

SVENSK STANDARD

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Ergonomi – 3-D scanningsmetoder för internationellt jämförbara antropometriska databaser – Del 2: Utvärderingsprotokoll av ytform och repeterbarhet av relativa landmärkespositioner (ISO 20685-2:2015)

Ergonomics – 3-D scanning methodologies for internationally compatible anthropometric databases – Part 2: Evaluation protocol of surface shape and repeatability of relative landmark positions (ISO 20685-2:2015)



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EUROPEAN STANDARD

EN ISO 20685-2

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2017

ICS 13.180

English Version

Ergonomics - 3-D scanning methodologies for
internationally compatible anthropometric databases -
Part 2: Evaluation protocol of surface shape and
repeatability of relative landmark positions (ISO 20685-
2:2015)

Ergonomie - Méthodologies d'exploration
tridimensionnelles pour les bases de données
anthropométriques compatibles au plan international -
Partie 2: Protocole d'évaluation de la forme extérieure
et de la répétabilité des positions relatives de repères
(ISO 20685-2:2015)

Ergonomie - Scanverfahren für international
kompatible anthropometrische Datenbanken - Teil 2:
Prüfprotokoll für Körperoberflächen und
Wiederholbarkeit relativer Messpunktpositionen (ISO
20685-2:2015)

This European Standard was approved by CEN on 8 February 2017.

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COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

The text of ISO 20685-2:2015 has been prepared by Technical Committee ISO/TC 159 “Ergonomics” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 20685-2:2017 by Technical Committee CEN/TC 122 “Ergonomics” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2017, and conflicting national standards shall be withdrawn at the latest by September 2017.

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The text of ISO 20685-2:2015 has been approved by CEN as EN ISO 20685-2:2017 without any modification.

Introduction

Anthropometric measures are key to many International Standards. These measures can be gathered using a variety of instruments. An instrument with relatively new application to anthropometry is a three-dimensional (3-D) scanner. 3-D scanners generate a 3-D point cloud of the outside of the human body that can be used in a number of situations including clothing and automotive design, engineering and medical applications. Recently, digital human models are created from a 3-D point cloud, and used for various applications related to technological design process. Quality control of scan-extracted anthropometric data is important since required quality can differ according to applications.

There are a number of different fundamental technologies that underlie commercially available systems. These include stereophotogrammetry, ultrasound and light (laser light, white light and infrared), among others. Further, the software that is available to process data from the scan varies in its methods. Additionally, methods to extract landmark positions are different between commercially available systems. In some systems, anthropometrists decide landmark locations and paste marker stickers, and scanner system calculate locations of marker stickers and identify their names, while in other systems, landmark positions are automatically calculated from the surface shape data. Quality of landmark locations have significant effects on the quality of scan-extracted 1-D measurements as well as digital human models created based on these landmarks.

As a result of differences in fundamental technology, hardware and software, the quality of body surface shape and landmark locations from several different systems can be different for the same individual. Since 3-D scanning can be used to gather these data, it was important to develop an International Standard that allows users of such systems as well as users of scan-extracted measurements to judge whether the 3-D system is adequate for these needs.

The intent of this part of ISO 20685 is to ensure the quality control process of body scanners, especially that of surface shape and locations of landmarks as specified by ISO 7250-1.

Ergonomics — 3-D scanning methodologies for internationally compatible anthropometric databases —

Part 2: Evaluation protocol of surface shape and repeatability of relative landmark positions

1 Scope

This part of ISO 20685 addresses protocols for testing of 3-D surface-scanning systems in the acquisition of human body shape data and measurements. It does not apply to instruments that measure the motion of individual landmarks.

While mainly concerned with whole-body scanners, it is also applicable to body-segment scanners (head scanners, hand scanners, foot scanners). This International Standard applies to body scanners that measure the human body in a single view. When a hand-held scanner is evaluated, it has to be noted that the human operator can contribute to the overall error. When systems are evaluated in which the subject is rotated, movement artefacts can be introduced; these can also contribute to the overall error. This part of ISO 20685 applies to the landmark positions determined by an anthropometrist. It does not apply to landmark positions automatically calculated by software from the point cloud.

The quality of surface shape of the human body and landmark positions is influenced by performance of scanner systems and humans including measurers and subjects. This part of ISO 20685 addresses the performance of scanner systems by using artefacts rather than human subjects as test objects.

Traditional instruments are required to be accurate to millimetre. Their accuracy can be verified by comparing the instrument with a scale calibrated according to an international standard of length. To verify or specify the accuracy of body scanners, a calibrated test object with known form and size is used.

The intended audience is those who use 3-D body scanners to create 3-D anthropometric databases including 3-D landmark locations, the users of these data, and scanner designers and manufacturers. This part of ISO 20685 intends to provide the basis for the agreement on the performance of body scanners between scanner users and scanner providers as well as between 3-D anthropometric database providers and data users.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7250-1, *Basic human body measurements for technological design — Part 1: Body measurement definitions and landmarks*

ISO 10360-8, *Geometrical product specifications (GPS) — Acceptance and reverification tests for coordinate measuring systems (CMS) — Part 8: CMMs with optical distance sensors*

ISO 20685, *3-D scanning methodologies for internationally compatible anthropometric databases*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

SS-EN ISO 20685-2:2017 (E)

3.1 error of spherical form measurement

error within the range of the Gaussian radial distance, determined by a least-squares fit of measured data points on a test sphere

Note 1 to entry: Error of spherical form measurement is associated with the performance of the body scanner and the sphericity of the test sphere.

3.2 spherical form dispersion value

smallest width of a spherical shell that includes n % of all the measured data points

Note 1 to entry: See [Figure 1](#), right.

Note 2 to entry: n should be 90 %.

3.3 standard deviation of radial distances

standard deviation of radial distances from measured data points and best-fit sphere

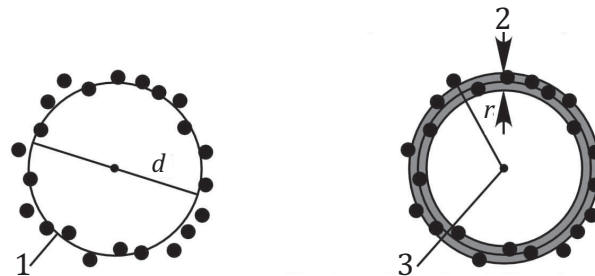
Note 1 to entry: Standard deviation of radial distances is an indicator of error of spherical form measurement and is highly correlated with error of spherical form measurement (90 %).

3.4 error of diameter measurement

error of the diameter of a least-squares fit of measured data points on a test sphere

Note 1 to entry: See [Figure 1](#), left.

Note 2 to entry: It is calculated as the measured diameter minus the calibrated diameter.



Key

- 1 best-fit sphere
- 2 spherical form dispersion value (n)
- 3 centre of the best-fit sphere
- d diameter of the best-fit sphere
- r radial distance of a measured data point from the centre of the best-fit sphere

NOTE Spherical form dispersion value (n), in which n % of the measured data points are located, is shown as the radial thickness of the shaded area of the right figure. Spherical form dispersion value (n) is calculated as the $100 - n/2$ percentile value minus $n/2$ percentile value of the radial distances of the measured data points from the centre of the best-fit sphere.

Figure 1 — Error of diameter measurement and spherical form dispersion value

4 Test protocol for evaluating surface shape measurement

4.1 General aspects

The environmental conditions shall correspond to the operating conditions of the 3-D body scanner. When operation mode needs to be modified to measure the test object, it shall be specified in the report.

4.2 Test sphere

Sphere made of steel, ceramic, or other suitable materials with diffusely reflecting surface are used to determine the quality parameter spherical form dispersion value and error of diameter measurement. It is desirable that the diameter of the sphere should be larger than 10 % of the largest dimension of a rectangular parallelepiped scanning volume.

The diameter and form of the test sphere shall be calibrated, and a calibration certificate shall be available. Since the form deviation and the roughness of the test sphere influence the test results, error of spherical form measurement in the certificate shall be smaller than one fifth of the maximum permissible error determined by the body scanner manufacturer.

The surface properties of the test sphere may significantly affect the test results. The material of test sphere shall be reported.

The reference sphere supplied with the body scanner for the calibration purposes shall not be used for this test.

Example of sphere is shown in [Annex A](#).

4.3 Procedure

4.3.1 Measurement of test sphere

The sphere shall be measured at least nine different positions within the scanning volume. Measurement positions shall include the following nine positions ([Figure 2](#)): position 1 is the centre of the scanning volume on the floor; position 2 to position 5 are 500 mm, 1 000 mm, 1 500 mm, and 2 000 mm off the floor, above position 1; position 6 and position 7 are 250 mm anterior to or posterior to the centre position and 1 000 mm off the floor; position 8 and position 9 are 400 mm right or left to the centre position and 1 000 mm off the floor.

When the sphere cannot be measured at positions described above due to a smaller scanning volume, measure the sphere at a position closest to the intended position, and record the exact position.