape flat around the last, crossing the marked points and following a plane perpendicular to the central line of the bottom surface of the last (see Figure 13).



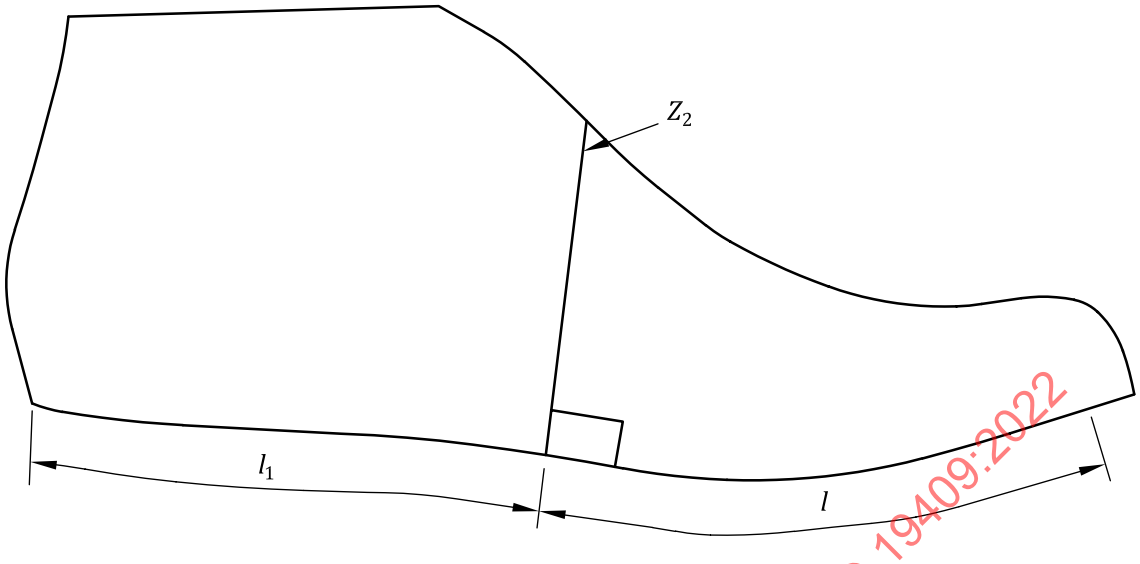
Key

a maximum of heel curve

Z_2 instep girth

Note *l* and *l* are equal in length and are the foot length (see figure 8)

Figure 12 — Instep girth method 2



Key

Z_2 instep girth

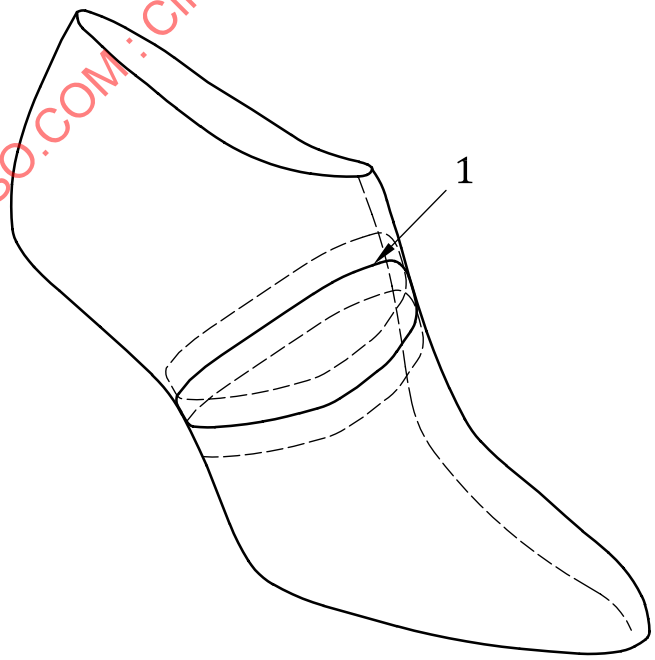
NOTE 1 l and l_1 are equal to the last length (see figure 10)

NOTE 2 l_1 is equal to half the foot length “l” minus maximum of heel curve "a” (see figures 8 and 12)

Figure 13 — Measurement of instep girth

7.7.3 Instep girth (method 3)

The instep girth has been measured with a tape (see 5.1) as a circumference at the shortest perimeter of last arch section (see Figure 14).



Key

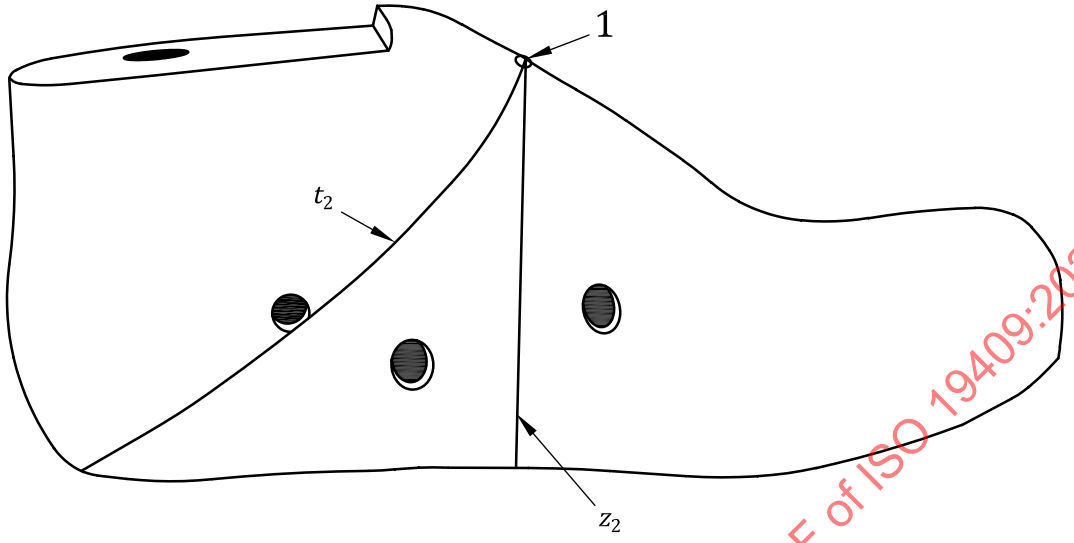
1 shortest circumference

_ _ _ _ dotted circumference lines are the longer lengths

Figure 14 — Instep girth method 3

7.8 Long heel girth

Long heel girth, t_2, is important for boot lasts to be measured from the middle of the feather line in the heel part back to this point, crossing the instep point 1 at the top of the last (see Figure 15).



Key

t_2 long heel girth
z_2 instep girth
1 instep point

NOTE See ISO/TS 19408:2015, 2.2.14.

Figure 15 — Long heel girth

7.9 Heel width (tread width and linear width)

7.9.1 General

All dimensions of heel width shall be measured by a distance of a given percentage of foot length. Select the foot length of the marked shoe size from the conversion table of ISO/TS 19407:2015, Tables 1 to 3. Calculate the given percentages of this length. Subtract from this value the measured distance of "a" maximum of heel curve (in accordance with ISO/TS 19408:2015, Figure A.6). Mark this value at the central line of the last bottom measured from the back of the heel. Draw a line perpendicular to the central line until the lateral and medial feather line.