Study on the inclusiveness of anthropometrics in European harmonised standards

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Final Report

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2023 EN

Table of contents

List of figures

List of tables

List of boxes

List of abbreviations

A	Ampere
AELs	Accessible emission limits
AIDC	Automatic identification and data capture
Aitex	Spanish Textile Industry Research Association
ANEC	European consumer voice in standardisation
ATV	All-terrain vehicles
BSI	British Standards Institution
CBRN	Chemical biological, radiological and nuclear
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CFCM	Community face coverings (masks)
CHP	Combined heat and power
DG GROW	The Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
DHI	Digital Health Innovation
EC	European Commission
EN	European standard
ETSI	European Telecommunications Standards Institute
EU	European Union
hEN	European harmonised standard
HF	Human factor
ICS	International Classification for Standards
IEC	International Electrotechnical Commission
IR	Infrared
ISO	International Organization for Standardization
KAN	Commission for Occupational Health and Safety and Standardization
kg	Kilograms
m	Metres
MPEs	Maximum permissible exposures
MS	Member States
MTS	Methods for testing & specification
NBSs	National standardisation bodies
NEN	Royal Netherlands Standardization Institute
NIOSH	National Institute for Occupational Safety and Health

NIPV	Nederlands Instituut Publieke Veiligheid
SCC	Standards Council of Canada
SMEs	Small and medium-sized businesses
SOPHIA	Socio-physical interaction skills for cooperative human-robot systems in agile production
TC	Technical committees
UNECE	United Nations Economic Commission for Europe
USA	United States of America
UV	Ultraviolet
v	Volt
WG	Working group

Abstract

European harmonised standards are used to design safe products. However, if standards do not consider the diversity of human bodies in terms of size, structure and composition, they may fail to ensure the safety, comfort, accessibility and usability of products for the whole European population.

This study provides the European Commission (the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs – DG GROW) with evidence to better understand the extent and implications of standards' non-inclusiveness. A methodology to identify, assess and prioritise standards with an anthropometric component has been developed and applied to 2 650 European standards supporting the 22 pieces of legislation within the remit of DG GROW – Unit H2 – Machinery & Equipment.

The findings show that anthropometric measures are relevant for 36% of these standards. Most of them fail to adequately consider all anthropometric dimensions. For 76 standards, the potential impact of non-inclusiveness on human health and safety is assessed as high, thus calling for an urgent revision of the relevant legislation.

Executive summary

Scope and objectives

Standards are essential in ensuring the safety of products by aligning them with EU legislation's health and safety requirements. To safeguard every European's safety and health, European standards should consider the diversity of human bodies in terms of size, structure and composition.

However, as observed in recent studies, the average male body has often been taken as a reference point, and this excludes, intentionally or unintentionally, large parts of the population. As a result, some European harmonised standards might not be suitable for all consumers and workers, with consequences for safety, health, comfort and usability.

Against this background, this study's objective is to provide the European Commission (DG GROW) evidence to better understand the extent and implications of standards' non-inclusiveness. In particular, the study aims to:

- develop a comprehensive, robust and transparent methodology to identify anthropometric-related standards and assess and prioritise those that do not sufficiently take the diversity of human bodies into account;
- apply the developed methodology to the European standards (ENs), including European harmonised standards (hENs), supporting the 22 pieces of legislation within the remit of Unit H2 of DG GROW[1];
- analyse the extent to which anthropometric-related standards supporting the legislation in scope takes the diversity of the human body of the entire European population into account, assess the impact of non-inclusive standards on health and safety, and identify priorities for their possible revision;
- collect stakeholders' views on the methodology developed and potential revisions of two selected anthropometric-related standards.

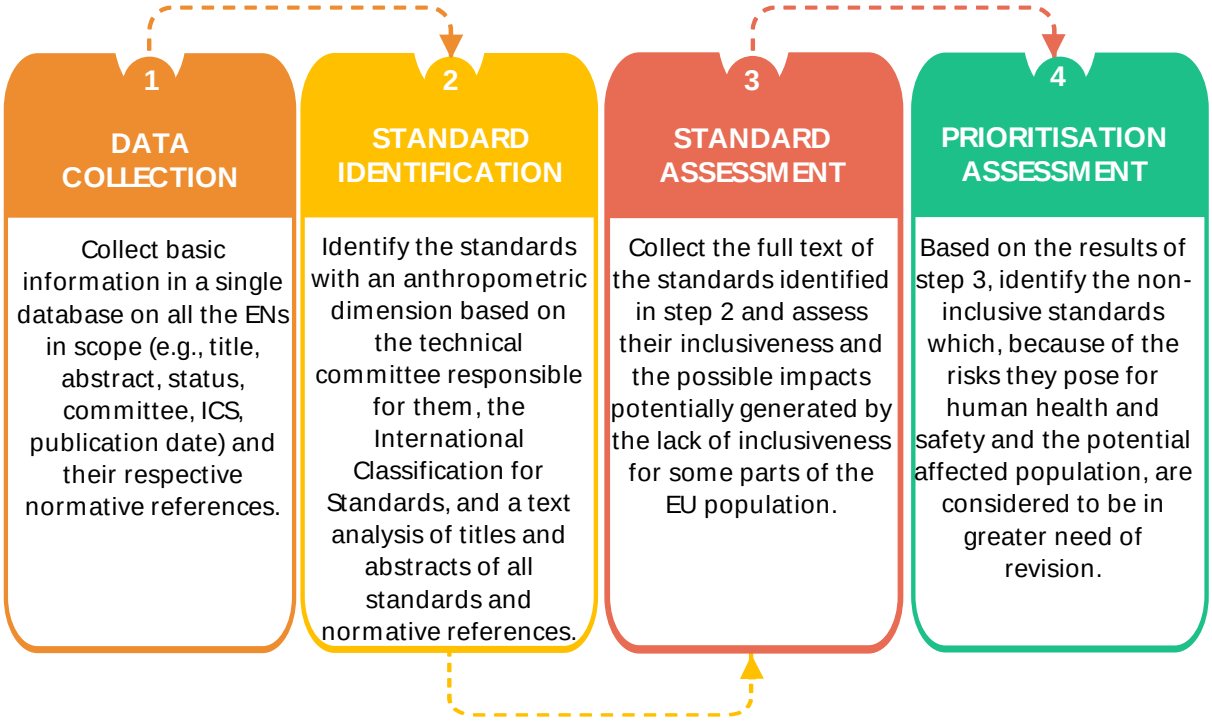
Methodology

For the purpose of the study, an analytical methodology has been developed, which relies on a mix of manual and semi-automated methods. It partly follows the approach proposed in the Guidelines on Developing Gender-Responsive Standards developed by UNECE in 2022[2].

The methodological approach is intended as a methodological framework that is also suitable for the ENs supporting the legislation in the study's scope. This approach can be applied to assess the standards supporting other pieces of legislation. The methodology has been structured around four analytical blocks, as depicted in the figure below.

[1] Machinery Directive 2006/42/EC; Lifts Directive 2014/33/EU; Personal protective equipment Regulation (EU) 2016/425; Pressure Equipment Directive 2014/68/EU; Simple Pressure Vessels Directive 2014/29/EU; Aerosol Dispensers Directive 75/324/EEC; Equipment for potentially explosive atmospheres Directive 2014/34/EU; Cableway Installations Regulation (EU) 2016/424; Recreational Craft Directive 2013/53/EU; Gas Appliances Regulation (EU) 2016/426; Noise emissions from outdoor equipment Directive 2000/14/EC; Low Voltage Directive 2014/35/EU; Electromagnetic Compatibility Directive 2014/30/EU; Radio Equipment Directive 2014/53/EU; 75/107/EEC Bottles as measuring containers; 76/211/EEC Pre-packaged products; 80/181/EEC Units of measurement; 2007/45/EC Pack sizes; 2009/34/EC Metrology framework; 2011/17/EU Repeal product specific directives; 2014/31/EU Non-Automatic Weighing Instruments; 2014/32/EU Measuring Instruments.

[2] UNECE (2022). "Guidelines on Developing Gender-Responsive Standards", WP.6 Working Party on Regulatory Cooperation and Standardization Policies, by the Steering Committee on Trade Capacity and Standards. Available at: https://unece.org/sites/default/files/2022-12/ECE_TRADE_472E.pdf.



Key findings

A total of 2 650 European standards, including European harmonised standards, are within the scope of the study. These standards support 15 of the 22 pieces of legislation within the remit of Unit H2 of DG GROW.

This study shows that 964 of them (36%) are anthropometric-related. This finding underscores the importance of anthropometric considerations when developing European standards. The number of anthropometric-related standards and their share of the total number of supporting standards varies widely among the legislative frameworks. In particular, the Machinery Directive (2006/42/EC) has the highest number of associated anthropometric-related standards, followed by the Personal Protective Equipment Regulation (2016/425/EU) and the Low Voltage Directive (2014/35/EU). Conversely, the Noise Emissions from Outdoor Equipment Directive, the Non-Automatic Weighting Instruments, the Simple Pressure Vessels Directive, and Measuring Instruments are not supported by any anthropometric-related standards. Even in sectors where the linkage with anthropometrics may seem less straightforward, considering human factors and ergonomics might be equally relevant.

Out of the 964 anthropometric-related standards, the adequacy with which anthropometric considerations are incorporated into the standard has been assessed for a subset of 276 standards (nearly 30%). This aims to ensure representativeness across the entire sample of anthropometric-related standards in terms of pieces of legislation and technical committees. This assessment revealed that most of the selected standards have a medium level of adequacy.

Most standards reference all relevant anthropometric dimensions and use statistical measures that are partly representative of the targeted population. In contrast, the adequacy is far less satisfactory as far as data transparency and data representativeness are concerned. Most standards do not reference the underlying studies/anthropometric datasets used to define the statistical measures included in the text (36%), or they state that the statistical measures are in line with another standard without any additional explanation (56%). Only a minority (8%) cites the anthropometric dataset used to develop the standard and define its statistical measures. Moreover, a significant number of standards (76%) do not adequately consider the statistical distribution of the anthropometric parameters or explicitly account for the human body's diversity, e.g. by stating that different values must be used based on the target population.

On the impact on health and safety due to the lack of inclusiveness, evidence shows that the largest share of standards have a medium impact. Evidence shows that most standards (71%) may cause injuries to users if anthropometric considerations are not properly accounted for. Only a minority (14%) could potentially lead to fatal consequences for the under-represented target population. An even smaller subset (11%) is likely to pose risks of illness.

By combining results on adequacy with results on the impact, evidence shows there is a medium or high urgency to revise most standards. Overall, there is a high priority to revise 26% of the standards, a medium priority for 38% and a low priority for 29%. For the remaining 6%, no revision is needed.

The distribution of standards by priority varies across the legislation. The Machinery Directive and the Personal Protective Equipment Regulation are where anthropometric considerations seem to have been more inclusively accounted for during the development of the underlying standards.

Overall, the findings provide valuable insights into areas where anthropometrics play a crucial role and where the lack of inclusiveness may cause a more severe impact. They also show what kind of revisions and improvements are needed to ensure the effectiveness of the standards in ensuring safety. By identifying the technical committees responsible for the standards in the European standardisation organisations and highlighting specific focus areas, stakeholders can prioritise their efforts in revising and improving the standards to address potential risks and protect the health and safety of the European population.

Nevertheless, to ensure that the revision of the standards makes them more inclusive, stakeholders highlighted the need to collect new anthropometric data that are representative of the European population. They also called for raising more awareness of the importance of anthropometric and ergonomic considerations in standards in standardisation organisations, technical committees and industry.

1. Introduction

This is the final report for the 'Study on the inclusiveness of anthropometrics in European harmonised standards'. It builds on research activities and analyses carried out throughout the study, including a stakeholder consultation. The following introductory section presents the background and general understanding of the topic, the purpose of the study and the methodological pillars.

1.1. Background and understanding

Standards provide guidelines, rules and definitions to make products, processes or services safer, simpler, more comfortable and efficient. Manufacturers, other businesses or conformity assessment bodies apply standards to demonstrate the quality and safety of their products, processes or services. At the same time, consumers can rely on them for a more informed choice. In the EU, the Commission may require the European standards organisations (CEN, CENELEC or ETSI) to develop or revise European harmonised standards (hENs) that reflect the requirements set out in EU legislation.

However, standards may fail to achieve their purpose if they do not consider the needs and characteristics of all possible users. In particular, to safeguard every European's interest and, most of all, their safety, European harmonised standards should consider the diversity of human bodies in terms of size, structure and composition. Anthropometric measures are often used in standards, for example, to create designs that fit the human body better, give specifications for a dummy, or provide instructions on how to use a specific tool. Therefore, to ensure European harmonised standards are representative of all Europeans, they should be based on anthropometric datasets that are representative of the user population's sex, age, etc. However, as observed in recent studies[3], the average male body has often been taken as a reference, which can intentionally or unintentionally exclude part of the population.

As a result, some European harmonised standards might not be fit for all consumers and workers, with consequences for safety, comfort, accessibility, and usability. Examples have been highlighted in recent studies and range from the probability for women to receive cardiopulmonary resuscitation in public[4] or survive a car accident[5], to the safety of their workplace[6] or their comfort when using some tools. There might also be consequences for society as a whole if parts of the population are excluded from using some products or services. Therefore, it is crucial to clearly identify the unintended impact of the lack of inclusiveness of certain standards.

This issue concerns values at the core of the EU, and the Commission is called on to address this situation. Promoting equality is one of the key principles of the EU, stated in Article 8 of the Treaty on the Functioning of the European Union and mentioned in the Political Guidelines for the next European Commission 2019-2024[7]. European harmonised standards are a key tool for the Commission to enact these general principles and encourage producers and businesses to apply them.

[3] Among others, Criado Perez C. (2022). *Invisible Women: Exposing Data Bias in a World Designed for Men*, Abrams Press.
Standards Council of Canada (2020). *When One Size Does Not Protect All: Understanding Why Sex Matters for Standardization.*

[4] Prasad R. (2019). 'Eight ways the world is not designed for women', BBC News, https://www.bbc.com/news/world-us-canada-47725946.

[5] Forman, J., Poplin, G. S., Shaw, C. G., McMurry, T. L., Schmidt, K., Ash, J., & Sunnevang, C. (2019). 'Automobile injury trends in the contemporary fleet: Belted occupants in frontal collisions', Traffic injury prevention, 20(6), 607-612.

[6] TUC (2017). *Personal protective equipment and women,* https://www.tuc.org.uk/research-analysis/reports/personal-protective-equipment-and-women.

[7] https://commission.europa.eu/system/files/2020-04/political-guidelines-next-commission_en_0.pdf

In recent years, **academics and specialised bodies have highlighted the issue of standards' non-inclusiveness**, and several initiatives have been launched. In 2016, the Working Party on Regulatory Cooperation and Standardisation Policies of the United Nations Economic Commission for Europe (UNECE) launched the Gender-Responsive Standards Initiative to guide standards bodies on how to develop gender-responsive standards. In 2019, CEN-CENELEC signed the UNECE Declaration for Gender-Responsive Standards and Standards Development and developed a 3-year Gender Action Plan with targeted actions to facilitate the creation of gender-responsive standards[8]. The British Standards Institution (BSI) has studied the issue from several perspectives. Recently, the BSI published guidance on how data gaps or bias might harm standards' inclusiveness and equality. The issue of developing gender-responsive standards has also been investigated by the Standards Council of Canada, which has acknowledged the need to tackle this issue[9].

1.2. Scope and objectives

Against this background, identifying non-inclusive European harmonised standards comprehensively and consistently is essential to understand the breadth of the issue. This **study's objective** was to 'assist the Commission with a specific analysis of anthropometrics in harmonised standards' (study's terms of reference). In other words, the study aimed to provide the Commission (DG GROW) with evidence to better understand the problems of standards' non-inclusiveness and develop a policy response to address them. This could include asking the European standardisation organisations to develop and revise those European standards that do not sufficiently take the diversity of the human body into account.

More specifically, the study was designed to:

- develop a comprehensive, robust and transparent methodology to identify anthropometric-related standards, and assess and prioritise those that do not sufficiently take the diversity of human bodies' diversity;
- apply the developed methodology to the European standards (ENs), including European harmonised standards (hENs)[10], supporting the 22 pieces of legislation within the remit of Unit H2 of DG GROW (shown in Figure 1);
- analyse the extent to which anthropometric-related standards take the diversity of the human body of the entire European population into account, the impact of non-inclusive standards on health and safety, and identify priorities for their possible revision;
- collect stakeholders' views on the methodology and potential revisions of two anthropometric-related standards.

The outlined methodology to identify, assess and prioritise European standards has been developed to be suitable not only for the sample of standards in this study's scope but also for other pieces of legislation, e.g. the Medical Devices Regulation ((EU) 2017/745).

[8] Presentation by Deborah Wautier – Project Manager Engagement, CEN-CENELEC 2020.

[9] Standards Council of Canada (2020). *When One Size Does Not Protect All: Understanding Why Sex Matters for Standardization.*

[10] In the rest of this report, we will refer interchangeably to 'standard', 'European standard', and 'European harmonised standards'.

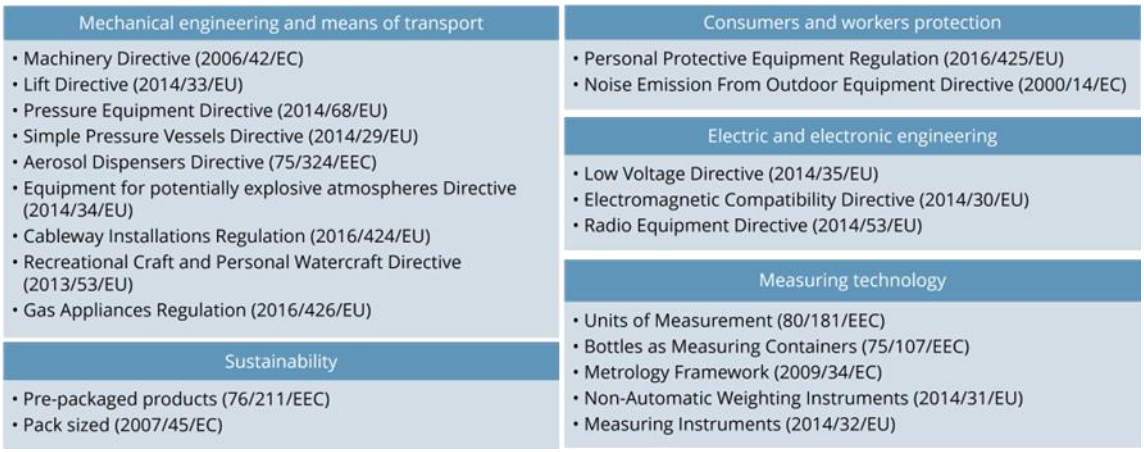


Figure 1:Legislation in the study's scope

1.3. Methodological pillars

An analysis methodology has been developed and finetuned to serve the purpose of the study, which relies on a mix of manual and semi-automated methods. It partly follows the approach proposed in the guidance note on how to develop gender-responsive standards drawn up by UNECE in 2022[11]. The methodology builds on three key pillars described below.

- **Participatory approach**: European standardisation organisations, technical committees (TCs), ergonomic and anthropometric experts and other stakeholders have been involved throughout the evaluation process. Although manual and semi-automated methods have been used to screen and assess hENs, we have liaised with TCs that have validated and double-checked the results on a voluntary basis. This participatory approach has ensured more accurate and sound results.
- **Data triangulation**: The identification and assessment phases have relied on many approaches and perspectives that have been triangulated according to pre-defined rules. The combination of many approaches has aimed to accommodate the variety of standards and ensured that no major aspects were overlooked.
- **Transparent approach for easier reuse of results**: The methodology is meant to provide clear indications about how to identify and assess anthropometric dimensions in standards. To be easily understood by a wide audience and allow for it to be reused in the future, detailed instructions and tools for the collection and assessment of information are provided. Illustrative examples are also given to show how the methodology has been applied.

1.4. Structure of the report

The report is structured as follows:

- **Chapter 1 – Introduction**. It provides the background to the study and its scope.
- **Chapter 2 – Methodological framework**. It describes the detailed methodology required to identify, assess and prioritise anthropometric-related standards.
- **Chapter 3 – Anthropometric inclusiveness of the standards under analysis**. It provides an overview of the standards supporting the pieces of legislation within the remit of Unit H2 of DG GROW. It also describes the results after applying the methodology, presented in Chapter 2, to identify, assess and prioritise the standards.

[11] https://unece.org/sites/default/files/2022-01/Guidelines%20on%20developing%20gender%20responsive%20standards%20Advanced%20Copy%20v0_1%20220119.pdf

- **Chapter 4 – Discussion and conclusions**. It summarises the study's findings, especially the evidence gathered during the stakeholder consultations.

The annexes provide supporting information and are structured as follows:

- **Annex I** – Technical details to collect data on standards in an automated way.
- **Annex II** – Tools used to identify anthropometric-related standards: the list of technical committees, the list of International Classification for Standard codes and the list of keywords.
- **Annex III** – The assessment grid.
- **Annex IV** – The full database of standards assessed and the results of the assessment (in Excel format).
- **Annex V** – Summary of the stakeholder consultation workshops on two selected standards.
- **Annex VI** – Factsheets summarising key information on a selection of standards with a high priority for revision.

2. Methodological framework

The methodology described in this chapter has been developed to achieve this study's specific objectives and allow it to be reused in the future. Moreover, although the methodology refers to European standards, it can be easily adapted for use in other types of documents, such as technical specifications and technical reports. The methodology is split into four analytical building blocks, summarised in the Figure 2. Each analytical building block is presented in the remainder of the chapter.

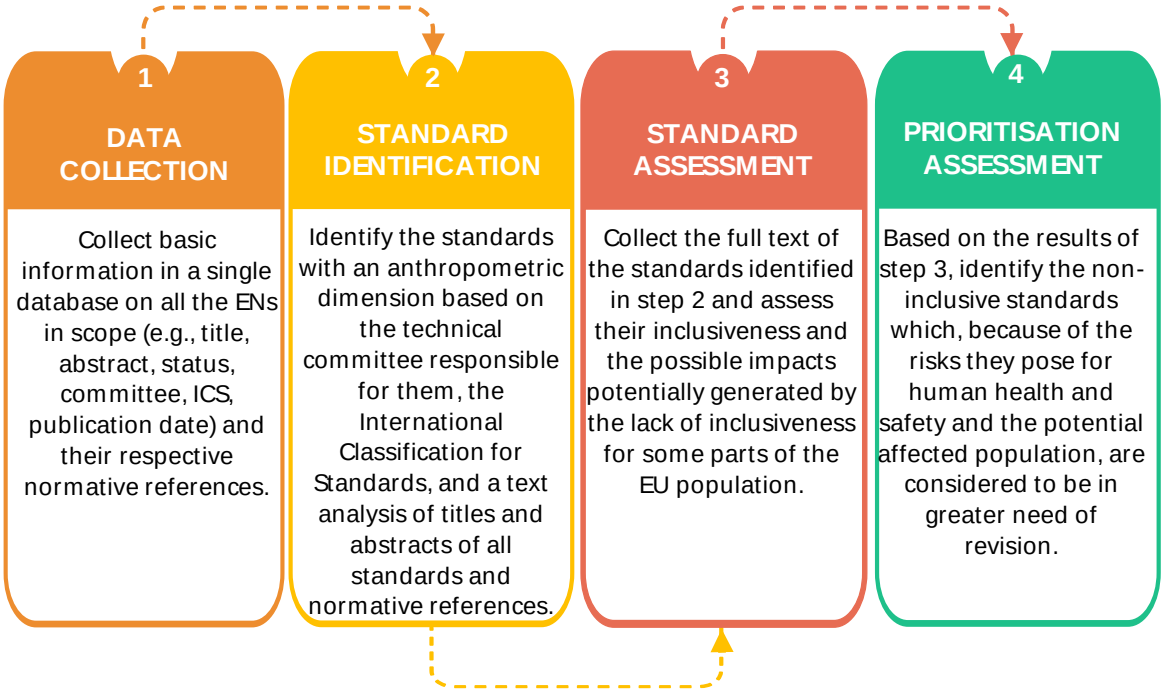


Figure 2:Analytical building blocks

Source: CSIL

2.1. Methodology for data collection

The first step of the methodology entails collecting basic information on standards and their respective normative references. This activity requires identifying the pieces of legislation of interest and then collecting basic information on all the supporting standards and

their normative references in a single database. The basic information includes the reference, title, abstract, status, responsible technical committee, international classification for standards and list of normative references.

Carrying out this activity is essential to identify standards with an anthropometric dimension (see Chapter 2.2 for further details). The output of this activity is a database with structured and comparable information for all the standards in scope and their normative references. This makes it possible to screen them quickly and identify the relevant standards in the next methodological steps. The database consists of two interlinked datasets: one with basic information on the standards in the scope of the analysis and another one with basic information on those standards' normative references. Figure 3 below provides a graphical representation of the overall process that could be used to build the database.

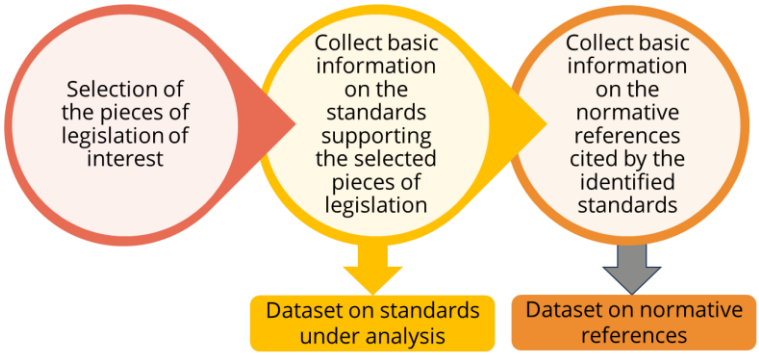


Figure 3:Steps in the compilation of the database

Source: CSIL

In what follows, we describe the data collection approach we adopted for the pieces of legislation in this study's scope. Since the scope of the analysis covers European standards drafted by the European standardisation organisations, the data sources used are the websites of those organisations (CEN, CENELEC, ETSI). Therefore, the methodology is valid for all studies on European standards[12].

2.1.1. Dataset on standards under analysis

The construction of the dataset on the standards under analysis aims to collect, in a structured way, a set of basic information for each standard supporting the piece(s) of legislation of interest. This set of information includes the reference number, title, abstract, status, responsible technical committee, international classification for standards and list of normative references. The resulting dataset is at the standard level, meaning that each row corresponds to a specific standard. For this study, we have tailored the data collection strategy to the website of the relevant European standardisation organisation. In particular, to make the data collection process as efficient as possible, we have developed ad hoc web-scraping and text-extraction algorithms.

Once the data for the CEN-CENELEC and ETSI standards have been extracted and downloaded, they have to be structured in a single dataset. Attention must be paid to including the most recent version of each standard in the database. This is because standards can be revised over time (e.g. amendments, corrigenda), and these revisions usually result in new standards. While these amendments and corrigenda can be relevant in the assessment phase (see Chapter 2.3), they are not useful in the identification phase (see Chapter 2.2). The revisions do not include any additional information about the underlying standard but usually have less information. Therefore, after excluding revisions of standards, the dataset should include, for each standard under analysis, information on the reference, the technical

[12] Note that the methodology can be adapted to accommodate different data sources: the most important aspect is to gather correct information with the largest possible coverage.

committee, the status, the title, the abstract, the international classification for standards and the list of normative references.

Annex I.1 shows the detailed procedure followed to build the standards database, including the script to collect data from the CEN-CENELEC website.

2.1.2. Dataset on cited normative references

The construction of the dataset on cited normative references aims to collect basic information – reference, title, abstract, status – for each normative reference cited by any of the standards under analysis. Like the dataset on the standards under analysis, this dataset is at the normative reference level, meaning that each row corresponds to a distinct normative reference.

The data collection strategy for data on normative references is less straightforward than the strategy outlined for the standards under analysis. Unlike European (harmonised) standards, which are drafted by one of the European standardisation organisations, normative references may also include ISO standards, IEC standards and other norms. The large number of organisations responsible for drafting the normative references is the biggest challenge in the data collection strategy.

On the one hand, the data collection needs to be adapted to the websites of multiple publishing organisations that may be responsible for a small number of normative references. On the other hand, accessing relevant information is not possible for all the normative references, e.g. sometimes the abstract is not available. To minimise these issues, the suggested strategy is to first retrieve information from the website of the responsible standardisation organisation (e.g. the ISO website for ISO standards) and, if the information is not available there, to retrieve it from the national standardisation bodies' websites[13].

As in the case of the standards under analysis, when constructing the dataset on normative references, attention needs to be paid to amendments and corrigenda. Even though a standard can directly cite a normative reference's revision, it is not useful in the identification phase as it can add noise to the analysis. Moreover, normative references can be ratified by other standardisation bodies, which implies that the same normative reference may be cited in different ways (e.g. the same standard may be referred to as EN 61318, IEC/TR 61318, IEC/TR 61318:1994, EN 61318:2008 or EN IEC 61318:2021).

To tackle this additional challenge, the construction of the dataset on normative references can be carried out in two phases. First, websites are scraped to retrieve information on all normative references cited in the standards under analysis, ensuring the largest data coverage. Then, the dataset is cleaned to remove duplicates. This ensures that the same normative reference is associated with the same title and abstract, regardless of its version. Figure 4 provides a graphical representation of the suggested procedure to build the dataset as well as an illustrative example. Annex I.2 outlines the detailed procedure followed to build the database of normative references.

[13] In some cases, websites of national standardisation bodies make it possible to browse many standards drafted by different standardisation organisations.

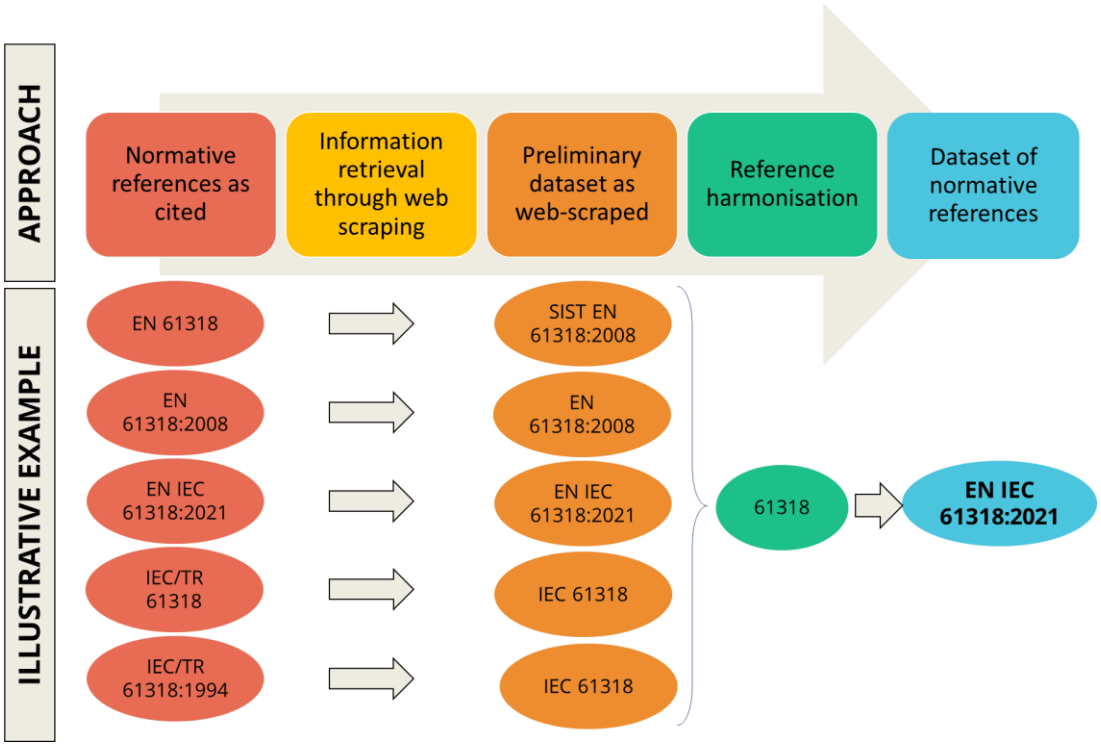


Figure 4:Construction of the dataset on cited normative references

Source: CSIL

2.2. Methodology to identify anthropometric-related standards

The second step of the methodology is to identify anthropometric-related standards. It involves screening the long list of standards collected, evaluating their scope, and assessing whether they have an anthropometric dimension.

2.2.1. Selection approaches

To ensure robust and precise results, the proposed methodology combines four different selection approaches. These involve identification based on:

- the **area of expertise of the technical committee** responsible for the standard;
- the **International Classification for Standards (ICS)** attributed to the standard;
- **keywords included in the standard's title and abstract**;
- the scope of the standard's **normative references**.

Each approach is applied separately to the entire sample of standards under analysis. The results are then triangulated to identify the final list of standards that have an anthropometric dimension.

The first approach entails selecting the relevant standards according to the **area of expertise of the responsible technical committee (TC)**. The rationale behind this approach is that each TC is responsible for drafting standards related to its area of competence. Therefore, if anthropometrics is related to a TC's area of expertise, it is likely the standards it has drafted have an anthropometric dimension.

Overall, **we identified 106 TCs** (out of the 759 working under CEN, CENELEC and ETSI) **as relevant for the identification of anthropometric-related standards** (see Annex II.1 for the complete list of relevant TCs). This was done by manually screening and analysing the title and scope of all TCs working under the European standardisation organisations.

The second approach entails selecting the relevant standards according to **their classification in the International Classification for Standards (ICS)**. The ICS is a hierarchical classification developed by the International Organization for Standardization. It classifies technical standards according to the economic sector/activity where they may be used. This approach builds on the assumption that if an ICS refers to an economic sector or activity where anthropometrics is relevant (e.g. ICS 13.340.10 Protective clothing) then the standards belonging to that ICS are, in turn, anthropometric-related.

Overall, out of the 941 existing ICS subgroups, **we identified 209 ICS subgroups as being relevant**, which belong to 96 distinct ICS groups (see Annex II.2 for the complete list of relevant ICS subgroups). This list was drawn up by carefully examining the description of each of the 941 ICS subgroups (or groups if there were no subgroups) and analysing samples of standards classified under these subgroups.

The third approach entails applying text-mining techniques to identify the standards that include **anthropometric-related keywords in their title or abstract**. To do this, an ontology consisting of a comprehensive list of keywords was developed. The keywords refer not only to the three main anthropometric dimensions (i.e. size, structure, composition) but also to age status, anthropometric and ergonomic lexicons, impact avoided, body part, gender, testing, users and other potential relevant aspects.

Overall, the ontology includes 152 keywords, provided in Annex II.3. The list was drawn up based on the knowledge acquired during interviews with ETSI and CEN-CENELEC, exchanges with the Commission and desk research. It was then revised and updated by iteratively double-checking the use of specific keywords on a sample of standards. Keywords have been grouped into semantic fields based on their sub-topic (e.g. age status, body part, structure), and a relevance score has been assigned to each semantic field based on the probability that the keywords belonging to that given field refer to an anthropometric dimension.

This approach tackles the issue of keywords having different anthropometric relevance and possible ambiguity (e.g. ‘safety’, which may be used to specify both human safety and non-human safety). Therefore, based on this classification, we propose considering those standards that include more than one keyword of high or medium relevance in their title and abstract to be anthropometric-related. If only keywords of low relevance are used, further investigation is needed to ascertain whether the standard is anthropometric-related.

The fourth approach entails selecting the relevant **standards according to their cited normative reference**. Each standard might mention one or more normative references. The methodology builds on the assumption that if a standard cites an anthropometric-related normative reference, it should be considered to be anthropometric-related. The normative references must first be classified as anthropometric-related or not. To do this, the identification approach based on keywords described above was applied. Information on the TC and the ICS subgroup is generally missing for normative references to standards drafted by non-European standardisation organisations. Hence, they could not be considered. Since identifying anthropometric-related normative references only depends on the text-analysis approach, to mitigate potential errors, only normative references classified with high- or medium-anthropometric relevance are considered to be anthropometric-related.

2.2.2. Triangulation phase

The data triangulation phase aims to combine the results obtained applying each approach to come to an overall assessment of whether a standard is anthropometric-related or not. It combines the results obtained from each identification approach to classify standards with the highest degree of precision possible. This is done by leveraging the specific characteristics of each method to overcome possible weaknesses of the others (as each approach described above has its strengths and weaknesses).

The TC and the ICS approaches clearly distinguish between anthropometric-related standards and non-relevant standards. However, some standards might have broad or borderline definitions when evaluating their relevance for an anthropometric study. Therefore, they might

include false positives (standards deemed relevant although they are not) and false negatives (standards deemed irrelevant although they are anthropometric-related).

However, the identification approach based on keywords in titles and abstracts, while excluding most non-relevant standards, is likely to include many non-anthropometric-related standards due to the ambiguity in natural language. The relevance assessment of each keyword partly overcomes this issue, but it is not entirely eliminated. These weaknesses concern not only the identification of relevant standards but also the identification of relevant normative references. Under these circumstances, excluding relevant normative references leads to erroneously excluding anthropometric-related standards.

Therefore, it is important to triangulate the results obtained from each approach to mitigate any possible weaknesses. Building on the knowledge acquired through the strategic interviews, exchanges with the Commission and the development of each selection method, a data triangulation strategy was developed by drawing up a set of rules that must be satisfied simultaneously. Following the data triangulation approach outlined in Table 1, each standard is classified as anthropometric-related (green dots in the table), uncertain standards (grey dots) and non-relevant (red dots). For standards whose relevance is difficult to determine, a manual check of the titles and abstracts is required.

Table 1 – Overview of the data triangulation strategy

Normative reference	ICS approach	TC approach	No of keywords	Maximum keyword relevance	Final selection
Yes	Yes	Yes	≥0	High-Medium-Low	Yes
Yes	Yes	No	≥0	High-Medium-Low	Yes
Yes	No	Yes	≥0	High-Medium-Low	Yes
Yes	No	No	≥0	High-Medium-Low	Yes
No	Yes	Yes	≥0	High-Medium-Low	Yes
No	Yes	No	>1	High-Medium	Yes
No	No	Yes	>1	High-Medium	Yes
No	No	No	>1	High-Medium	Yes
No	No	Yes	= 1	High-Medium-Low	Uncertain
No	Yes	No	= 1	High-Medium-Low	Uncertain
No	Yes	No	= 0	NA	No
No	Yes	No	>1	Low	No
No	No	Yes	= 0	NA	No
No	No	Yes	>1	Low	No
No	No	No	= 0	NA	No
No	No	No	= 1	High-Medium-Low	No

Source: CSIL

2.3. Methodology for the assessment of anthropometric-related standards

The third step of the methodology aims to evaluate whether the standards with an anthropometric dimension are sufficiently inclusive and, if not, the impact they have (e.g. on health, safety, comfort) on an under-represented population.

2.3.1. Assessment grid

An assessment grid has been developed to evaluate if the standards identified as anthropometric-related have any shortcomings in the provisions related to anthropometrics. The assessment grid is based on clear and well-defined dimensions and scenarios to ensure that the assessment is consistent across all the standards and that information is collected in a structured and systematic way. The assessment grid should be completed by closely reviewing the full text of the standards.

Overall, the assessment grid is structured like a questionnaire, including, by and large, closed questions in six sections. It includes an introductory section to investigate the scope of the standard, four sections that gather information on the extent to which anthropometrics has been considered, and a concluding section on the potential impact (see Annex III for further details).

2.3.2. Anthropometrics adequacy

The adequacy assessment aims to determine whether the standards with an anthropometric dimension have been conceived and developed with considerations for the diversity of the European population. Factors assessed include gender, age and the various anthropometric measurements (e.g. height, weight, strength) of all possible users in Europe. Specifically, in line with recent approaches developed to evaluate standards in terms of accessibility and gender responsiveness[14], the proposed methodology requires evaluating the adequacy of each anthropometric-related standard along four dimensions: (i) anthropometric coverage; (ii) statistical inclusiveness; (iii) data transparency; and (iv) data representativeness. Table 2 provides information on these four sub-indicators developed to measure the anthropometric adequacy of the selected standards.

Each anthropometric-related standard is classified based on the four above-mentioned adequacy sub-indicators based on the information in the assessment grid. Then, an inadequacy score is given to each sub-indicator category, ranging from 0 (full adequacy) to 2 (no adequacy). This approach allows for calculating an overall adequacy index, derived as a simple average of the scores assigned to the four sub-indicators. While a weighted average could potentially capture the relative importance of each sub-indicator, weights are not incorporated to avoid introducing additional subjective factors.

Therefore, by applying the simple average to the sub-indicators' scores, which range between 0 and 2, the overall adequacy index score also falls between 0 and 2. Based on the overall score, each standard is classified as described below.

- **Full adequacy**. These standards have an overall score equal to 0, indicating that their provisions fully account for the diversity of the European population. They have accounted for relevant anthropometric dimensions and incorporated comprehensive considerations of anthropometric factors, ensuring inclusiveness for all potential users across Europe.
- **High adequacy**. These standards have an overall score that ranges between 0.01 and 0.67 (inclusive). While not achieving full adequacy, they demonstrate a significant level of consideration of anthropometric factors.
- **Medium adequacy.** These standards have an overall score that ranges between 0.68 and 1.34 (inclusive). Although they exhibit a moderate level of adequacy, these standards may partially address the diversity of the European population but could benefit from further improvements to ensure greater inclusiveness.

[14] BSI (2022). 'Enabling the development of inclusive standards – Understanding the role of data and data analysis – Guide'. Department for Business, Energy & Industrial Strategy; Standards Council of Canada (2020). When One Size Does Not Protect All: Understanding Why Sex Matters for Standardization.; UNECE (2022). 'Guidelines on Developing Gender-Responsive Standards'.

- **Low adequacy**. These standards have an overall score that ranges between 1.35 and 2 (inclusive). These standards demonstrate limited consideration for anthropometric factors and do not adequately address the diversity of the European population. They may lack comprehensive provisions or overlook important anthropometric measurements, potentially resulting in inadequate provisions for certain user groups.

Table 2 – Overview of sub-indicators measuring the standards' anthropometric adequacy

Sub-indicator	Sub-indicator rationale	Sub-indicator categories	Score
Anthropometric coverage	The anthropometric coverage sub-indicator aims to answer the question: '*Have all relevant anthropometric dimensions been considered?*'. It investigates to what extent each standard covers all relevant anthropometric dimensions (i.e. size, structure, composition).	**Coherent standard**: all relevant anthropometric dimensions are included in the standard	0
		Simplistic standard: among the relevant dimensions, only one has not been included in the standard	1
		Overly simplistic standard: several relevant dimensions have not been included in the standard.	2
Statistical inclusiveness	The statistical inclusiveness sub-indicator aims to answer the question: '*Have representative statistical measures been used?*'. It investigates to what extent the standard was developed using data that is representative of the European population[15].	**Representative standard**: the standard is developed based on statistical measures that provide a faithful representation of the diversity of European bodies.	0
		Partly representative standard: the standard is developed based on statistical measures that provide a faithful representation of the diversity of a subgroup of European bodies.	1
		Unrepresentative standard: the standard is developed based on statistical measures that do not provide a faithful representation of the diversity of European bodies.	2
Data transparency	The data transparency sub-indicator aims to answer the question: '*Have relevant underlying anthropometric studies/data been cited?*'. It investigates the transparency of the data and studies used to develop the standard[16].	**Transparent**: the anthropometric data underlying the choice of the statistical values employed in the standard are referenced in the standard	0
		Partly transparent: the anthropometric data underlying the choice of the statistical values employed in the standard are not referenced in the standard, but the standard mentions another standard that might justify it.	1
		Not transparent: the anthropometric data underlying the choice of the statistical values employed in the standard are not referenced in the standard	2

[15] This only applies to the anthropometric dimensions covered by the standard.

[16] This only applies if statistical measures are included in the standard.

Data representativeness	The data representativeness sub-indicator aims to answer the question: '*Have disaggregated data been used or has the diversity of the human body been acknowledged?*'. It investigates to what extent the data used to develop the standard are representative of the European population[17].	**Comprehensive standard**: the standard considers the diversity of European bodies, which is extensively mentioned in the standard, and disaggregated statistical measures are used.	0
		Vague standard: the standard does not sufficiently consider the diversity of European bodies, or the standard considers the diversity of European bodies, but disaggregated statistical measures are not used.	1
		Overly generic standard: the standard does not consider the diversity of Europeans' bodies, and disaggregated statistical measures are not used.	2

Source: CSIL

2.3.3. Assessment of the impact on health and safety

Assessing the impact of anthropometric-related standards on society is essential for understanding the size of the issue, particularly where non-inclusive standards are concerned. Standardised socio-economic data on the number of people potentially at risk and the likelihood that a negative event, such as death or an accident, occurs due to non-inclusive standards could ideally help determine the size of the impact on society.

However, this approach is unfeasible for two main reasons. First, it is difficult to carry out a causality assessment: for example, it is impossible to determine if a death in a bike accident occurred because the helmet lacked inclusive anthropometric design considerations or because of other factors. Second, a large share of standards cover products or test methods that apply to various sectors and activities; therefore, it might not even be possible to analyse the distribution of injuries and accidents by sector.

To overcome these issues, similar to the approach developed to assess standards' anthropometric adequacy, **the proposed methodology to assess the impact of each anthropometric-related standard is based on two dimensions: (i) severity of the impact; and (ii) size of the reference population**. Table 3 provides information on these sub-indicators.

Table 3 – Overview of sub-indicators measuring the standards' impact on society

Sub-indicator	Sub-indicator rationale	Sub-indicator categories	Score
Severity of the impact	The severity of the impact sub-indicator aims at answering the question: '*What kind of impact could the standard have on society?*'. It investigates what kind of impact the lack of inclusiveness could have on the	**No health impact**: the lack of inclusiveness would have no health impact on those whose anthropometric features are not considered by the standard.	0
		Illness: the lack of inclusiveness could cause the onset of illness for those whose anthropometric features are not considered by the standard.	1
		Injuries: the lack of inclusiveness could cause injuries to those whose anthropometric features are not considered by the standard.	2

[17] This only applies if statistical measures are included in the standard.

	unrepresented sub-population[18].	**Death**: the lack of inclusiveness could cause the death of those whose anthropometric features are not considered by the standard.	3
Size of the reference population	The size of the reference population sub-indicator aims to answer the question: '*Does the standard apply to a single sector/sport/type of transport, multiple sectors/sports/types of transport or the entire population?*'. It investigates the size of the population to which the standard applies.	**One sport; one sector; one type of transport:** the product covered is potentially used by users for a single sport, in a single sector (excluding healthcare) or for one type of transport (e.g. cableways).	1
		N sports; N industries; schooling; healthcare; transport: the product covered is potentially used by users in various sports and industries, schooling, and healthcare.	2
		Entire population; households: the product covered is potentially used by the entire population or households.	3

Source: CSIL

As outlined in Table 3, each anthropometric-related standard is classified based on the two above-mentioned impact sub-indicators by analysing the scope of each standard through the assessment grid. Then, an impact severity score is assigned to each sub-indicator category, ranging from 0 (no health impact) to 3 (very severe impact/entire population). This approach makes it possible to calculate an overall impact index, derived as a simple average of the scores assigned to the two sub-indicators. This implies that the overall impact index would depend on the severity of the impact and the size of the reference population. This means that standards that, at most, may cause injuries might have an overall higher impact than standards potentially causing deaths if the former covers a product used by a larger share of the population. Moreover, if a standard is not expected to have an impact on health and safety, then it is automatically classified as 'No impact', regardless of the reference population.

Therefore, by applying the simple average to the sub-indicators' scores associated with standards having an impact on health and safety, which range between 1 and 3, the overall impact index score also falls between 1 and 3. Based on the overall score, each standard is classified as described below.

- **No impact on health and safety**. These standards have an overall score equal to 0, indicating that their provisions do not have an impact on the health and safety of the reference population.
- **Low impact on health and safety**: These standards have an overall score that ranges between 1 and 1.67 (inclusive). They have a potential impact on the health and safety of the European population, but if so, the impact is low.
- **Medium impact on health and safety:** These standards have an overall score that ranges between 1.68 and 2.34 (inclusive). They have a potential impact on the health and safety of the European population, and if so, the overall impact is medium.
- **High impact on health and safety**: These standards have an overall score that ranges between 2.35 and 3 (inclusive). They have a potential impact on the health and safety of the European population; if so, the impact is high.

[18] In cases where several negative outcomes are applicable to the same standard, the category representing the most severe impact it can cause is considered.

2.4. Methodology to prioritise the revision of non-inclusive anthropometric-related standards

The final step of the methodology aims to determine the urgency to revise the standards that are inadequately inclusive and have an impact on the health and safety of the European population. A multicriteria analysis is employed to prioritise the revision of these standards by using the results of the adequacy and impact assessments described above. The adequacy and impact indexes, developed in the previous phases, have been combined to create a composite prioritisation index.

Following the approach developed by the Canadian Standards Association, the prioritisation index classifies each standard with a high, medium or low priority for revision. Therefore, based on the overall adequacy and impact assessment, the priority rating index has been classified as described below.

- **High priority for revision**: These are standards that have a high impact on the health and safety of the European population and a high or medium level of anthropometric adequacy.
- **Medium priority for revision**: These are standards that have: (i) a medium impact on the health and safety of the European population and a medium or low level of anthropometric adequacy; or (ii) a low impact on the health and safety of the European population and a low level of anthropometric adequacy.
- **Low priority for revision**: These are standards that have: (i) a high level of anthropometric adequacy regardless of the impact on the health and safety of the European population; or (ii) a low impact on the health and safety of the European population and a medium level of anthropometric adequacy.
- **No need for revision**: These are standards that have no impact on the health and safety of the European population or a full level of anthropometric adequacy.

Table 4 provides an illustrative representation of the rules setting out the categories of the prioritisation index, i.e. urgency for revision.

Table 4 – Categorisation of the priority

		IMPACT INDEX			
		NO	LOW	MEDIUM	HIGH
ADEQUACY INDEX	FULL				
	HIGH				
	MEDIUM				
	LOW				

Legend:	No need for revision	Low priority	Medium priority	High priority

Source: CSIL

In principle, different criteria to identify high-priority standards could be applied, depending on the distribution of the adequacy and impact indexes. For instance, one may want to apply a more conservative approach and consider those standards that have a potentially high impact

and low adequacy. Alternatively, one may decide to increase the number of standards to be revised with a high urgency and include those with low adequacy and a medium impact.

3. Anthropometric inclusiveness of the standards analysed

This chapter shows the results of applying the methodology presented in Chapter 2 to the European harmonised standards within the remit of DG GROW's Unit H2. The full set of information used for the assessment is included in a searchable Excel database (see Annex IV).

3.1. Overview of the standards

Overall, 2 650 European standards, including European harmonised standards, are within the scope of the study[19]. These standards support 15 pieces of legislation out of the 22 within the remit of DG GROW's Unit H2[20]. Seven pieces of legislation do not require any standard.

As shown in the chart below, most standards under analysis belong to the Machinery Directive (2006/42/EC) and the Low Voltage Directive (2014/34/EU). These two directives are supported by more than half of the total number of standards within the study's scope, amounting to 862 and 655 standards respectively. Additionally, a significant number of standards support the Personal Protective Equipment Regulation (2016/425/EU), the Radio Equipment Directive (2014/53/EU), the Electromagnetic Compatibility Directive (2014/30/EU) and the Pressure Equipment Directive (2014/68/EU). Conversely, the remaining pieces of legislation require compliance with a relatively lower number of standards.

For each piece of legislation supported by at least one European (harmonised) standard (hEN), the number of associated standards varies between 1 and 862. Interestingly, among the 2 650 standards within the study's scope, 186 (7.02%) support more than one piece of legislation. Overall, this phenomenon seems more relevant for the Electromagnetic Compatibility Directive, the Low Voltage Directive and the Machinery Directive. Specifically, 76 European harmonised standards support both the Electromagnetic Compatibility Directive and the Low Voltage Directive, while 36 support the Machinery Directive and the Low Voltage Directive.

Each European standard (EN) undergoes drafting and supervision by a technical committee (TC). A total of 186 different TCs were responsible for supervising the European standards within the scope of the present study. The analysis reveals that approximately 35% of the ENs within the scope were drafted by just 10 TCs (see Figure 6). The TCs responsible for a larger number of standards are the 'Electromagnetic Compatibility and Radio Spectrum Matters' (ERM), 'Protective clothing including hand and arm protection and lifejackets' (CEN/TC 162) and 'Safety of household and similar electrical appliances' (CEN/TC 61). These three TCs have contributed to developing 159, 129 and 99 standards respectively. The distribution of European standards across the responsible TCs is quite uneven, as 110 TCs were responsible for less than 10 standards each.

[19] This figure counts the unique number of standards supporting any of the 22 pieces of legislation in the remit of unit H2 of DG GROW. Moreover, standards may be complemented with amendments and/or corrigenda; if so, we have not included the list of amendments and corrigenda (as described in Chapter 2.1.1).

[20] These include the: (i) Aerosol Dispensers Directive (75/324/EEC); (ii) Pre-packaged Products Directive (76/211/EC); (iii) Pack Sizes Directive (2007/45/EC); (iv) Units of Measurement Directive (80/181/EEC); (v) Bottles as Measuring Containers Directive (75/107/EEC); (vi) Metrology Framework Directive (2009/34/EC); and (vii) Metrology Directive (2011/17/EU).

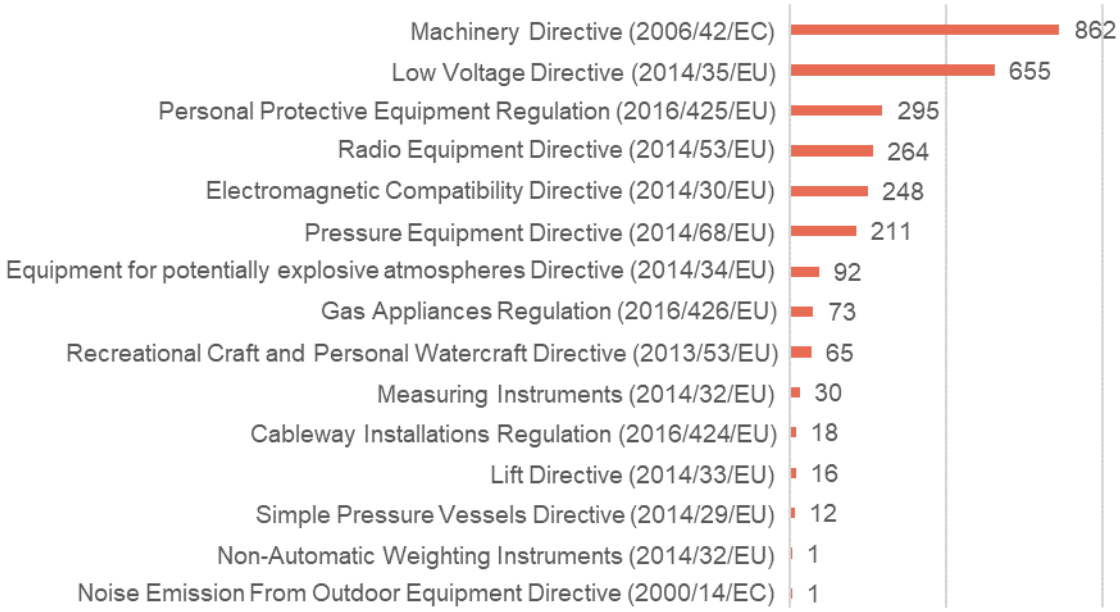


Figure 5: Number of European standards by piece of legislation

Source: CSIL

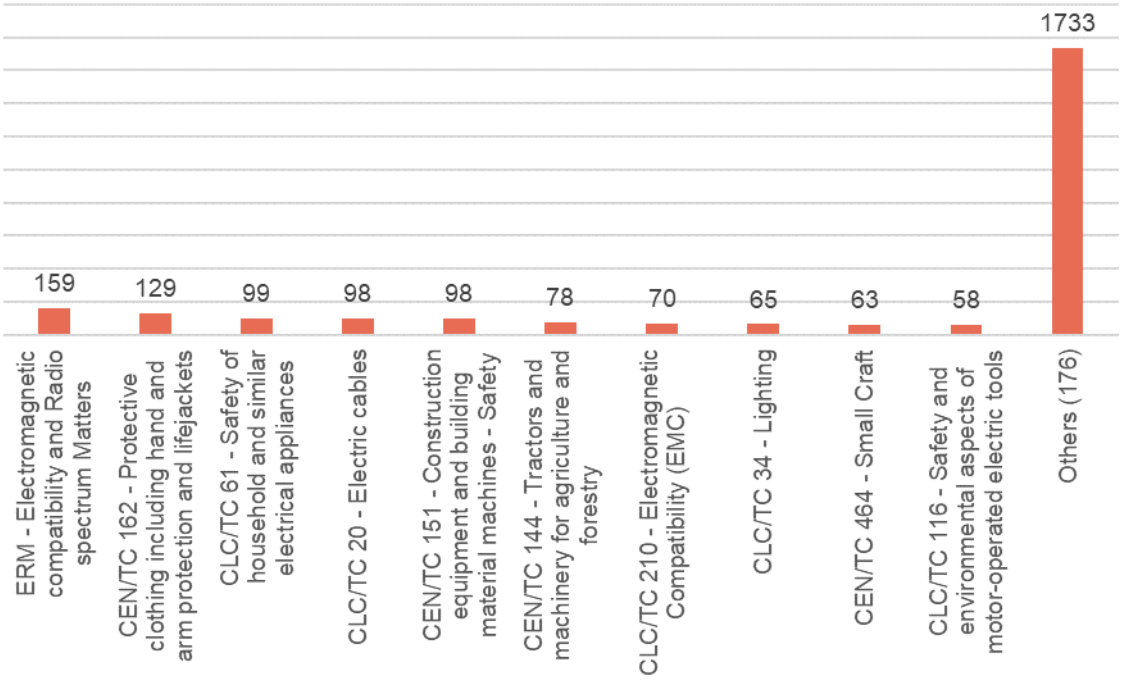


Figure 6: Number of standards by technical committee (TC)

Source: CSIL

Interestingly, most TCs were responsible for drafting ENs supporting multiple pieces of legislation, with only 40% of the TCs responsible for drafting standards supporting a single piece of legislation. This distinction does not necessarily correlate with the number of standards the TCs were responsible for, but rather reflects the focus of their respective working groups. For example, the 129 hENs drafted by CEN/TC 162, 'Protective clothing including hand and arm protection and lifejackets' exclusively support the Personal Protective Equipment Regulation. In contrast, the 99 standards drafted by CEN/TC 61, 'Safety of household and similar electrical appliances' support both the Machinery Directive and the Low Voltage Directive.

Regarding the sectoral coverage of standards, out of the 2 650 ENs within the study's scope, 2 426 standards have an assigned ICS code. Approximately 73% of ENs fall under the 10 most frequently represented ICS primary sectors. These sectors include '29 - Electrical Engineering' and '13 - Environment, Health Protection, Safety' (see Figure 7). Interestingly, while the vast majority of standards dealing with electrical engineering support the Low Voltage Directive, standards falling under '13 - Environment, Health Protection, Safety' mainly support the Machinery Directive and the Personal Protective Equipment Regulation. Additionally, it is worth mentioning that the subgroup '13.180 - Ergonomics' is a subset of ICS 13 and is associated with 19 hENs within scope.

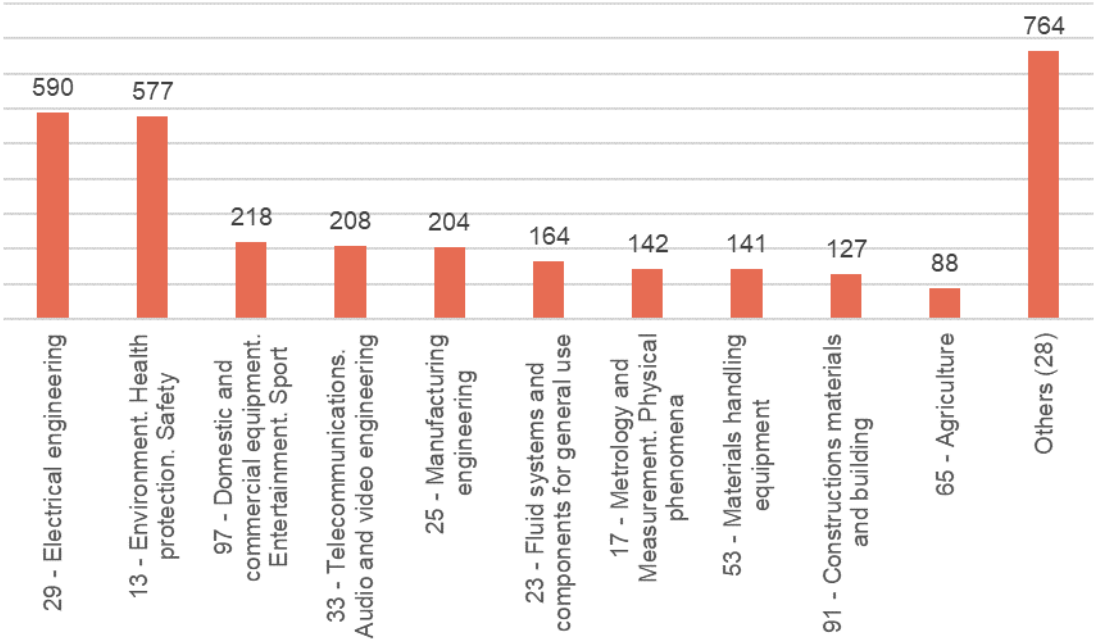


Figure 7:Number of standards by ICS field

Source: CSIL

Furthermore, European standards often cite one or more normative references. Within the analysed sample of standards, 6 262 distinct normative references were cited. Analysing the titles, abstracts and other basic information of these norms makes it possible to look more closely at the standards based on the normative references they mention.

Figure 8 shows the 10 most frequently occurring normative references. Some 6 of these references pertain to the topic 'Safety of machinery'. This finding aligns with the fact that, as previously discussed, the 'Machinery Directive' is the piece of legislation supported by the largest number of standards. Additionally, 3 other references among the top 10 relate to 'Acoustics.' Interestingly, these references are also associated with machinery and equipment. Overall, a closer examination of the titles and abstracts of these standards reveals that they cover generic topics concerning the safety of machinery and equipment. As a result, these norms are frequently mentioned, often in conjunction with the many European standards that address the design and safety of specific machines and equipment.

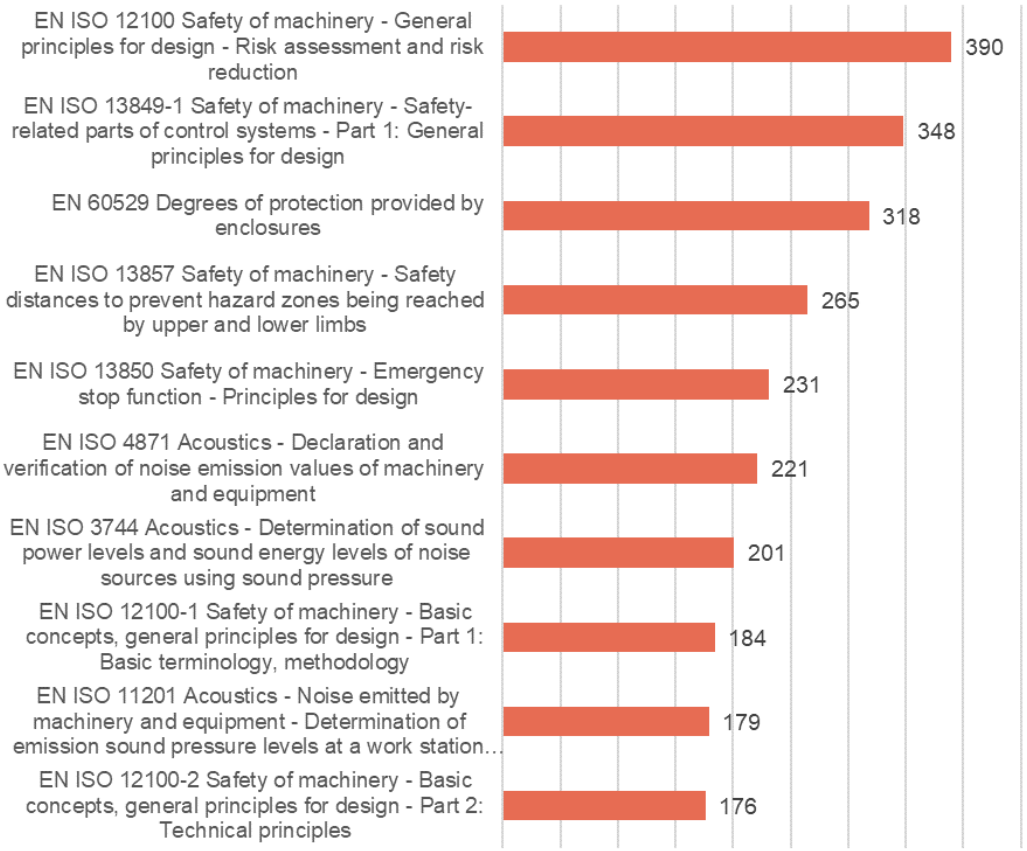


Figure 8: Number of European standards by normative reference

Source: CSIL

3.2. Identification of anthropometric-related standards

Applying the methodology designed to identify anthropometric-related standards (see Chapter 2.2) shows that **out of the 2 650 standards under analysis, 964 (36%) are anthropometric-related standards.** This indicates that slightly over one third of the standards supporting the 22 pieces of legislation within the remit of DG GROW's Unit H2 incorporate provisions that are, or rather are expected to be, related to anthropometrics. This finding underscores the **significant role of anthropometric considerations in the development of European standards**. It also highlights the importance of incorporating inclusive human dimensions, characteristics and variability into the design, safety and usability aspects of products, equipment and systems covered by the harmonised standards. The identification of such a high number of anthropometric-related standards also emphasises the need for continuous collaboration with relevant stakeholders, including experts in anthropometry, ergonomics, product design, engineering and user research.

Out of the entire sample, **the 964 anthropometric-related standards support 11 pieces of legislation**. This implies that 4 pieces of legislation rely on non-anthropometric standards: the Noise Emissions from Outdoor Equipment Directive, the Non-Automatic Weighting Instruments Directive, the Simple Pressure Vessels Directive, and the Measuring Instruments Directive. These directives address specific regulatory aspects that do not directly involve anthropometric considerations but focus on other technical requirements, such as noise emissions, measurement accuracy, or safety of non-anthropometric equipment.

Figure 9 shows how the anthropometric-related standards are distributed across the different pieces of legislation. The number of anthropometric-related standards and their share in the total number of supporting standards widely varies among the different legislative frameworks. Notably, **the 'Machinery Directive' (2006/42/EC) has the highest number of associated**

anthropometric-related standards, followed by the 'Personal Protective Equipment Regulation' (2016/425/EU) and the 'Low Voltage Directive' (2014/35/EU). These three directives also accounted for the highest number of standards within the overall sample, as described in the previous section. This indicates the significance of anthropometric considerations in the design, safety and usability of machinery, equipment and personal protective gear.

A closer look at the ratio between anthropometric-related standards and the total number of standards supporting each legislative framework provides further insights into the relevance of anthropometric considerations. In most cases, the share of anthropometric-related standards out of the total number of supporting standards is below 20%. However, there are notable exceptions where anthropometrics holds a significant weight. An overwhelming majority (98.6%) of standards supporting the 'Personal Protective Equipment Regulation' are classified as anthropometric-related. This exceptionally high proportion underscores the critical role of anthropometric principles in ensuring the effectiveness, comfort and especially safety of personal protective equipment. Given the direct interaction between individuals and this type of equipment, considerations such as proper fit, user comfort and ergonomic design become crucial for optimal protection and user satisfaction.

Similarly, high proportions of anthropometric standards are observed within the 'Cableway Installation Regulation' (77.8%) and the 'Machinery Directive' (62.3%). The substantial presence of anthropometric-related standards in these areas follows the relevance of anthropometrics for factors such as user accessibility, operator comfort and the prevention of ergonomic hazards. It also reflects the importance of ensuring that these systems are not only technically sound but also consider the physical characteristics, capabilities and safety of the individuals who interact with them.

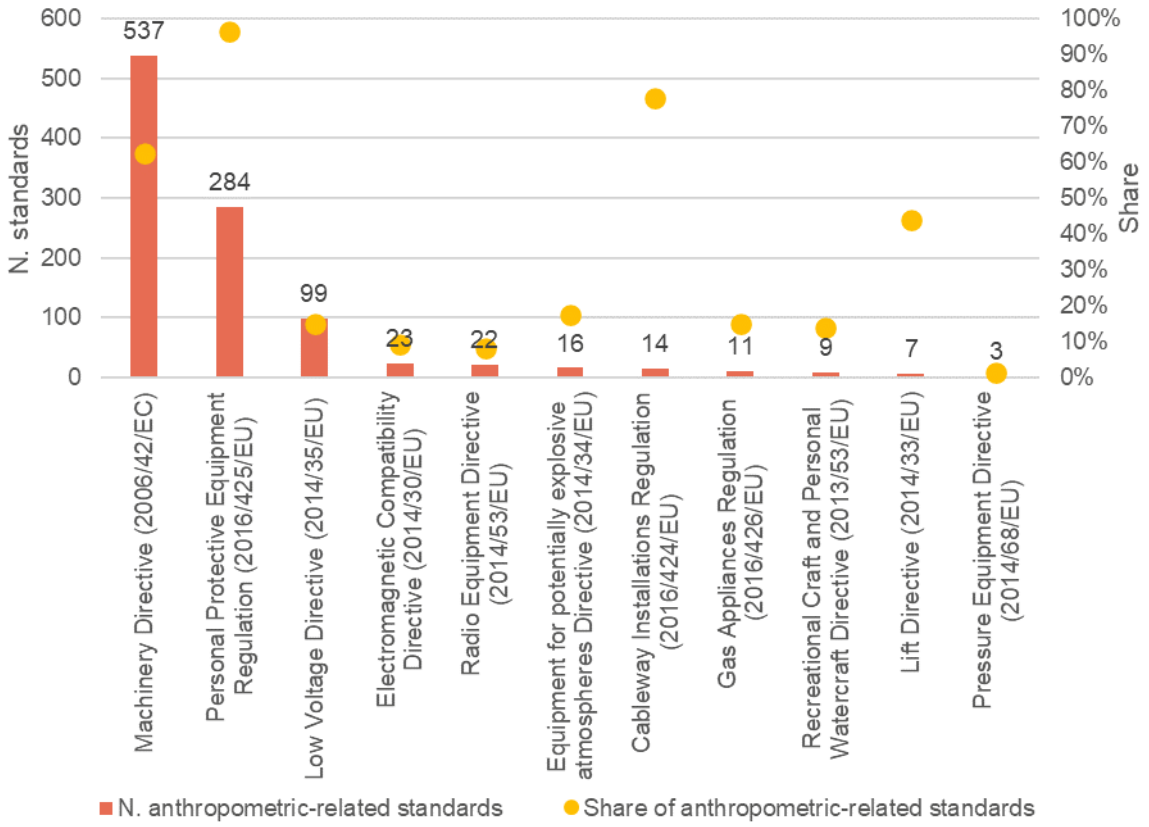


Figure 9: Number of anthropometric-related standards by piece of legislation.

Note: The dots represent the share of anthropometric-related standards out of the total population of standards supporting the piece of legislation

Source: CSIL

The relevance of anthropometrics within a standard extends across diverse domains and requires stakeholder collaboration. The anthropometric-related standards under analysis have been drafted and supervised by 103 distinct TCs, and out of them, only 24 TCs were identified as TCs likely to draft anthropometric-related standards. This finding suggests that the relevance of anthropometrics in standards goes beyond the scope and activity sector of the responsible TC. Figure 10 provides further insights into the involvement of TCs in developing anthropometric-related standards.

Even within sectors where the connection to anthropometrics may seem less straightforward, consideration of human factors and ergonomics might be equally relevant. Among the TCs responsible for a large number of anthropometric-related standards, we find both TCs whose focus on anthropometric aspects is straightforward (e.g. 'Protective clothing including hand and arm protection and lifejackets' - CEN/TC 162) and TCs focusing on sectors where the direct linkage with anthropometrics may not be immediately apparent (e.g. Construction equipment and building material machines - Safety' - CEN/TC 151). This said, CEN/TC 162, 'Protective clothing including hand and arm protection and lifejackets', emerges as the leading contributor, with 97% of its produced standards identified as anthropometric-related. This outcome aligns with the nature of protective clothing, which must be designed to fit the human body, therefore necessitating adherence to anthropometric considerations. Similarly, TCs such as CEN/TC 79, 'Respiratory protective devices', CEN/TC 158, 'Head protection', and CLC/TC 116, 'Safety and environmental aspects of motor-operated tools', which focus on specific areas of safety equipment, were responsible for a high number of anthropometric-related standards, drafting 42, 25, and 24 such standards respectively.

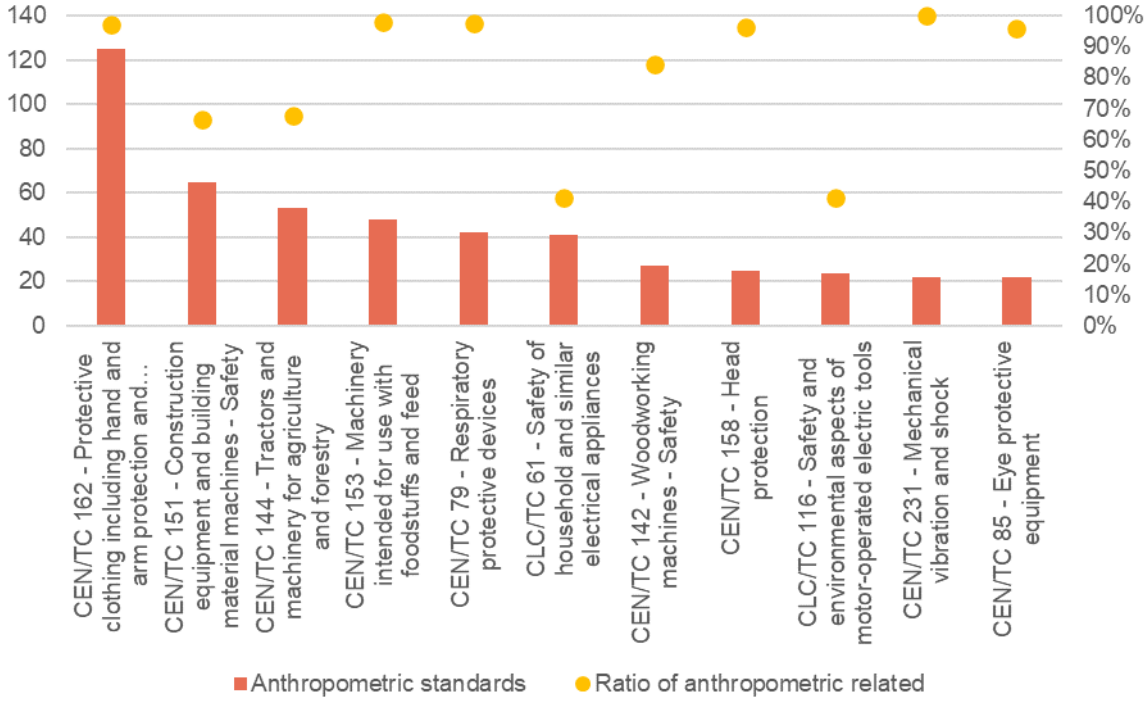


Figure 10: Number of anthropometric-related standards and ratio over the total standards by responsible TC

Source: CSIL

The relevance of anthropometrics in sectors where it may seem less straightforward also applies when the distribution of anthropometric-related standards by associated ICS is concerned. Consistent with the distribution of anthropometric-related standards by TC, Figure 11 shows that the three most relevant ICS groups are '13.340 - Protective equipment', '65.060 - Agricultural machines, implements and equipment', and '13.110 - Safety of machinery'. Within ICS '13.340 - Protective equipment', the majority of anthropometric-related standards pertain to '13.340.10 - Protective clothing', '13.340.20 - Head protective equipment', and '13.340.30 - Respiratory protective devices'. These ICS subgroups cover 83, 66 and 42 anthropometric-related standards respectively.

When examining the ratio between the number of anthropometric-related standards and the total number of standards related within the same ICS group, three ICS groups stand out. These are '13.340 - Protective equipment' (96% anthropometric), '67.260 - Plants and equipment for the food industry' (98% anthropometric), and '97.220 - Sports equipment and facilities' (100% anthropometric). This finding corroborates the significant role that anthropometric considerations play in ensuring the design, functionality and safety of protective equipment, machinery in the food industry, and sports equipment and facilities.

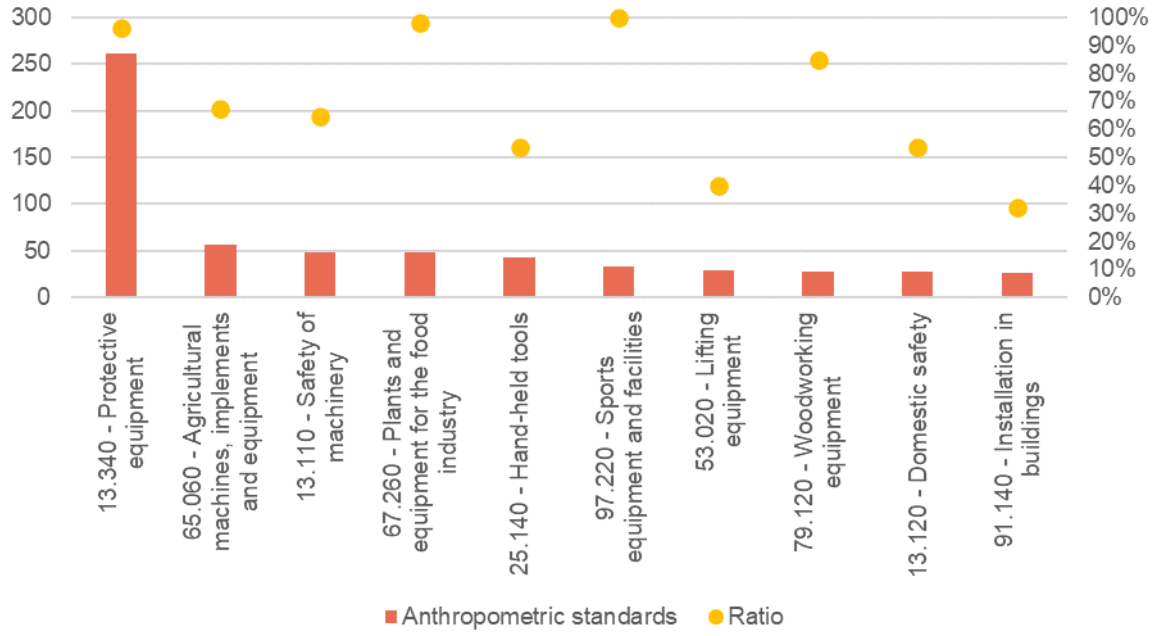


Figure 11: Number of anthropometric-related standards and the ratio over the total number of standards by ICS group

Source: CSIL

3.3. Assessment of anthropometric-related standards

Out of the 964 anthropometric-related standards described in the previous chapter, due to time constraints, **the assessment methodology was applied to a subset of 276 standards** (29%)[21]. The selection strategy, in agreement with DG GROW, aimed to ensure representativeness across the entire sample of anthropometric-related standards in terms of legislation and TCs. Hence, anthropometric-related standards were randomly selected from within homogeneous groups of standards supporting the same piece(s) of legislation and drafted by the same TC. Moreover, anthropometric-related standards for which only the normative approach selection method (see Section 2.2.2) applies were excluded if none of the cited anthropometric-related normative references was a European standard.

3.3.1. Anthropometrics adequacy

The assessment of the anthropometrics adequacy of the 276 selected anthropometric standards revealed that **most of the selected standards are anthropometrically adequate as far as the anthropometric coverage and the statistical inclusiveness sub-indicators are concerned**. Conversely, for the data transparency and data representativeness sub-indicators the adequacy is far less satisfactory.

[21] The team actually revised 322 standards in depth, but after having read the main text, 56 were re-classified as not anthropometrically relevant. This revision allowed the team to fine-tune the identification methodology to minimise the number of 'false positives', i.e. the number of standards erroneously classified as anthropometric-related.

A significant majority of the selected anthropometric-related standards (202, 73%) are considered coherent, i.e. they include reference to all relevant anthropometric dimensions. As an illustrative example, the standard EN ISO 14738:2008, supporting the Machinery Directive, explicitly mentions that '(…) the layout of workstations shall be designed according to the body size of the target population of operators (…)'. Likewise, other standards specify that the power buttons need to be placed where operators can easily make use of them, and so on. Only a minority are considered too simplistic, meaning that even though relevant, most anthropometric dimensions are not addressed in the main text. For example, standard EN 1891:1998 supporting the Personal Protective Equipment Regulation specifies requirements, testing, marking and information for two types of rope to be used by people, but without referencing the relevance of human size, or more specifically human weight.

Most standards are not only coherent but also define product requirements (e.g. product sizing, resistance) that sufficiently safeguard the overall population. **The majority of standards (202, 73%) use statistical measures that are partly representative**. Indeed, most standards either specify ranges and lower (upper) bounds or refer to other standards in their provisions[22]. This implies that, on average, a sufficiently large share of the population is potentially covered, but it is unlikely that individuals or groups of individuals whose anthropometric measures are outliers are equally protected. However, the extent to which partly representative statistical measures are actually inadequate need to be reviewed, considering the underlying data used to set the limit values.

In contrast, **unrepresentative standards are based on the characteristics of an average (male) person**. As an illustrative example, EN 12930:2015, supporting the Cableway Installations Regulation, specifies the general safety requirements applicable to the calculations for cableway installations designed to carry persons and states that '(…) the average mass of a person shall be assumed to be 75 kg. In the case of cableway installations which transport persons plus their winter sports equipment, as well as for ski-tows, the average mass of a person shall be assumed to be 80 kg (…)'. Assuming that a person's average mass corresponds to a man's average cannot be considered representative of the European population. While women might be indirectly covered, men weighing more than 75 kg are not properly considered.

Unfortunately, **most standards either do not include any reference to the underlying studies/anthropometric datasets used to define the statistical measures** included in the text (100, 36%) or state that the statistical measures are in accordance with another standard without any additional explanation (155, 56%). Only a minority (21, 8%) cite the anthropometric dataset used to develop the standard and define the statistical measures in it. This implies a limitation in the statistical inclusiveness sub-indicator, namely that in most cases the assessment considers only the type of statistical measure specified in the standard without critically assessing the actual data values. Specifically, percentile values are considered 'representative statistics', while ranges, lower or upper bound values are considered 'partially representative statistics' without explaining how the values were derived statistically. Finally, statistical measures based on average male anthropometric dimensions are categorised as 'not representative'.

Consequently, the results tend to be rather conservative due to this categorisation methodology. Apart from a few exceptions, we have not questioned the representativeness of the specified values but only the type of statistical measure used. As an illustrative example, regarding hot surfaces it is common practice that provisions indicate upper values to avoid users getting burned. In these cases, standards are considered partly representative, although it might be the case that the upper value is such that the entire population, including children, is satisfactorily protected. Discussions with stakeholders shed light on the fact that existing anthropometric databases are generally not updated or fully representative of the European population. For instance, the anthropometric-related measurements included in the standard

[22] When a standard refers to another standard defining how a product is to be designed or tested, we classified it as 'partly representative'. Further research on the cited standard must be carried out to understand the actual standard's inclusiveness.

EN 1005-2:2003 build on NIOSH data collected in the US between the 1960s and 1980s on military adult men.

As for the data transparency sub-indicator, the distribution of standards across the categories of the data representativeness sub-indicator shows that most standards are not sufficiently representative of the European population. **A significant number of the analysed standards, 210 (76%), are categorised as 'too generic'**, i.e. the statistical distributions of the anthropometric parameters were not appropriately considered. Only in a few cases do standards explicitly consider the human body's diversity and state that different measures need to be used depending on the target population. Among the 26 standards considered well-detailed, EN 842:1996 supporting the Machinery Directive specifies that 'considering the enormous complexity of the visual environment in many places and also considering the widely differing personalities and abilities of the possible observers, a system of visual danger signals should be checked with a representative sample of people. In order to be representative, the group shall also include persons [who] more than 45 years old'. However, this is an exception in the sample of selected anthropometric-related standards.

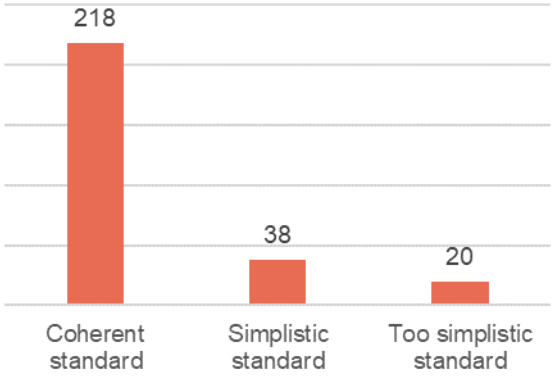


Figure 12: Distribution of selected standards by anthropometric coverage level

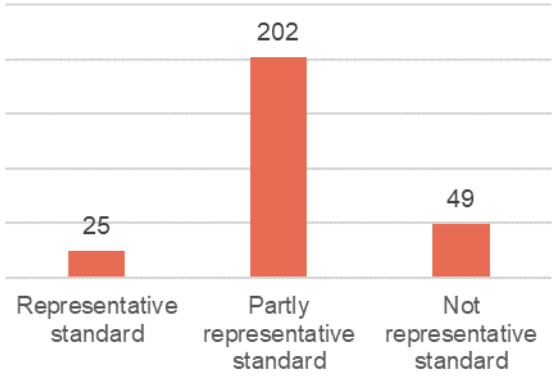


Figure 13: Distribution of selected standards by statistical inclusiveness level

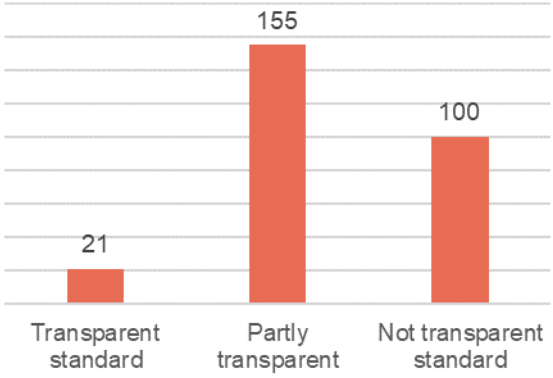


Figure 14: Distribution of selected standards by data transparency level

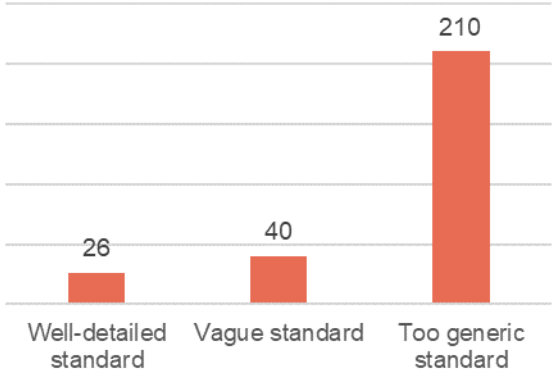


Figure 15: Distribution of selected standards by data representativeness level

Source: CSIL

Combining the scores of the four above-mentioned sub-indicators resulted in the creation of the composite anthropometric adequacy indicator, as described above. The analysis shows that **the anthropometrics adequacy level of most standards is medium** (see figure below). Some 210 (76%) have a medium adequacy level. The finding builds on the fact that, as discussed above, most standards are adequate on aspects such as anthropometric coverage and statistical measures but poorly inclusive regarding human body data representativeness. Indeed, they explicitly account for relevant anthropometric dimensions, i.e. size, structure or composition, and usually refer to other standards as far as statistical measures are concerned,

but rarely require the use of representative statistical measures, e.g. percentiles, nor use disaggregated statistical measures to account for the diversity of the European population.

Consequently, the number of standards with either full or high adequacy is very limited. Out of those analysed in depth, only five standards have full adequacy on all sub-indicators and therefore on the overall adequacy score. On the opposite side, 41 standards have a low anthropometric adequacy level, meaning that their adequacy level was insufficient on at least three sub-indicators.

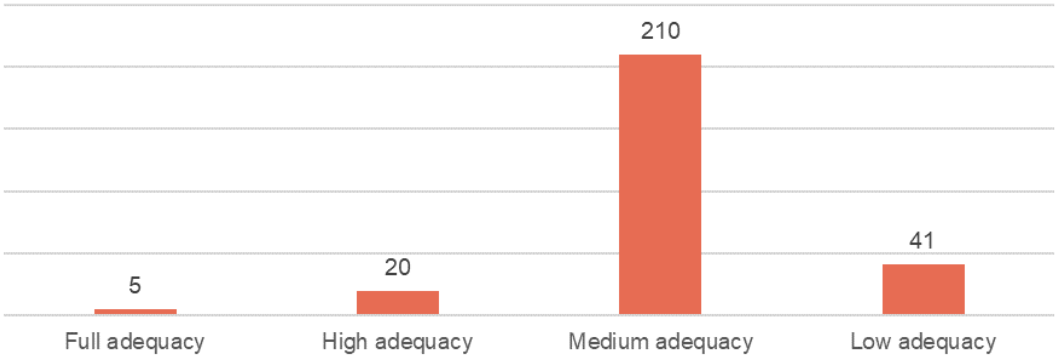


Figure 16: Distribution of selected standards by adequacy index level

Source: CSIL

The distribution of standards by adequacy index and piece of legislation provides further insights into the areas where anthropometrics considerations are not sufficiently inclusive of the European population. The 25 standards that incorporate inclusive anthropometric considerations and measurements refer to two pieces of legislation only, the Machinery Directive and the Personal Protective Equipment Regulation. These are also the two pieces of legislation supported by a tiny share of standards with a relatively low adequacy level. It is, however, worth mentioning that it is these two pieces of legislation that are supported by the highest number of standards. Consequently, most standards classified with low adequacy support these two pieces of legislation even though they represent less than 15% of the total number of standards analysed when considering distribution by piece of legislation.

Finally, it is worth mentioning that the standards supporting the other pieces of legislation, although very limited in number, are all characterised by either medium or low adequacy. Given the limited number of standards under assessment, a horizontal comparison was not performed since it could lead to biased conclusions. However, it is noted that poorly inclusive standards by and large support pieces of legislation for which the direct linkage with anthropometrics is less straightforward, e.g. the Directive on equipment for potentially explosive atmospheres.

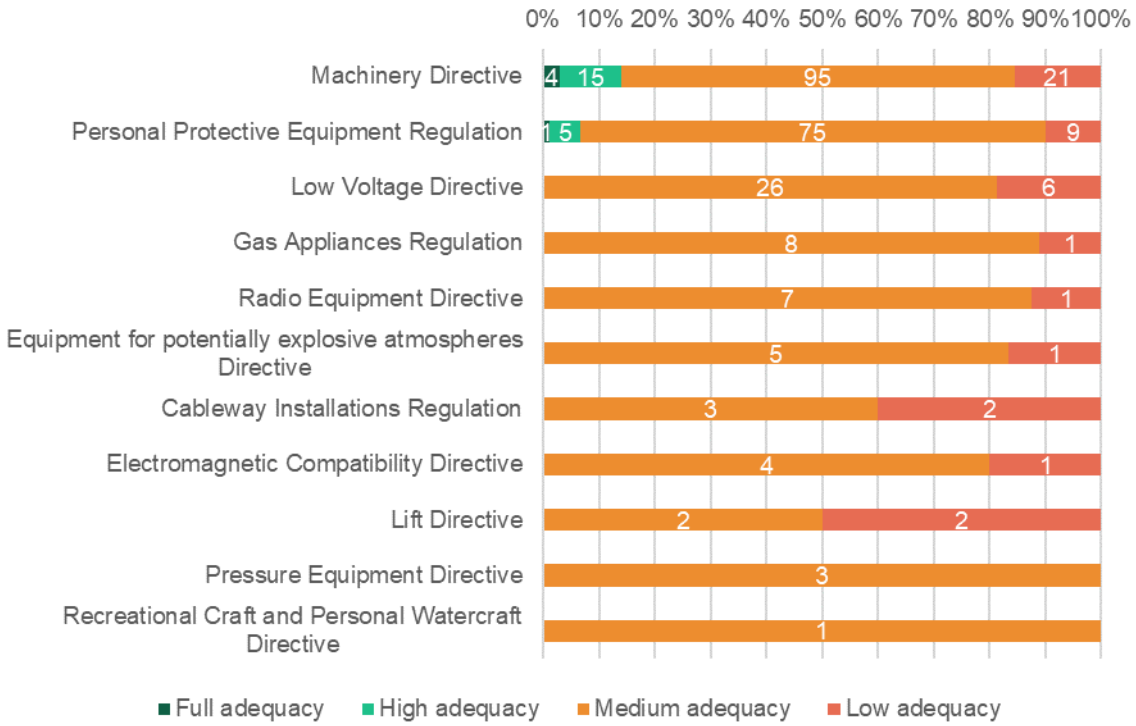


Figure 17: Distribution of selected standards by adequacy index level and piece of legislation

Note: Whenever a standard supports more than one piece of legislation, it is double-counted in the figure.

Source: CSIL

3.3.2. Assessment of the impact on health and safety

Applying the assessment methodology to the 276 selected anthropometric standards revealed that **most standards may cause injuries to users if anthropometric considerations are not properly accounted for**. Some 195 (71%) standards may potentially lead to injuries among the reference population if the product is not designed or tested in accordance with representative anthropometric measures. For example, a piece of operating machinery that fails to account for the diversity of European bodies poses a significant risk to the musculoskeletal system. Without proper ergonomic design considerations, workers are exposed to increased hazards. The lack of accommodation for diverse body sizes and proportions may, among other things, force individuals into strained body positions, leading to awkward postures and excessive reaching, bending or twisting. Repetitive movements, such as machinery handling devoid of ergonomic support, can result in overuse injuries like tendonitis or cumulative trauma disorders such as carpal tunnel syndrome. Prolonged periods of physical strain and reduced circulation due to inadequate equipment fit contribute to musculoskeletal fatigue, discomfort and the heightened risk of injuries. Moreover, as highlighted by stakeholders, in some cases workers tend to adopt 'creative solutions' to reduce their discomfort, which potentially increases their risk of accident.

Only a minority of assessed standards, 40 (14%), could potentially **lead to fatal consequences** for the under-represented targeted population, while an even smaller subset, 29 (11%), are likely to pose risks of illness. However, we would stress that the remaining 12 standards, while not resulting in health-related risks, can still have negative outcomes, such as discomfort and exclusion from use. For example, standard EN 12331:2021, which specifies requirements for the design and manufacture of mincing machines, may, if anthropometric measurements are not sufficiently considered, hinder operators from having full accessibility to the entire machine from their workstation and so compromise some operators' ability to use the machine.

Interestingly, **the typology of the reference population potentially affected by non-inclusive standards is almost homogeneously distributed**. A slightly higher number of

standards, 104 (38%), are found to have an impact on people involved in 'multiple sports, multiple industries, schooling, healthcare, and transport'. For instance, EN ISO 11393-3:2018, supporting the Personal Protective Equipment Regulation, specifies test methods for assessing the resistance of footwear to cutting by hand-held chainsaws that may be used by operators in different industries. Additionally, 94 standards (34%) may have an impact on 'users in single sport, single industry, and niche transport', while the remaining 78 (28%) are expected to have a potential impact on the 'entire population and households'. Standards covering household appliances are the most straightforward example of standards potentially affecting the entire population. By contrast, standards covering a relatively limited share of the European population are, for example, those concerning products used in a single sport. For example, EN 13546:2002 specifies the general requirements for protective equipment used by hockey players, and so a single sport, hockey, is concerned.

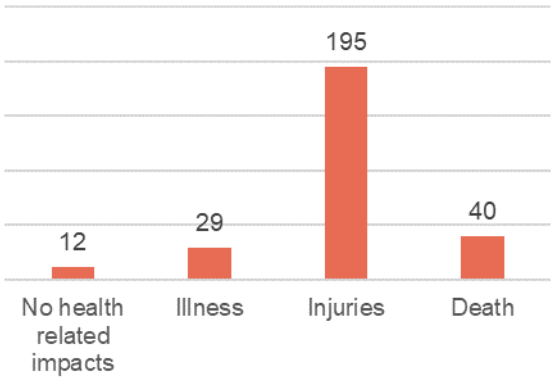


Figure 18: Distribution of selected standards by severity of impact

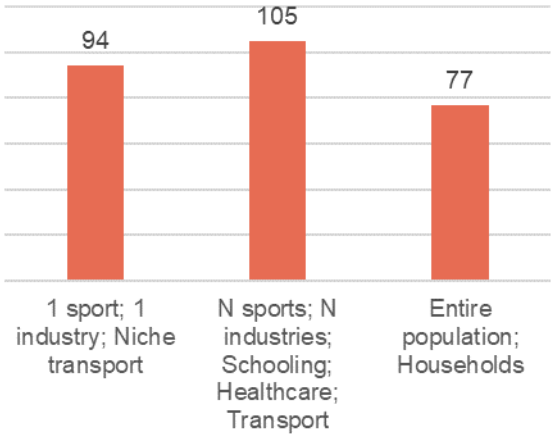


Figure 19: Distribution of selected standards by reference population size

Source: CSIL

Analysis of these two sub-indicators has made it possible to create a composite impact indicator that combines the scores obtained (see above for further details). The distribution of standards with health-related impacts across the relevant categories follows a normal distribution pattern. **A significant portion of the standards, 104 (38%), falls into the medium impact category** concerning the health and safety of the European population. This is because, as previously discussed, many standards may potentially lead at most to injuries. Moreover, many standards cover products likely to be used by a relatively large share of the European population.

However, we should not disregard the number of standards with either a low or high impact on the health and safety of the European population. Out of the assessed standards, 84 (30%) are expected to have a potential low impact, while an additional 76 (28%) have the potential for a high impact. Among the low-impact standards, the majority might pose a risk of injuries to a narrow group of individuals. In contrast, the high-impact standards are generally expected to cause injuries or even fatalities across the entire population.

Table 5 – Number of standards by impact rating

	Severity index			
	No health-related impact	Illness	Injury	Death

Reference population size					
	Large	1	13	51	12
	Medium	7	9	76	13
	Small	4	7	68	15

Legend:	No impact on health and safety	Low impact on health and safety	Medium impact on health and safety	High impact on health and safety

Source: CSIL

The distribution of standards by impact index and piece of legislation provides further insight into the areas where lack of inclusiveness may potentially lead to more severe impacts on the European population. Of the 12 standards that have no implications on the health and safety of the European population, 11 support the Machinery Directive, while the remaining one supports the Low Voltage Directive. Interestingly, the Machinery Directive is also a piece of legislation supported by a relatively large share of anthropometric-related standards that overall have a low impact on the health and safety of the European population. Indeed, about 50% of assessed anthropometric-related standards supporting the Machinery Directive have either no or, at most, low impact on the health and safety of the European population.

Conversely, anthropometric-related standards supporting the Personal Protective Equipment Regulation and the Low Voltage Directive are expected to have a more severe impact on the health and safety of the European population if anthropometric measurements are not sufficiently inclusive and representative. In the case of the Personal Protective Equipment Regulation, if protective equipment does not perfectly fit users, the potential risk is evident.

Finally, it is worth mentioning that the standards supporting the other pieces of legislation, although very limited in number, are all, with a few exceptions, characterised by either a medium or a high impact level. The standards assessed that support the Equipment for Potentially Explosive Atmospheres Directive and the Recreational Craft and Personal Watercraft Directive are all expected to have a low impact on the health and safety of the European population, even if anthropometric considerations are not properly addressed.

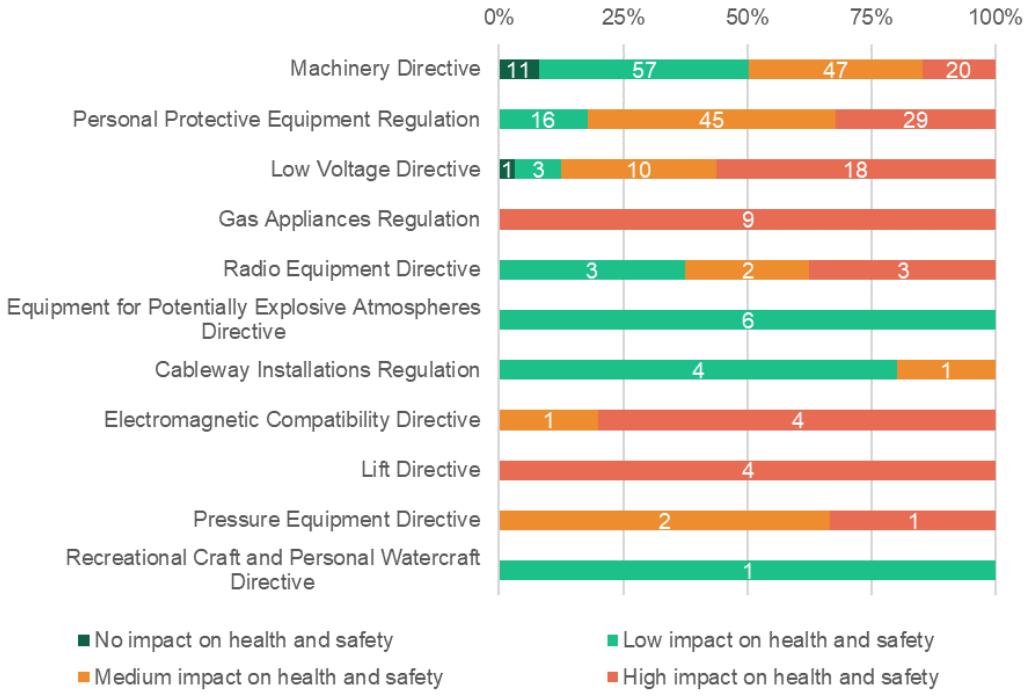


Figure 20: Distribution of selected standards by level of impact on health and safety and by piece of legislation

Source: CSIL

3.4. Prioritisation of anthropometric-related standards

The urgency of revising most standards is either medium or high. Overall, out of the 276 standards assessed in depth, the prioritisation exercise highlighted that 72 (26%) standards should be revised with a high priority, 106 (38%) with a medium priority, 81 (29%) with a low priority, while for the remaining 17 (6%) there is no need to revise the text. These results are set out in the table below. However, after in-depth assessment it may be that revising the standards' anthropometric provisions becomes less urgent than expected. This is due to the limitations in assessing data adequacy resulting from the lack of information on the data and studies underlying the standards.

Table 6 – Number of standards by priority rating

		IMPACT INDEX			
		NO	LOW	MEDIUM	HIGH
ADEQUACY INDEX	FULL	0	1	3	1
	HIGH	6	4	7	3
	MEDIUM	6	67	76	61
	LOW	0	12	18	11
Legend:		No need for revision	Low priority	Medium priority	High priority

Source: CSIL

Box 1. An example of a highly inclusive standard

The assessment and prioritisation exercise identified only one standard that, in spite of having a potentially high negative impact if anthropometrical considerations were not taken into account, was drafted in an adequate way. This is standard EN ISO 15536-1:2008 'Ergonomics - Computer manikins and body templates - Part 1: General requirements (ISO 15536-1:2005)' drafted by the CEN Committee on Ergonomics. The standard establishes general requirements for the design and development of computer manikins, body templates and manikin systems to be used for the design of workspaces. The standard specified the characteristics of the manikins used to ensure that human body shapes for workspace design are accurate and reliable in their anthropometric and biomechanical aspects. It considers the percentile distribution of human size, structure and composition, thus ensuring that the manikins represent a very wide spectrum of human bodies.

Annex VI includes summary factsheets for a sample of high-priority standards. **The distribution of standards by priority rating varies across the different pieces of legislation**. As shown in the figure below, 15 out of the 17 standards that do not need revision to make them more inclusive support the Machinery Directive. As for the remaining 2, one supports the Personal Protective Equipment Regulation and the other the Low Voltage Directive. Among the standards for which revision is a low priority, most support the Machinery Directive. However, the 6 standards supporting the Equipment for Potentially Explosive Atmospheres Directive all have low priority for revision. The pieces of legislation supported by

more critical standards are the Personal Protective Equipment Regulation and the Low Voltage Directive.

As far as the Gas Appliance Regulation is concerned, all anthropometric-related standards included in the sample for assessment are of high priority. They mostly relate to provisions for household appliances and provide limit values that are not justified considering the diversity of the human body. Additionally, the underlying studies justifying the limit values are not included. Hence, as it is not possible to determine whether those limit values safeguard the entire population or only a part, they are conservatively considered as partly inadequate. Since they potentially affect the entire population, they are all of high priority.

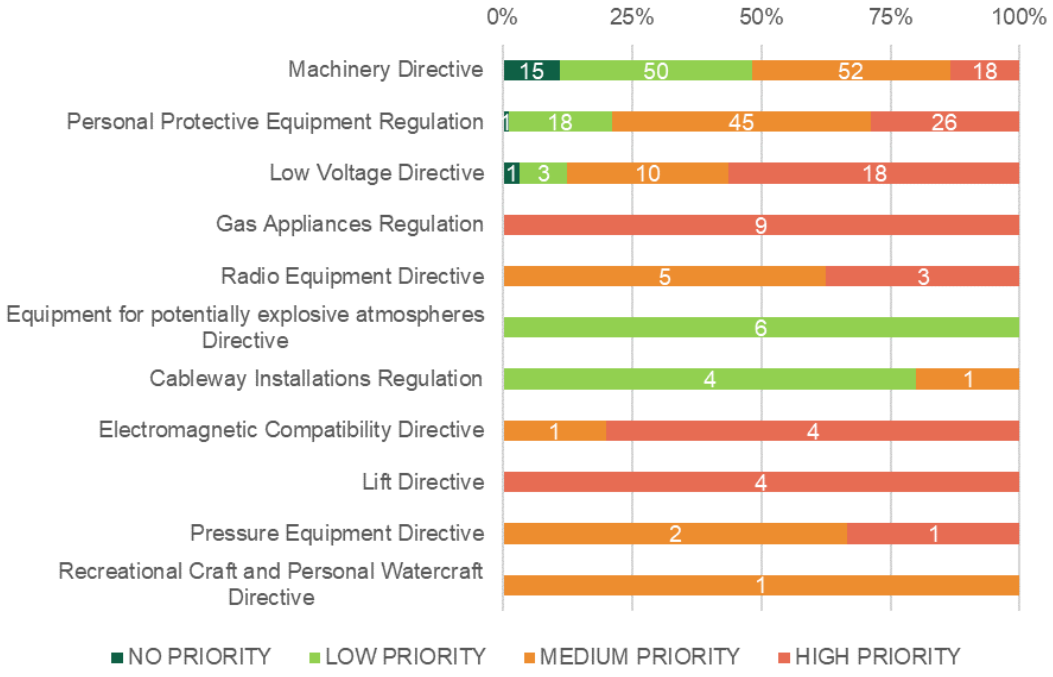


Figure 21: Distribution of standards by priority rating and piece of legislation

Source: CSIL

Focusing specifically on 72 high-priority standards, multiple TCs might play a crucial role in addressing these standards. The high-priority standards were indeed under the responsibility of 28 technical committees (see figure below) out of the 88 responsible for the 276 standards under assessment. The revision process might therefore be launched as a pilot exercise among a restricted sample of TCs before scaling it up to all standards in need of revision.

Among the 28 TCs responsible for high-priority standards, 'Safety of household and similar electrical appliances' (CLC/TC 61) and 'Respiratory protective devices' (CEN/TC 79) were responsible for the highest number of standards in need of revision, with a high level of priority, accounting for 13 and 10 standards respectively. Other TCs responsible for a relatively large number of high-priority standards are 'Protection against falls from height including working belts' (CEN/TC 160), 'Protective clothing including hand and arm protection and lifejackets' (CEN/TC 162), and 'Lifts, escalators and moving walks' (CEN/TC 10), with 6, 5 and 4 standards respectively. All other TCs were responsible for less than 3 standards identified as requiring high-priority revision.

Overall, the findings provide valuable insights into the areas where anthropometrics play a key role, and the lack of inclusiveness may cause more severe impacts. The findings also show where revisions and improvements are needed to ensure the standards' effectiveness and safety. By identifying the responsible TCs and highlighting specific focus areas, stakeholders can prioritise their efforts in revising and enhancing the standards to address potential risks and protect the health and safety of the European population.

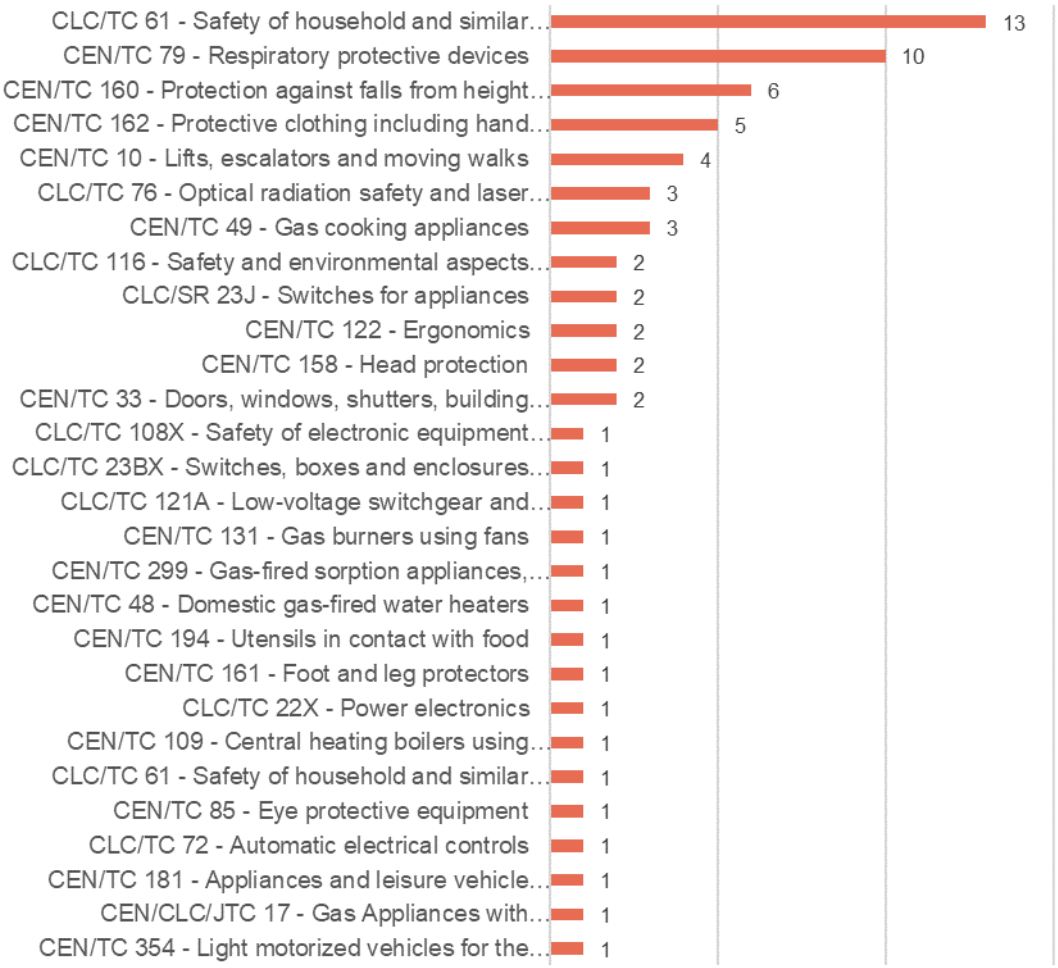


Figure 22: Distribution of high-priority rating standards by technical committee

Source: CSIL

4. Main takeaways from the stakeholder consultation

The findings presented in the previous chapters evidence the relevance of anthropometrics in the European standards supporting the 22 pieces of legislation within the remit of DG GROW (Unit H2). They also show that a large share only partly includes anthropometric considerations that are inclusive of the targeted population. The lack of inclusive anthropometric considerations poses a risk to the health and safety of the European population. Depending on the scope of the standard, its potential negative impact may be significant. As discussed in Chapter 3, most standards may cause injuries to users if anthropometric considerations are not properly accounted for. As part of the study, two workshops were organised on two different standards to discuss with key stakeholders the implications of the lack of inclusiveness in the anthropometric provisions and the best way to possibly update them (see agenda and full summary in Annex V). The workshops provided a glimpse into the potential discussions that could be orchestrated among various stakeholders to explore the necessary steps for revising specific standards and improving their inclusiveness.

The first workshop, held on 12 October 2023, centred around anthropometric aspects covered by **standard EN 1005-2, focusing on manual handling of machinery and components**, supporting the Machinery Directive 2006/42/EC. While the standard offers ergonomic recommendations on the ideal vertical and horizontal location of machinery, it contains shortcomings, notably due to reliance on outdated anthropometric data gathered from US military adult men in the 1960s and 1980s. Stakeholders, expressing concerns about the standard's applicability to Europe's diverse population, highlighted the inadequacy in

addressing variations in size, structure and other anthropometric dimensions. During the workshop, two companies presented innovative strategies they had implemented to tailor workstations and machinery to accommodate diverse human body types, improving manual handling conditions. These interventions not only reduced user discomfort and the risk of musculoskeletal disorders but also demonstrated potential gains in productivity and decreased employer costs associated with illness. Participants in the workshop, including standardisers, companies, ergonomics experts and other academic experts, unanimously underscored the importance of revising the standard and, to achieve this, the pressing need for updated and more representative anthropometric data, considering diverse individual characteristics and capacities.

The second workshop, organised on 13 October 2023, discussed standard **EN ISO 15831:2004, focusing on thermal manikins used in evaluating clothing insulation** and supporting the Personal Protective Equipment Regulation. The standard currently lacks specificity regarding gender and age, and relies on very broad anthropometric ranges. While these ranges are potentially inclusive of the adult population, as they allow the body height of the manikins to be between 1.55 and 1.85 metres, in practice only male body shapes are used for testing, supposedly in order to ensure comparability in measurement and testing results. Some stakeholders expressed concerns about safety and health implications, advocating for a revision of the standard to address diversity, including at least distinctions between male and female manikins and consideration for children. However, while all stakeholders acknowledged that clothing insulation properties strongly depend on the fitting of clothes to the manikins, there was no consensus on the influence that anthropometric differences could play on fitting and insulation. It was emphasised that considering different types of human manikins would significantly increase testing costs. At the same time, it was highlighted that future technological advancements, such as the development of advanced simulation modelling and machine-learning algorithms, could potentially mitigate testing costs in the future, making it less costly to make products adapted to the whole population.

The two workshops also reached some similar conclusions, which could be extended to other standards. First, stakeholders stressed that **the lack of updated and representative anthropometric data is a key challenge** for the development of inclusive standards and highlighted the need to launch a new anthropometric data survey. Data should be collected that is representative of the European population in terms of gender and age as a minimum. Before launching the data collection, it is necessary to determine the sampling strategy, the sampling size, the list of parameters needed, and the data update strategy, acknowledging that there is a trade-off between the number of parameters covered and the possibility of regular updates. The ongoing feasibility study commissioned by CEN-CENELEC on anthropometric data on children might feed into this process.

Second, the discussions highlighted that not all stakeholders may be prepared to recognise the necessity of incorporating anthropometric and ergonomic considerations to enhance the inclusiveness of standards. The workshops demonstrated the **advantages of fostering collaboration** among diverse actors, including standardisers, testing labs, product manufacturers, workers, end users and ergonomic experts.

Third, **some trade-offs should be recognised and managed** when considering revising standards. On the one hand, more detailed standards can ensure higher safety levels for workers and consumers, but they may escalate costs for manufacturers. On the other hand, broader and more generic standards grant users more flexibility, but may not necessarily safeguard the European population, as illustrated by the thermal manikin standard example. Moreover, a trade-off between inclusiveness and costs exists and it is essential to examine the thresholds of inclusivity before costs become disproportionately high, e.g. in terms of the percentile of the population to cover.

Finally, based on the workshop discussions, it can be affirmed that **the assessment methodology** developed by the study team to assess the inclusiveness of standards **has received validation**. Stakeholders consulted not only endorsed the study team's assessments

of the standards but also demonstrated keen interest in both the study itself and the broader topic.

ANNEXES

ANNEX I – TECHNICAL DETAILS FOR DATA COLLECTION ON STANDARDS

I.1. Construction of the dataset on standards under analysis

I.1.1. Data collection from the CEN-CENELEC website

The CEN-CENELEC website has a *search page* that allows not only filtering and searching standards based on multiple criteria (the EU legal act they support, status and so on) but also downloading the results of the search strategy in an Excel file. The exported Excel file includes information on the reference of the standard and additional information such as the responsible technical committee, the working item number, the title, the status, and relevant dates (i.e. date of ratification, date of availability, date of announcement, date of publication, date of withdrawal).

However, the dataset downloadable from the search webpage does not include information on the abstract of the standard or the normative references, the international classification for standards, or the supporting piece of legislation. These data are instead included in the webpage of each standard. Hence, we have employed web-scraping techniques to collect all relevant data efficiently[23]. More specifically, for standards developed by committees working under either CEN or CENELEC, we have structured the data collection strategy as follows:

1. **Use the CEN-CENELEC search standards webpage as a data source**[24]. The list of standards supporting each EU legal act is publicly available on the European Commission website. However, the available dataset includes a minimum set of information deemed not sufficient for the objectives of this study. Therefore the CEN-CENELEC website has been used as the primary source of information, and the data available on the Commission website were considered as a secondary source of information to double-check that all supporting standards were included in the final database.
2. **Use the filter fields of the CEN-CENELEC search standards webpage to identify the list of standards of interest**. The CEN-CENELEC search standard webpage includes the following filter fields: (i) keywords; (ii) committee; (iii) deliverable; (iv) legal framework; (v) status; and (vi) standards classification. For this study, we used the 'Legal Framework' filter field to extract the complete list of standards supporting each piece of legislation[25]. For each piece of legislation, we further narrowed the list of results by setting the 'Deliverable Type' filter field equal to 'EN' and the 'Status' to either 'Approved' or 'Published'[26].
3. **Retrieve the complete list of hyperlinks.** The URL of each standard's webpage is included as a hyperlink in the list resulting from the search strategy set out in the previous step. To automatedly collect the complete list of URLs, we used a Chrome extension called Instant Data Scraper. This is an automated data extraction tool that uses artificial intelligence to predict which data are most relevant on an HTML page and saves the data in an Excel file.

[23] Alternatively, if the number of searched standards is limited, the researcher may extract information manually from the webpage of each standard.

[24] https://standards.cencenelec.eu/dyn/www/f?p=CEN:105::RESET:::.

[25] The same hEN may support more than one piece of legislation. Thus, at this stage it is possible that information on the same hEN will be downloaded more than once if the same hEN supports more than one piece of legislation of interest. Data cleaning procedures were employed afterwards to eliminate the duplicates.

[26] Since the search webpage displays only the first 1 000 standards that correspond to the search criteria, the search strategy was split into sub-searches exploiting the committee filter field in cases where the results include more than 1 000 standards.

4. **Collect selected information from standards' webpages.** Collecting data from standards' webpages is the core step. To do so, we developed an algorithm that automatedly opens the complete list of URLs collected in the previous step for each piece of legislation in scope, extracts information from the different standard webpages and saves it in a dataset.
5. **Consolidate the CEN-CENELEC standard dataset.** This is the final step for creating the dataset including information on all standards drafted by committees working under CEN or CENELEC. Since the same hEN may support more than one piece of legislation, we identified and discarded duplicates in this final step using an automated procedure.

I.1.2. Data collection from the ETSI website

The ETSI website has a *search page*[27] that can be used to filter and search standards based on multiple criteria (the EU legal act they support, status and so on). Unlike the CEN-CENELEC website, for ETSI the results of the search strategy cannot be downloaded. Another difference from the CEN-CENELEC website is that the relevant information is not available on the webpage of the standard; instead, it is included in the primary texts freely available on the ETSI website. Therefore we slightly adapted the data collection strategy for standards developed for technical committees working under ETSI as follows:

1. **Use the ETSI search standards webpage as a data source**[28]. As for standards drafted by the CEN-CENELEC, for standards drafted by ETSI, the ETSI website was used as the primary source of information. The data available on the European Commission website serve as a secondary source of information to double-check that all supporting standards are included in the final database.
2. **Use the filter fields of the ETSI search standards webpage to identify the list of standards of interest**. The ETSI search standard webpage includes the following filter fields: (i) ETSI document type; (ii) technical body; (iii) work item status; (iv) funded work programme; and so on. We used the filter field on the 'Funded Work Programme: Directive' to extract the complete list of standards supporting relevant pieces of legislation[29]. For each piece of legislation, we further narrowed the list of results by setting the 'ETSI document type' filter field equal to 'EN – European Standard (Telecommunications series)' and the 'Work Item Status' to 'Active'.
3. **Retrieve the full text of each standard**. To automatedly download the full text of all standards, we developed an ad hoc algorithm that collects each standard's URLs included in the main search page and saves the underlying document in a local folder.
4. **Collect selected information from the standards' main text**. This is the core activity as it extracts the needed information from the standards' main texts. To do so, we developed a text-extraction algorithm that automatically opens the downloaded pdfs, extracts information from each main text and saves it in the ETSI standard dataset.

[27] https://portal.etsi.org/webapp/WorkProgram/Expert/QueryForm.asp
[28] https://standards.cencenelec.eu/dyn/www/f?p=CEN:105::RESET:::.
[29] Footnote 25 applies here too.

I.1.3. Script for the data collection from the CEN-CENELEC website

```python
## Import necessary packages
import requests
from bs4 import BeautifulSoup as soup
import pandas as pd

## Import the list of web-links to scrape: The list in our case has been retrieved
## by searching on the search page of CEN-CENELEC, and scraping the results via a
## google extension (Instant Data Scraper).
data_links = pd.read_excel("links.xlsx")

## Create list with all the links. In our case they are in the first column of the
##file imported above.
links = data_links.iloc[:, 0]

## Scrape the links. The data will be stored in the list "new_info", which will contain
## a dictionary for each page scraped, with all the information retrieved.
new_info = []
for l in range(0, len(links)):
    url = links[l]
    ## Use request.get method to get the html web-page.
    page = requests.get(url)
    ## Use BeautifulSoup package for reading the html.
    mppp = soup(page.text, "html.parser")
    ## Find all the tables: the information we are looking for are all stored
    ## in objects with html id "table".
    table = mppp.find_all("table")
    ## Create a dictionary to store the data.
    scraped_info = {}
    scraped_info["web_link"] = str(links[l])
    for x in table:
        td_obj = x.find_all("td")
        th_obj = x.find_all("th")
        ## If the length of "th" objects in the table is different from the length of "td" objects,
        ## the table is the one containing the title.
        if len(td_obj) != len(th_obj):
            scraped_info["title"] = td_obj[0].get_text() + td_obj[1].get_text() + td_obj[2].get_text()
        ## In the other cases, through this loop the information are obtained.
        elif len(td_obj) == len(th_obj):
            for i in range(0, len(td_obj)):
                scraped_info[th_obj[i].get_text()] = str(td_obj[i].get_text())
    new_info.append(scraped_info)

## Create a  pandas dataframe of the results
final_df = pd.DataFrame(new_info)
colonne = final_df.columns

## Partially process the data: substitue"\n" with a blank space.
for key, row in final_df.iterrows():
    for i in colonne:
        if final_df(row[i], str):
            final_df.at[key, i] = row[i].replace("\n", " ")

## Finally store the results in the desired path
final_df.to_excel("scraped_data.xlsx")
```

I.2. Construction of the dataset on normative references

As mentioned in Chapter 2.2, we constructed the dataset on normative references in two steps. We first created a preliminary dataset by web-scraping standardisation bodies' websites and then cleaned the resulting dataset to ensure that each normative reference is unique in the final dataset. Further details on the performance of these two steps are provided below.

I.2.1. Preliminary dataset as web-scraped

We constructed the preliminary dataset on normative references using an incremental procedure and relying on multiple sources.

First, we searched for normative references already included in the dataset of standards previously developed. Information on about 150 normative references was obtained in this way.

As a second step, we made use of the information available on the CEN-CENELEC website. An advantage of the CEN-CENELEC website is that as long as a CEN-CENELEC technical committee drafted the normative reference, the URL of the normative reference's webpage is provided on the citing standard webpage. This makes it possible to directly access the normative reference's web page and retrieve the needed information, using the same web-scraping algorithm developed to compile the standard dataset. Roughly 2 200 additional normative references were retrieved in this way.

The International Organization for Standardization (ISO) drafted many of the remaining normative references, so it was convenient to use the ISO website[30] to gather information on additional normative references. Titles and abstracts for roughly 2 600 were obtained in this way.

Finally, we identified two additional websites that could be searched for standards drafted by several entities: Iteh[31], the Slovenian NBS, and IHS Markit[32], an online store for standards. By developing an ad hoc web-scraping algorithm, we retrieved relevant information for most of the remaining normative references.

At the end of this process, information on about 150 normative references was still missing. To keep the process efficient, we manually searched for missing information on the web to complete the dataset. In some cases, we did not manage to find the exact normative reference as mentioned in the citing standard. This was because the standard was citing a previous version (e.g. still at the stage of Technical Report or Technical Specification), whereas only the most recent one (e.g. standard) was available online.

The resulting preliminary database includes information on all normative references as cited in the analysed standards. However, it may include some duplicates. Normative references may be revised (e.g. amendments, corrigenda) over time as well as they can be ratified by other standardisation bodies, meaning that the same normative reference may be cited in different ways (e.g. EN 61318; IEC/TR 61318; IEC/TR 61318:1994; EN 61318:2008; EN IEC 61318:2021). In these cases, each version is included in the preliminary dataset. It may be the case that although the standard is the same, the information retrieved is slightly different (see Box 2). This issue cannot be overlooked because the methodology proposed for identifying anthropometric-related normative references builds only on the keyword approach. Therefore it is crucial that the same standard appears only once in the dataset with complete and updated information. Otherwise we risk classifying the same normative reference as 'anthropometric-related' and 'not anthropometric-related', which would lead to erroneous classifications of the analysed standards.

Box 2. Examples of different references referring to the same field of application

Different normative references can refer to the same field but be published in subsequent versions or by different standardisation organisations. An example is provided below. All these normative references were retrieved via web-scraping techniques and were collected in the preliminary dataset:

[30] https://www.iso.org/home.html.

[31] https://standards.iteh.ai/.

[32] https://global.ihs.com/index.cfm?&index_home=true.

- **SIST EN 61318:2008** – *Title*: 'Live working – Conformity assessment applicable to tools, devices and equipment'. *Abstract*: 'This International Standard provides elements for product conformity assessment. […]. This standard defines assessment methods for products having completed production phase to assure that they conform to the requirements of the corresponding product standard […].'
- **EN 61318:2008** – *Title*: 'Live working – Conformity assessment applicable to tools, devices and equipment'. *Abstract*: 'This International Standard provides elements for product conformity assessment. […]. This standard defines assessment methods for products having completed production phase to assure that they conform to the requirements of the corresponding product standard. […].'
- **EN IEC 61318:2021** – *Title*: 'Live working – Methods for assessment of defects and verification of performance applicable to tools, devices and equipment'. *Abstract*: 'Provides elements for product conformity assessment. […]. This standard defines assessment methods for products having completed production phase to assure that they conform to the requirements of the corresponding product standard. […].'
- **IEC 61318** – *Title*: 'Live working – Methods for assessment of defects and verification of performance applicable to tools, devices and equipment'. *Abstract:* 'This document defines methods to assess defects and to verify that products after the manufacturer process meet the requirements of the corresponding product standard. […].'

It is evident that all these standards refer to the same standard – the assessment of conformity for tools, devices and equipment in live working. They have nevertheless been mentioned in different forms, and the web-scraping procedure returned the above results.

I.2.2. Dataset of normative references

To overcome the issue of having the information on the same normative reference duplicated within the dataset because published in different versions or by different organisations, we assigned to each normative reference a unique identifier based on its reference. This unique identifier is made up of the numerical part of the reference (i.e. excluding the indication of the standardisation body and the publication year). This makes it possible to group all normative references that belong to the same 'family', regardless of the responsible standardisation organisation and the year of publication.

Therefore we revised the entire preliminary dataset to assign the same title and abstract to each normative reference within a given family. The title and abstract for each unique identifier were chosen from the most recent and complete observation (i.e. having both title and abstract). Following this procedure, the number of unique normative references was reduced from 9 979 to 6 416.

ANNEX II – TOOLS FOR THE IDENTIFICATION OF ANTHROPOMETRIC-RELATED STANDARDS

II.1. List of relevant technical committees

The table below lists all technical committees that are considered more likely to draft anthropometric-related standards. To ensure that the identification of anthropometric-related standards can be applied to every piece of legislation, the list also includes technical committees beyond the scope of this study.

Table 7 – Technical committees that are likely to draft anthropometric-related standards

European Standardization Organization	Committee	Title
CEN-CENELEC	CEN/CLC/JTC 12	Design for All
CEN-CENELEC	CEN/CLC/JTC 16	Active Implantable Medical Devices
CEN-CENELEC	CEN/CLC/JTC 3	Quality management and corresponding general aspects for medical devices
CEN-CENELEC	CEN/CLC/JTC 4	Services for fire safety and security systems
CEN-CENELEC	CEN/CLC/WS HECTOS	CEN-CENELEC Workshop on Guidelines on evaluation systems and schemes for physical security products
CENELEC	CLC/BTTF 116-2	Alcohol interlocks
CENELEC	CLC/TC 106X	Electromagnetic fields in the human environment
CENELEC	CLC/TC 116	Safety and environmental aspects of motor-operated electric tools
CENELEC	CLC/TC 204	Safety of electrostatic painting and finishing equipment
CENELEC	CLC/TC 37A	Low voltage surge protective devices
CENELEC	CLC/TC 62	Electrical equipment in medical practice
CENELEC	CLC/TC 64	Electrical installations and protection against electric shock
CENELEC	CLC/TC 76	Optical radiation safety and laser equipment
CENELEC	CLC/TC 78	Equipment and tools for live working
CENELEC	CLC/TC 81X	Lightning protection
CEN	CEN/SS C20	Explosives and firework
CEN	CEN/SS H99	Products for household and leisure use - Undetermined
CEN	CEN/SS I03	Limits and fits
CEN	CEN/SS S02	Transfusion equipment
CEN	CEN/SS S03	Syringes
CEN	CEN/SS S13	Ergonomics
CEN	CEN/SS S99	Health, environment and medical equipment - Undetermined
CEN	CEN/SS T03	Road Vehicles
CEN	CEN/TC 10	Lifts, escalators and moving walks
CEN	CEN/TC 122	Ergonomics

European Standardization Organization	Committee	Title
CEN	CEN/TC 136	Sports, playground and other recreational facilities and equipment
CEN	CEN/TC 137	Assessment of workplace exposure to chemical and biological agents
CEN	CEN/TC 140	In vitro diagnostic medical devices
CEN	CEN/TC 158	Head protection
CEN	CEN/TC 159	Hearing protectors
CEN	CEN/TC 160	Protection against falls from height including working belts
CEN	CEN/TC 161	Foot and leg protectors
CEN	CEN/TC 162	Protective clothing including hand and arm protection and lifejackets
CEN	CEN/TC 163	Sanitary appliances
CEN	CEN/TC 170	Ophthalmic optics
CEN	CEN/TC 201	Leather and imitation leather goods and footwear manufacturing machinery - Safety (Disbanded)
CEN	CEN/TC 204	Sterilization of medical devices
CEN	CEN/TC 205	Non-active medical devices
CEN	CEN/TC 206	Biological and clinical evaluation of medical devices
CEN	CEN/TC 207	Furniture
CEN	CEN/TC 215	Respiratory and anaesthetic equipment
CEN	CEN/TC 217	Surfaces for sports areas
CEN	CEN/TC 224	Personal identification and related personal devices with secure element, systems, operations and privacy in a multi sectorial environment
CEN	CEN/TC 225	AIDC technologies
CEN	CEN/TC 226	Road equipment
CEN	CEN/TC 231	Mechanical vibration and shock
CEN	CEN/TC 233	Biotechnology
CEN	CEN/TC 242	Safety requirements for passenger transportation by rope
CEN	CEN/TC 245	Leisure accommodation vehicles
CEN	CEN/TC 248	Textiles and textile products
CEN	CEN/TC 251	Health informatics
CEN	CEN/TC 252	Child care articles
CEN	CEN/TC 274	Aircraft ground support equipment
CEN	CEN/TC 278	Intelligent transport systems
CEN	CEN/TC 285	Non-active surgical implants
CEN	CEN/TC 289	Leather
CEN	CEN/TC 290	Dimensional and geometrical product specification and verification
CEN	CEN/TC 293	Assistive products and accessibility

European Standardization Organization	Committee	Title
CEN	CEN/TC 309	Footwear
CEN	CEN/TC 310	Advanced automation technologies and their applications
CEN	CEN/TC 320	Transport - Logistics and services
CEN	CEN/TC 332	Laboratory equipment
CEN	CEN/TC 333	Cycles
CEN	CEN/TC 347	Methods for analysis of allergens
CEN	CEN/TC 354	Light motorized vehicles for the transportation of persons and goods and related facilities and not subject to type-approval for on-road use
CEN	CEN/TC 362	Healthcare services - Quality management systems
CEN	CEN/TC 364	High chairs and learning towers
CEN	CEN/TC 367	Breath-alcohol testers
CEN	CEN/TC 392	Cosmetics
CEN	CEN/TC 398	Child Protective Products
CEN	CEN/TC 403	Aesthetic surgery and aesthetic non-surgical medical services
CEN	CEN/TC 409	Beauty Salon Services
CEN	CEN/TC 410	Jewellery and precious metals
CEN	CEN/TC 422	Side curtains ventilation systems - safety
CEN	CEN/TC 429	Food hygiene - Commercial warewashing machines - Hygiene requirements and testing
CEN	CEN/TC 430	Nuclear energy, nuclear technologies, and radiological protection
CEN	CEN/TC 431	Service Chain for Social Care Alarms
CEN	CEN/TC 435	Tattooing services
CEN	CEN/TC 437	Electronic cigarettes and e-liquids
CEN	CEN/TC 448	Funeral services
CEN	CEN/TC 449	Quality of care for older people
CEN	CEN/TC 450	Patient involvement in person-centred care
CEN	CEN/TC 453	Dietary supplements and sports food free of doping substances
CEN	CEN/TC 470	Quality along the patient pathway in medical imaging
CEN	CEN/TC 52	Safety of toys
CEN	CEN/TC 55	Dentistry
CEN	CEN/TC 70	Manual means of fire fighting equipment
CEN	CEN/TC 79	Respiratory protective devices
CEN	CEN/TC 85	Eye protective equipment
CEN	CEN/WS 068	Quality criteria for health checks
CEN	CEN/WS 069	Car-Adaptations for Drivers and Passengers of Motor Vehicles
CEN	CEN/WS 102	CEN Workshop on guidelines for introducing tele-medical and pervasive monitoring technologies balancing privacy protection against the need for oversight and care

European Standardization Organization	Committee	Title
CEN	CEN/WS 110	Performance test method for lower limb wearable robots for walking on irregular terrains
CEN	CEN/WS 118	Absorbent hygiene products - Test methods for analysing trace chemicals
CEN	CEN/WS CBRN	Basic CBRN training curriculum for first responders and medical staff including first receivers
CEN	CEN/WS CFCM	Response to Covid 19 - Community face coverings (Masks)
CEN	CEN/WS COVR	Safety in close human-robot interaction: procedures for validation tests
CEN	CEN/WS DHI	Digital health innovations – Good practice guide for obtaining user consent for personal health information
CEN	CEN/WS EXOSK	Integration process of new technologies of physical assistance such as exoskeletons
CEN	CEN/WS ModGra	ModGra -Graphical representation of physical process models
CEN	CEN/WS SOPHIA	SOPHIA - Biomechanical risk assessment: Guideline for introducing and implementing real-time instrumental-based tools for biomechanical risk assessment
ETSI	eHealth	eHealth
ETSI	HF	Human Factors
ETSI	MTS	Methods for Testing & Specification
ETSI	SAFETY	Safety
ETSI	USER	User Group

Source: CSIL based on CEN-CENELEC website and ETSI website

II.2. List of relevant International Classification for Standard codes

The table below lists all ICS codes that are considered likely to refer to anthropometric-related standards. To ensure that the identification of anthropometric-related standards can be applied to every piece of legislation, the list includes ICS codes beyond this study's scope.

Table 8 – List of ICS codes that are likely to cover anthropometric-related standards

ICS code	ICS title
01.060	Quantities and units
01.040.11	Health care technology (Vocabularies)
01.040.13	Environment. Health protection. Safety (Vocabularies)
01.040.61	Clothing industry (Vocabularies)
03.020	Sociology. Demography
03.040	Labour. Employment
03.180	Education
03.080.30	Services for consumers
03.120.01	Quality in general
03.120.10	Quality management and quality assurance

ICS code	ICS title
03.120.20	Product and company certification. Conformity assessment
03.120.30	Application of statistical methods
03.120.99	Other standards related to quality
03.200.01	Leisure and tourism in general
03.200.10	Adventure tourism
03.200.99	Other standards relating to leisure and tourism
07.100.01	Microbiology in general
07.100.10	Medical microbiology
07.100.20	Microbiology of water
07.100.30	Food microbiology
07.100.40	Cosmetics microbiology
07.100.99	Other standards related to microbiology
11.140	Hospital equipment
11.160	First aid
11.200	Birth control. Mechanical contraceptives
11.020.01	Quality and environmental management in health care
11.020.10	Health care services in general
11.020.20	Medical science
11.020.99	Other standards related to health care in general
11.040.01	Medical equipment in general
11.040.10	Anaesthetic, respiratory and reanimation equipment
11.040.20	Transfusion, infusion and injection equipment
11.040.25	Syringes, needles and catheters
11.040.30	Surgical instruments and materials
11.040.40	Implants for surgery, prosthetics and orthotics
11.040.50	Radiographic equipment
11.040.55	Diagnostic equipment
11.040.60	Therapy equipment
11.040.70	Ophthalmic equipment
11.040.99	Other medical equipment
11.060.01	Dentistry in general
11.060.10	Dental materials
11.060.15	Dental implants
11.060.20	Dental equipment
11.060.25	Dental instruments
11.080.01	Sterilization and disinfection in general
11.080.10	Sterilizing equipment
11.080.20	Disinfectants and antiseptics
11.080.30	Sterilized packaging

ICS code	ICS title
11.080.99	Other standards related to sterilization and disinfection
11.100.01	Laboratory medicine in general
11.100.10	In vitro diagnostic test systems
11.100.20	Biological evaluation of medical devices
11.100.30	Analysis of blood and urine
11.100.99	Other standards related to laboratory medicine
11.120.01	Pharmaceutics in general
11.120.10	Medicaments
11.120.20	Wound dressings and compresses
11.120.99	Other standards related to pharmaceutics
11.180.01	Aids for disabled and handicapped persons in general
11.180.10	Aids and adaptation for moving
11.180.15	Aids for deaf and hearing impaired people
11.180.20	Aids for incontinence and ostomy
11.180.30	Aids for blind or partially sighted people
11.180.40	Aids for drinking and eating
11.180.99	Other standards related to aids for disabled and handicapped people
13.100	Occupational safety. Industrial hygiene
13.110	Safety of machinery
13.120	Domestic safety
13.140	Noise with respect to human beings
13.160	Vibration and shock with respect to human beings
13.180	Ergonomics
13.200	Accident and disaster control
13.240	Protection against excessive pressure
13.260	Protection against electric shock. Live working
13.280	Radiation protection
13.300	Protection against dangerous goods
13.310	Protection against crime
13.020.01	Environment and environmental protection in general
13.020.10	Environmental management
13.020.20	Environmental economics. Sustainability
13.020.30	Environmental impact assessment
13.020.40	Pollution, pollution control and conservation
13.020.50	Ecolabelling
13.020.55	Biobased products
13.020.60	Product life-cycles
13.020.70	Environmental projects
13.020.99	Other standards related to environmental protection

ICS code	ICS title
13.220.01	Protection against fire in general
13.220.10	Fire
13.220.20	Fire protection
13.220.50	Fire
13.220.99	Other standards related to protection against fire
13.340.01	Protective equipment in general
13.340.10	Protective clothing
13.340.20	Head protective equipment
13.340.30	Respiratory protective devices
13.340.40	Hand and arm protection
13.340.50	Leg and foot protection
13.340.60	Protection against falling and slipping
13.340.70	Lifejackets, buoyancy aids and flotation devices
13.340.99	Other protective equipment
17.160	Vibrations, shock and vibration measurements
17.240	Radiation measurements
17.040.01	Linear and angular measurements in general
17.040.10	Limits and fits
17.040.20	Properties of surfaces
17.040.30	Measuring instruments
17.180.01	Optics and optical measurements in general
17.180.20	Colours and measurement of light
17.180.30	Optical measuring instruments
17.180.99	Other standards related to optics and optical measurements
21.020	Characteristics and design of machines, apparatus, equipment
25.200	Heat treatment
25.140.01	Hand
25.140.30	Hand-operated tools
25.140.99	Other hand-held tools
27.200	Refrigerating technology
27.220	Heat recovery. Thermal insulation
35.240.15	Identification cards. Chip cards. Biometrics
35.240.80	IT applications in health care technology
37.020	Optical equipment
37.040.10	Photographic equipment. Projectors
37.060.10	Motion picture equipment
39.060	Jewellery
39.040.01	Horology in general
39.040.10	Watches

ICS code	ICS title
39.040.20	Clocks
39.040.99	Other time-measuring instruments
43.100	Passenger cars. Caravans and light trailers
43.140	Motorcycles and mopeds
43.150	Cycles
43.180	Diagnostic, maintenance and test equipment
43.040.80	Crash protection and restraint systems
45.100	Cableway equipment
45.120	Equipment for railway/cableway construction and maintenance
49.060	Aerospace electric equipment and systems
49.090	On-board equipment and instruments
49.095	Passenger and cabin equipment
49.120	Cargo equipment
49.140	Space systems and operations
49.025.60	Textiles
53.120	Equipment for manual handling
59.140.20	Raw skins, hides and pelts
59.140.30	Leather and furs
59.140.35	Leather products
59.140.40	Machines and equipment for leather and fur production
61.020	Clothes
61.040	Headgear. Clothing accessories. Fastening of clothing
61.060	Footwear
65.160	Tobacco, tobacco products and related equipment
71.040.10	Chemical laboratories. Laboratory equipment
71.100.70	Cosmetics. Toiletries
87.100	Paint coating equipment
91.020	Physical planning. Town planning
91.220	Construction equipment
91.060.50	Doors and windows
91.100.60	Thermal and sound insulating materials
91.140.30	Ventilation and air
91.140.65	Water heating equipment
91.140.70	Sanitary installations
91.140.90	Lifts. Escalators
95.040	Military engineering
95.060	Weapons
97.020	Home economics in general
97.030	Domestic electrical appliances in general

ICS code	ICS title
97.060	Laundry appliances
97.080	Cleaning appliances
97.120	Automatic controls for household use
97.140	Furniture
97.145	Ladders
97.150	Floor coverings
97.160	Home textiles. Linen
97.170	Body care equipment
97.180	Miscellaneous domestic and commercial equipment
97.190	Equipment for children
97.195	Items of art and handicrafts. Cultural property and heritage
97.040.01	Kitchen equipment in general
97.040.10	Kitchen furniture
97.040.20	Cooking ranges, working tables, ovens and similar appliances
97.040.30	Domestic refrigerating appliances
97.040.40	Dishwashers
97.040.50	Small kitchen appliances
97.040.60	Cookware, cutlery and flatware
97.040.99	Other kitchen equipment
97.100.01	Heating appliances in general
97.100.10	Electric heaters
97.100.20	Gas heaters
97.100.30	Solid fuel heaters
97.100.40	Liquid fuel heaters
97.100.99	Heaters using other sources of energy
97.130.01	Shop fittings in general
97.130.10	Shelving
97.130.20	Commercial refrigerating appliances
97.130.30	Trolleys for supermarket purposes
97.130.99	Other shop fittings
97.200.01	Equipment for entertainment in general
97.200.10	Theatre, stage and studio equipment
97.200.20	Musical instruments
97.200.30	Camping equipment and camp
97.200.40	Playgrounds
97.200.50	Toys
97.200.99	Other equipment for entertainment
97.220.01	Sports equipment and facilities in general
97.220.10	Sports facilities

ICS code	ICS title
97.220.20	Winter sports equipment
97.220.30	Indoor sports equipment
97.220.40	Outdoor and water sports equipment
97.220.99	Other sports equipment and facilities

Source: CSIL based on ISO (2015)

II.3. List of relevant keywords

Table 9 – Keywords that are used in anthropometric-related standards

Anthropometric dimension	Keywords	Anthropometric relevance
Age status	Adult, age, child, elder, young, youth.	High
Anthropometric / ergonomic	Anthropometric, biodynamic, biomechanic, ergonomic, isometric.	Medium
Avoided impact	Accident, exposure, harness, health, health, injury, protect, safety, well-being.	Low
Body part	Abdomen, ankle, arm, belly, body part, brow, bust, buttock, calf, cervical, cheekbone, chest, chin, crotch, ear, elbow, eye, face, facial, feet (foot), finger, fingertip, fist, hand, head, heel, hip, iliac, instep, jaw, knee, knuckle, leg, limb, lip, metacarpal, metatarsal, midriff, mouth, neck, palm, pelvis, pinch, popliteal, pupil, shoulder, skin, spine, thigh, thorax, thumb, tibiale, toe, torso, trunk, vertex, waist, wrist.	High
Composition	Blood, percentage body, endurance, fat, heat balance, hormones, metabolic, metabolism, muscular, water content, water mass.	High
Gender	Female, gender, male.	High
Measure	Height, kg, weight.	Low
Other	Body access, body movement, breath, design for all, grasp, grip, human, mental, outstretched, physiological, physiology, respiratory, presence sensor, smell, strength, taste, thermal interaction, field of vision, zygomatic.	Medium
Size	Body length, body mass, body shape, lean mass, body size.	High
Structure	Ambulation, anatomic, anatomical, barycentre, barycentric, body proportion, exoskeleton, musculoskeletal, posture, skeletal, stature.	High
Testing	Cut-outs, dummy, force limits, manikin, phantom, test subject, tolerance limit.	Medium
User and type of user	Consumer, installer, official, operator, passenger, patient, people, person, player, population, society, staff, user, worker, workforce.	Low

Source: CSIL

ANNEX III – THE ASSESSMENT GRID

Box 3. The questionnaire included in the assessment grid

1. Identification of the standard and scope

1. What is the scope of the standard?
2. To what extent does the standard concern products that may have different impacts on persons depending on their anthropometric measures? High/Medium/Low/Not relevant. Please justify the answer

2. Anthropometric dimension

1. Does the standard consider humans' size? Y/N/Not relevant – If yes, report the sentence/paragraph
2. Does the standard consider humans' structure? Y/N/Not relevant – If yes, report the sentence/paragraph
3. Does the standard consider humans' composition? Y/N/Not relevant – If yes, report the sentence/paragraph
4. Does the standard consider aspects of the human body other than the three above-mentioned anthropometric dimensions? Y/N/Not relevant – If yes, report the sentence/paragraph

3. Anthropometrics data used

1. What type of statistical measures were used (e.g. average, median, percentile, and so on)? If applicable, report the sentence/paragraph
2. What type of anthropometric measures were used (e.g. international anthropometric measures, European anthropometric measures, typical body shapes, and so on)? Report the sentence/paragraph
3. Does the study mention any reference to the dataset used or to other standards? Y/N – If yes, please specify
4. Were limit values included with reference to the underlying study? Y/N – If yes, please specify

4. Anthropometrics data representativeness

1. Does the standard take into account the diversity of Europeans' interests, e.g. it is specified that it may affect women and men differently? Y/N/Not relevant – If yes, report the sentence/paragraph
2. Were disaggregated data used to develop the standard? Y/N
3. If data were disaggregated, which level of disaggregation was used? (e.g. gender, body type, etc.) Were data disaggregated by sex? Y/N If yes, report the sentence/paragraph
4. If data were not disaggregated, were data limitations acknowledged in the standard and assumptions articulated? Was it justified? If so, how?
5. Does the standard identify an under-represented population? Y/N If yes, report the sentence/paragraph

5. Representativeness of the test sample to test the product

1. What is the size of the test sample to be used?
2. Are the individuals to be included in the test sample representative of the European population? Y/N – If yes, report the sentence/paragraph
3. Are outliers (e.g. persons with disabilities) to be included in the test sample? Y/N – Report the sentence/paragraph
4. Was the under-represented part of the population consciously excluded or unintentionally? Please justify your response

5. Safeguards and possible impacts of a lack of inclusiveness

1. Which benefits is the standard expected to achieve? Human safety; Comfort; Environment; Health; Easy-of-use; Other, please specify
2. Which impact could the lack of inclusiveness cause on the unrepresented sub-population? Death; Injuries; Illness; Discomfort; Exclusion from use; Other, please specify

Source: CSIL

ANNEX IV – DETAILED DATA USED FOR STANDARDS' IDENTIFICATION, ASSESSMENT, PRIORITISATION

See accompanying Excel file.

ANNEX V – WORKSHOP SUMMARIES

V.1. Summary of workshop on the standard on manual handling of machinery (EN 1005-2:2003+A1:2008)

The workshop, held on 12 October 2023, focused on the anthropometrics aspects covered by the standard EN 1005-2:2003+A1:2008 'Safety of machinery - Human physical performance - Part 2: Manual handling of machinery and component parts of machinery', supporting the Machinery Directive 2006/42/EC. The final agenda is presented below.

Time	Content
10:00 – 10:30	**Welcome coffee and registration**
10:30 – 10:50	**Introduction** Welcome by the European Commission DG GROW - Mehdi Hocine (Head of Unit H2 Machinery & Equipment) and Frauke Hoss (Policy officer) Presentation of the study - Emanuela Sirtori (CSIL) Opening the workshop - Raffaele Di Benedetto (CIE)
10:50 – 11:30	**Presentation of the standard and its assessment** Aleid Ringelberg (CEN/TC 122 - Ergonomics) Alessandra Caputo (CSIL)
11:30 – 12:30	**Anthropometric problems encountered with the standard: the employers' perspectives** Marco Fiammotto (Denso Corporation) Tania Boatto (Xylem Inc.)
12:30 – 14:00	**Lunch break**
14;00 – 15:00	**Anthropometric problems encountered with the standard: the workers' perspectives** Jan Dul (Rotterdam School of Management, Erasmus University) Carl Lind (The Swedish Work Environment Authority) Henk de Vries (Rotterdam School of Management, Erasmus University)
15:00 – 15:15	**Coffee break**
15:15 – 16:15	**How to make the standard more anthropometrically inclusive?** Open discussion with participants facilitated by Raffaele Di Benedetto (CIE)
16:15 – 16:30	**Concluding remarks** Raffaele Di Benedetto (CIE) Frauke Hoss (European Commission - DG GROW)

The standard **EN 1005:2-2003+A1:2008** ('Safety of machinery - Human physical performance - Part 2: Manual handling of machinery and component parts of machinery') supports the Machinery Directive. It lays out **ergonomic recommendations for the design of machinery involving manual handling of machinery** and component parts of machinery, including tools linked to the machine, **in professional and domestic applications**. As stated in its scope, the standard applies to the manual handling of machinery, component parts of machinery and objects processed by the machine (input/output) of **3 kg or more, for carrying less than 2 m**.

The standard provides **three methods for assessing and reducing risk factors to their lowest possible level**, drawing inspiration from the National Institute for Occupational Safety & Health (NIOSH) approach used in the development of the Revised NIOSH Lifting Equation. The standard includes guidance on the **reference mass** that an individual can lift, considering

factors like gender, age, and the machine's field of application (professional versus domestic). For machinery designed for professional use, the reference mass is either 15 kg or 25 kg for the adult working population[33]. In exceptional circumstances (e.g. when technological developments or interventions are not sufficiently advanced), this reference mass can extend up to 40 kg. Based on the NIOSH Lifting Equation, the standard provides multipliers that should be used to determine the object's **optimal vertical and horizontal location**. According to the measurements included in the standard, the optimal vertical location (i.e. the vertical distance of the midpoints of the hands above the floor, measured at the origin and destination of a lift) is 75 cm.

The assessment carried out by the study team has revealed that **the standard partially addresses the diversity of the European population** but could benefit from further improvements to ensure greater inclusiveness. On the one hand, the EN 1005-2:2003+A1:2008 standard indirectly refers to all relevant anthropometric dimensions (i.e. size and structure) and partially acknowledges the differences in human body dimensions related to gender and age. On the other hand, there are concerns regarding the proposed ideal vertical location (i.e. 75 cm) and maximum vertical location (i.e. 175 cm). Indeed, on one hand, machinery located at 75 cm may lead to musculoskeletal disorders if a worker's height is above the average (above the 50th percentile) and, on the other hand, parts located at 1.75 m may also lead to musculoskeletal disorders because they could be out of reach if a worker's height is below the average (below the 50th percentile). Another critical aspect relates to data. All the anthropometric-related data included in the standard are provided without an explicit reference to the underlying anthropometric database or study. In this respect, the discussion at the workshop shed light on the fact that all measurements included in the standard mainly build on data collected in the USA between the 1960s and 1980s. Finally, while the standard specifies ergonomic recommendations for children and older people, it does not specify the age thresholds that determine these age classes.

The discussion then moved to how to address the main shortcomings of the standard and strategies to make it more inclusive. Musculoskeletal disorders are the most common work-related health issue declared by workers and the second most frequent one causing occupational disability-adjusted life years. As a result, **stakeholders agreed on the importance of addressing such disorders proactively by improving the standards**, rather than being reactive (i.e. intervening only after the application of the standard has caused health or safety problems). Two presentations by industry (Denso Corporation and Xylem Inc.) showed innovative ways in which companies adjusted their workstations and machinery to improve the conditions for manual handling. It was shown that these changes not only improved the comfort of workers and reduced the probability of incurring safety and health issues but also increased productivity and reduced the costs of injuries and professional illness for the employer. Additionally, a trade-off emerged between engineers and designers who try to design workstations in full compliance with the standard and employees who seek comfort in their working conditions. It was argued that **when machinery lines are designed in full compliance with the standard, workers may tend to adopt 'creative solutions**' to reduce their discomfort, which potentially increase the risk of accidents (see presentation by Fiammotto).

According to the workshop participants, **the primary and most predominant concern to make the standard more inclusive relates to data representativeness**. As mentioned above, all measurements in the standard mainly rely on anthropometric data collected from a survey conducted in the USA between the 1960s and 1980s on military adult men. It is clear that these anthropometric data do not necessarily represent the European population, which is the standard's target population. There have been substantial changes in anthropometric measures over time. As an illustrative example, in Italy, the average male height increased

[33] The technical committee CEN/TC 122, responsible for this standard, decided to set the maximum reference mass of the machine for professional purposes at 25 kg even though, at the time of drafting, the common practice was to have a 40 kg reference mass. The reason underlying the CEN/TC choice to lower the reference mass was the lack of scientific studies on the health impact that such weighted machinery could have.

from 164.7 cm in 1914 to 177.8 in 2015. Similarly, the average female height increased from 153.0 cm in 1914 to 164.6 in 2015[34]. Furthermore, Ciriello et al. (2008, 2011) have shown that the work capacity[35] has declined in the US over time.

It was widely agreed that **more updated and representative anthropometric data are needed**. The data informing the standard requires new research that considers the diversity in human characteristics and capacities in greater detail. This research effort should be focused on the population of intended users in terms of application field (domestic, professional general, professional exceptional) and the specific population group. There should be more granular representativeness to account for a broader range of individuals and long-term changes in the population structure (at least age, gender and country, or at least some macro-geographical regions). An expert stressed that inclusiveness does not depend on anthropometrics per se, which is inclusive by definition, but on the quality and regular update of anthropometric data. Periodical data updates or discussions on whether the population has changed, especially in the context of an ageing working population and immigration flows, are deemed to be very relevant.

Stakeholders pointed out many **aspects to be considered if a new anthropometric data survey has to be launched**. First, it would be of utmost importance to gather data on the maximum safe load levels that ensure the safest conditions (in terms of health and safety) with reference to the work capacity of the European workforce (today and in the future), separated by sex and age, to secure the same level of protection for the entire population. In this respect, stakeholders suggested that paragraph 1.1.6 Ergonomics of Annex I of the Machinery Directive could be revised to account for the difference between maximum strength levels and safe levels. Another key aspect to consider when collecting data is migration. The share of immigrants in a country should be well reflected in the characteristics of the working population. Overall, it would be important to gather sufficient data that enable experts to make simulations for individuals who do not reflect the average person.

Nevertheless, before launching this survey, the target population should be decided on. It could cover only some EU Member States, all Member States or the global population. Given the importance of updating the database regularly, a decision should be taken as to whether to gather fewer parameters on the human body that are updated more frequently or more parameters updated less often. Finally, it is crucial to remember that collecting anthropometric data might be very complex and that some ethical issues may have to be addressed.

Moving beyond data concerns, there was a discussion on the **necessity and suitability of making the requirements included in the standard more detailed or less detailed**. One option is to have a simpler harmonised standard that provides all the general principles that should be guaranteed, including anthropometrics considerations. More detailed guidelines for users (e.g. designers and ergonomists) could be provided separately. This option would create a stimulus to innovation and potentially increase inclusiveness. However, it was highlighted that a less detailed standard might raise problems in interpretation and increase legal uncertainty for machinery designers and some end-user companies, especially SMEs, which generally find more detailed standards easier to use. Another option would be to have the full set of information needed by designers in the standard. An expert suggested including different tables with the reference mass, the ideal and maximum vertical location and other parameters by geographical area. This would imply having wider ranges of anthropometric values instead of average values. In this case, the standard may still not be fully inclusive as it would hardly cover the diverse characteristics of the entire European population (e.g. extremes and outliers would not be included). Therefore, it would be necessary to agree on the acceptable share of the population that would not be adequately protected by the standard.

[34] https://www.corriere.it/salute/muscoli-ossa-articolazioni/23_aprile_28/altezza-italia-non-si-cresce-cittadini-piu-bassi-fe150b86-e4d1-11ed-9767-c520489f6dde.shtml#:~:text=Secondo%20le%20statistiche%20degli%20Ncd,donne%20di%20164%2C6%20cm

[35] Work capacity is the overall ability and capability of the employees to perform their tasks and responsibilities efficiently.

Another aspect that emerged is that **some technical expertise in ergonomics is required to draft and implement inclusive standards** that respect anthropometric differences. For example, many injuries and disorders are acquired over a long period of time. Therefore, it is not only important to consider the movement itself, but also how often it is to be carried out. Besides the mass of an object and the vertical and horizontal location and displacement, there are several contributing factors related to musculoskeletal risks and work capacity related to manual handling, such as the duration and frequency, floor conditions and hand/object coupling, as well as thermal environment. Exposure to vibrations is another important element to consider. It was pointed out that technical committees responsible for drafting standards would benefit from including experts who can inform them on how the standards can be made more inclusive, based on the end users and the context in which it will be applied. At the same time, the industrial sector may want to involve specialised experts capable of interpreting the standard and ensuring that both the worker's performance and their comfort and safety are taken into account.

Furthermore, it was noted that **standards need to be more attractive and widely used**. Once standards are made more relevant from an anthropometric point of view, only their wide use can guarantee more inclusiveness in the way machinery and equipment are designed and manufactured. An idea was even suggested to launch a study on the use of standards. Currently, it is impossible to investigate who is using a particular standard, estimate the number of manufacturers complying with it and determine where they are located. Stakeholders have the perception that the use of standards is still very limited. In a recent study funded by the Dutch Ministry of Social Affairs and Employment on 109 SMEs, product and organisational improvements within companies were found to be driven by performance goals more than by anthropometric considerations. However, improvements made to improve the work environment, make it more suitable and increase work performance also have a positive impact on well-being. Therefore, one possible way to make an anthropometric-adequate standard more attractive is to stress the possible benefits it would bring in terms of company performance.

In conclusion, the discussion focused on how anthropometric science can serve to increase inclusiveness in the practical application of standardisation. Besides increasing safety, the goal is to reduce discomfort, fatigue, physical stress and psychological stress for machinery operators, necessitating a shift in focus when drafting machinery standards. To achieve this goal, the following aspects should be considered.

- Recent anthropometric data that are representative of the standard's target population are needed.
- Ergonomic considerations should be mainstreamed in the standard, but more discussion is needed to agree on the level and detail of prescriptiveness of the standard and the limits of inclusiveness (i.e. the parts of the population for which the standard should aim to be inclusive).
- It is important to stimulate collaboration between all stakeholders, from ergonomists to manufacturers, industry representatives, standardisation experts, workers and end users in order to align incentives for ergonomics/safety and performance/competitiveness.

V.2. Summary of workshop on the standard on measurement of thermal insulation by means of thermal manikins (EN ISO 15831:2004)

The workshop, held on 13 October 2023, focused on the anthropometrics aspects covered by the standard EN ISO 15831:2004 'Clothing – Physiological effects – Measurement of thermal insulation by means of a thermal manikin', supporting the Personal Protective Equipment Regulation (EU) 2016/425. The final agenda is presented below.

TIME	CONTENT
10:00 – 10:30	**Welcome coffee and registration**
10:30 – 10:50	**Introduction** Welcome by the European Commission DG GROW - Mehdi Hocine (Head of Unit H.2 Machinery & Equipment) and Frauke Hoss (Policy officer) Presentation of the study - Emanuela Sirtori (CSIL) Opening the workshop - Raffaele Di Benedetto (CIE)
10:50 – 11:30	**Presentation of the standard and its assessment** Kalev Kuklane (NIPV - Nederlands Instituut Publieke Veiligheid) Alessandra Caputo (CSIL)
11:30 – 12:30	**The relevance of anthropometric data in designing thermal manikins** Francesca Romana D'Ambrosio (University of Salerno) Thomas Hvitved (PT Teknik) Miriam Martinez Albert (Aitex - Spanish Textile Industry Research Association)
12:30 – 14:00	**Lunch break**
14;00 – 15:00	**The relevance of thermal manikin size on consumers and workers' safety** Kalev Kuklane (NIPV - Nederlands Instituut Publieke Veiligheid) Henk Vanhoutte (European Safety Federation)
15:00 – 15:15	**Coffee break**
15:15 – 16:15	**How to make the standard more anthropometrically inclusive?** Open discussion with participants facilitated by Raffaele Di Benedetto
16:15 – 16:30	**Concluding remarks** Raffaele Di Benedetto (CIE) Frauke Hoss (European Commission - DG GROW)

The standard EN ISO 15831:2004 ('Clothing – Physiological effects – Measurement of thermal insulation using a thermal manikin') supports the Personal Protective Equipment Regulation (EU) 2016/425. It 'describes the requirements of the thermal manikin and the test procedure used to measure the thermal insulation of a clothing ensemble, as it becomes effective for the wearer in practical use in a relatively calm environment, with the wearer either standing or moving'. As stated in its scope, 'this thermal insulation, among other parameters, can be used to determine the physiological effect of clothing on the wearer in specific climate/activity scenarios'.

The standard prescribes the **size and shape of the thermal manikin**. It states that 'the manikin, made from metal or plastic, shall be constructed to simulate the body of an adult human, i.e. it shall consist of an anatomically formed head, chest, abdomen, back, buttock, arms, hands, legs and feet. The body height of the manikin shall be (1.70 ± 0.15) m, with a body surface area of (1.7 ± 0.3) m^2. The manikin body proportions should correspond to those required for standard sizes of garments, because deviations in fit will affect the results.' The standard also defines the surface temperature the manikin must maintain and requirements for the controlled climatic chamber and other test procedures.

The assessment carried out by the study team revealed that the standard partially addresses the diversity of the European population but could benefit from further improvements to ensure greater inclusiveness. On the one hand, the standard refers to relevant anthropometric dimensions (i.e. size, structure, composition) and defines **quite large ranges for the manikin size that cover a wide share of the population**. On the other hand, the standard does not distinguish between male and female manikins, nor does it require considering age differences. It has to represent an adult human body, thus excluding children and older people. Another critical aspect relates to data. All the anthropometric-related data included in the standard are provided without an explicit reference to the underlying anthropometric database or study. Overall, **the absence of considerations for female body shapes and diversified**

anthropometrics may pose safety and health concerns for women and other people whose body shapes fall outside the indicated ranges or have different proportions.

The workshop discussion focused on the main shortcomings identified by key stakeholders and the best approaches to overcome them and make the standard more inclusive. The discussion started with detailed considerations on the effectiveness of the standard in evaluating the thermal insulation qualities of garments. It was shown that the assessment of the clothing's insulation properties strongly depends on the fitting to the manikin during the testing phase. Even though this fact seemed widely accepted, some experts pointed out the importance of accounting for physical differences based on gender and body size when assessing the insulating properties of clothing. This is because **specific physiological characteristics influence the fit**, resulting in variations in the average air layer between the body and the clothing, especially when considering a moving body. A larger air layer leads to more favourable measurements of the insulation properties of the garment.

At the moment, manikin manufacturers do not face any challenge in complying with the standards because the required anthropometric ranges are very wide. Therefore, the standard is considered quite generic and very easy to comply with. However, even if manikins could be customised according to users' needs (for example, gender, age, posture), the types of manikins produced and used today by the industry are limited.

First, **the clothing industry seems to prefer testing protective clothing on male manikins** even when it is female clothing. Male manikins are preferred because testing all garments on the same manikin reduces the variation in measurements, so products become more comparable. It was acknowledged that thermal measurements of the same garment might lead to different results depending on the manikin used. Child manikins have occasionally been used by research organisations (as shown in the presentation by the Nederlands Instituut Publieke Veiligheid).

Second, there is a **cost-related challenge** associated with using different types of human manikins, given that their production costs could reach some hundred thousand euro. There are also costs linked to repeating these procedures for different application scenarios. Therefore, given the limited demand from the market for additional tests on non-standard manikins, the prevailing practice remains testing garments or clothing that best fit the manikin in use, i.e. only testing the size of the garment that fits the manikin best, extending the validity of results on the assumption of well-fitting clothing.

Given these considerations, there was a lively discussion in the workshop about whether or not there is a need to introduce **more stringent requirements in the standard**. If included, these requirements should ensure that thermal manikins represent a more diverse range of body shapes to effectively certify the thermal insulation properties of clothing when worn by individuals with varying physical characteristics. Most stakeholders agreed that the current standard should be revised to **distinguish at least between male and female manikin and consider a child manikin**.

The thermal manikin industry is operating in a market with increasing diversification. Manikins are designed based on their intended use, i.e. according to the request of the client. Specific technical and anthropometric factors are considered to most accurately simulate the scenarios and conditions to be analysed. If the standards were to include more stringent requirements, manikin designers would be ready to comply.

The discussion then delved into the **lack of research on the relationship between anthropometrics, garments' thermal insulation properties and clothing fit**. Thermal insulation depends on many different parameters besides those related to anthropometrics (testing conditions, fitting, etc.). As the anthropometric measures most relevant to ensure realistic testing are currently unknown, they cannot be included in the standard. While conducting tests on several conventional manikins covering a broad spectrum of physical characteristics is not feasible because of the high costs, technological advancements, such as computer simulations and cheaper manikin products made possible by additive manufacturing, may help address this challenge. Advanced simulation models developed through research in

anthropometrics and material thermal insulation could assist in creating a more inclusive and, consequently, more effective standard. If a comprehensive anthropometric database was available, manikin designers might exploit simulation and machine-learning algorithms to test the thermal properties of different scenarios. In the future, it is reasonable to believe that, if data and models are created, simulation models might inform tests on manikins, and results from these tests might inform the simulation models.

In this context, **data quality** plays a critical role. Outdated and non-representative data of the population can only lead to an approximation that fails to address the complexity the standard should consider. The results are unacceptable if simulations run on anthropometric databases that are too small.

It was also noted that if this standard is changed, other standards linked to this one will also have to be adapted so they are consistent. **Consistency between all standards**, including between CEN and ISO standards, should be ensured.

In summary, it is clear that when drafting a standard concerning human features, there is a trade-off between the possibility of including a sufficiently broad range of anthropometric characteristics to accommodate diverse end users and the need for precise prescriptions. Such precision is crucial for assessing the thermal insulation properties of clothing, guaranteeing the measurement of comparable and meaningful data. Potentially viable approaches for improving inclusiveness in the standard have been proposed and examined during the open discussion. While increasing complexity raises regulatory costs, scientific research must still attempt to meet the growing need for inclusiveness in regulatory provisions. A proposed approach would consist of **separating the procedure of thermal validation of the textile from the validation of appropriate fitting on different body types**. This two-step process would first analyse the textile-insulation characteristics of the garment without having to use manikins. Then, a second test would apply harmonised provisions and requirements for testing the fit of the clothing on manikins with a more inclusive range of anthropometric characteristics.

Experts with different skill sets, from engineers to specialised ergonomists, should work together to draft the standard.

V.3. List of participants

Table 10 – List of workshop participants

STAKEHOLDER TYPE	ORGANISATION	ROLE	EN 1005-2:2003	EN ISO 15831:2004
Organiser	European Commission – DG GROW (H2)	Head of Unit	Yes	Yes
Organiser	European Commission – DG GROW (H2)	Policy Officer	Yes	Yes
Organiser	CSIL	Partner and Senior Researcher	Yes	Yes
Organiser	CSIL	Partner and Senior Researcher	Yes	Yes
Organiser	CSIL	Researcher	Yes	Yes
Organiser	CIE	CEO	Yes	Yes
Organiser	CIE	Sales Manager	Yes	Yes
Academia	Aalborg University	Professor	Yes	No
Academia	Brno University of Technology	Professor	No	Yes

Academia	Erasmus University Rotterdam	Professor	Yes	No
Academia	Erasmus University Rotterdam	Professor	Yes	No
Academia	TU Dresden	Visiting Professor	No	Yes
Academia	University of Salerno	Professor	Yes	Yes
Expert	VerV	Board Member	Yes	No
Expert	European Commission	HAS consultant	No	Yes
European association	ANEC	Senior Programme Manager	No	Yes
European association	European Platform for Sport Innovation	Executive Director	No	Yes
European association	European Platform for Sport Innovation	Junior Director	No	Yes
European association	European Safety Federation	Secretary General	No	Yes
European association	European Textile Services Association	EU Affairs Manager	Yes	Yes
Manufacturer	Decathlon France	Research & Development Engineer	No	Yes
Manufacturer	Denso Thermal Solutions	EHS Manager	Yes	No
Manufacturer	P.T. Teknik	Sales, Business Development and Administration	No	Yes
Manufacturer	Volvo Truck Center	Prevention Adviser Ergonomics	Yes	No
Manufacturer	Xylem	EHS Manager	Yes	No
Notified body	Aitex	Head of Comfort Department	No	Yes
Notified body	Centexbel	Certification Manager	No	Yes
Regulatory authority	The Swedish Work Environment Authority	Administrative official, specialist in Ergonomics	Yes	No
Research centre	National Institute for NBC Protection	Researcher	No	Yes
Research centre	Nederlands Instituut Publieke Veiligheid	Researcher Occupational Health and Safety	No	Yes
Standardisation organisation	CEN/TC 122	WG 4 Biomechanics Convenor	Yes	No
Standardisation organisation	CEN-CENELEC	Programme Manager	No	Yes
Standardisation organisation	CEN/TC 122	WG 1 AnthropometryConvenor	Yes	Yes
Standardisation organisation	CEN/TC 122	WG 1 Anthropometry Convenor	Yes	No
Standardisation organisation	NEN	Head of Professional development and processes	Yes	No

Workers organisation	KAN	Head of European Representation	Yes	Yes

ANNEX VI – FACTSHEETS ON HIGH-PRIORITY STANDARDS

This Annex contains standardised information for a selection of standards assessed to be a high priority for revision.

EN 894-1:1997

Safety of Machinery - Ergonomics requirements for the design of displays and control actuators - Part 1: General principles for human interactions with displays and control actuators

Machinery Directive

CEN/TC 122 - Ergonomics

EN 894-1 applies to the design of displays and control actuators on machinery. It specifies general principles for human interaction with displays and control actuators to minimise operator errors and to ensure an efficient interaction between the operator and the equipment.

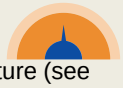
ANTHROPOMETRIC ADEQUACY

EN 894-1 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

The standard considers the human structure. It states that displays and control actuators have to be placed so that they are within the operator's field of vision and consider the positioning of the operator's arm. Moreover, the standard explains that 'body movements that are required to operate control actuators should not cause discomfort for the operator' and that control actuators should be operated equally well with both hands.

Statistical inclusiveness



The standard considers the human structure (see Anthropometrics coverage). However, considerations on the human body are qualitative, and no statistical measures are provided. The standard refers to EN 614-1 for the incorporation of ergonomic principles in the design process.

Transparency

The standard is only partly transparent because it refers to EN 614-1 but without further specifications. An analysis of EN 614-1 would be needed to reconstruct the anthropometric data sources.

Data representativeness

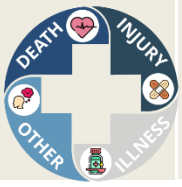
Although the standard qualitatively considers the anthropometric dimensions, it does not recommend taking into account the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 894-1 has a potentially high impact on the health of the European population.

Severity of the impact

Improper considerations of human structure can have potential safety implications. It can result in hazards, such as ergonomic strain, inaccurate operations, limited visibility, unintended activation, and accessibility barriers. When anthropometric differences are overlooked, the displays and control actuators on machinery can pose risks, leading to accidents, injuries and death and jeopardising the overall safety of users.



Reference population

The provisions outlined in the standard are applicable to the design of displays and control actuators on machinery in all sectors where such machinery is used. These sectors cover a wide range of industries, including manufacturing, construction, agriculture and transportation.

EN 12978:2003

Industrial, commercial and garage doors and gates - Safety devices for power operated doors and gates - Requirements and test methods

Machinery Directive

CEN/TC 33 - Doors, windows, shutters, building hardware and curtain walling

EN 12978 covers the design, construction and testing of sensitive protective devices used to detect pedestrians who may be exposed to injury by power-operated doors, gates and barriers, electrically powered from a public supply. The devices are intended for installation in areas in the reach of persons and for which the main intended uses are giving safe access for goods and vehicles accompanied or driven by persons in industrial, commercial, public or residential premises.

ANTHROPOMETRIC ADEQUACY

EN 12978 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

The standard partly covers the relevant anthropometric dimensions. It mentions the working force dimension that might potentially move or deform the active area of a Personnel Sensing Protective Equipment sensing element. However, it does not mention human size, which is key for an accurate detection of pedestrians by sensitive protective devices.

Statistical inclusiveness

The standard specifies that 'the maximum working force shall be compatible with the requirements of EN 14453:2000, annex A', without providing further details. Therefore, a thorough analysis of EN 14453:2000 shall be carried out to properly assess the inclusiveness of the requirements underlying the maximum working force.

Transparency

The standard is partly transparent because it cites EN 14453:2000 to refer to anthropometric-related aspects (but does not provide further specifications). An analysis of EN 14453:2000 would be needed to reconstruct anthropometric data sources.

Data representativeness

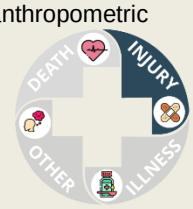
The standard indirectly recognises that the European population might be very diverse in terms of the human body. It explicitly states that some potentially hazardous situations might not be eliminated and so 'particular attention should be given to the risk analysis when small children and/or elderly persons have to be detected'.

IMPACT ON THE EUROPEAN POPULATION

EN 12978 has a potentially high impact on the health of the European population.

Severity of the impact

Improper anthropometric considerations, especially related to human size, can have safety implications, which could indirectly affect the risk of injury. It can result in hazards, such as risk of accidental contact, the slip, trip and fall of people, and reduced accessibility. When anthropometric differences are overlooked, protective devices used to detect pedestrians can pose risks, leading to accidents and jeopardising the safety of users.



Reference population

The requirements set out in the standard apply to sensitive protective devices used to detect pedestrians. These devices are commonly used in residential buildings as well as commercial settings. This implies that the entire population might potentially benefit from the products if inclusively designed and constructed.

EN 15997:2011

All terrain vehicles (ATVS - Quads) - Safety requirements and test methods

Machinery Directive

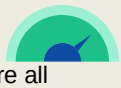
CEN/TC 354 - Light motorized vehicles for the transportation of persons and goods and related facilities and not subject to type-approval for on-road use

EN 15997 applies to the design and construction of all-terrain vehicles (ATVs) using liquid fuels (e.g. petrol, diesel). It deals with significant hazards, hazardous situations and events relevant to ATVs when they are used as intended or misused under conditions that are reasonably predictable.

ANTHROPOMETRIC ADEQUACY

EN 15997 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage



Human size, structure and composition are all relevant and explicitly considered. Generally speaking, the size and structure of individuals influence the design and layout of ATVs to ensure comfortable and ergonomic operations and determine the reach and control capabilities. Human strength and physical abilities are also mentioned to ensure that ATVs are accessible to a wide range of riders.

Statistical inclusiveness

The standard states that a test jig must be used to simulate a person and provides absolute statistical measures that are likely referring to the average man. The ankle height should be 80 mm, the tibia length 420 mm, the femur length 290 mm, the distance from edge to saddle 50 mm, the heel length 90 mm, the length of the front foot part 175 mm, the boot tip height 80 mm, and the total boot height 210 mm.

Transparency

The standard is partly transparent because it refers to other anthropometric-related standards without mentioning the anthropometric data sources. It refers to EN 614-1 ‘Safety of machinery - Ergonomic design principle’ and to EN ISO 12100-2 ‘Safety of machinery - technical principles’, when providing the ergonomic requirements for the design and construction of ATVs.

Data representativeness

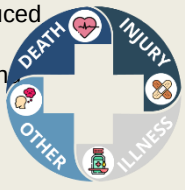
The design of handlebars, footrests, and seat dimensions should consider the existing variability in a rider’s height, arm and leg length, body proportions and weight distribution. However, the standard does not account for the fact that these anthropometric measures might be very different among European individuals.

IMPACT ON THE EUROPEAN POPULATION

EN 15997 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human size, structure, and composition can have safety implications, increasing the risk of injury and mortal accidents. It can result in hazards, such as reduced accessibility, unproper control of the vehicle, and safety and stability issues.



Reference population

The requirements outlined in the standard are applicable to all-terrain vehicles (ATVS - Quads) that are used in many working environments. These include industrial and commercial settings, research and rescue operations, farming and agriculture, and recreational activities and sports.

EN 50636-2-100:2014

Household and similar electrical appliances - Safety - Part 2-100: Particular requirements for hand-held mains-operated garden blowers, vacuums and blower vacuums

Machinery Directive

CLC/TC 116 - Safety and environmental aspects of motor-operated electric tools

EN 50636-2-100:2014 specifies the safety requirements and verification for the design and construction of handheld mains-operated electrical garden vacuums and garden blower/vacuums (with/without shredding means) and garden blowers for use at and around the home or for similar purposes. Their rated voltage is not more than 250 V single phase.

ANTHROPOMETRIC ADEQUACY

EN 50636-2-100:2014 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

While consideration of the human structure and composition are explicitly considered, considerations of human size are missing. The standard provides details on the test finger, arm probes, and the vibration levels the machine might generate. However, the standard does not mention the relevance of a user's height in designing electrical garden vacuums.

Statistical inclusiveness

The standard defines two arm probes using absolute values. However, absolute value statistics may not ensure the accessibility and safety of all users. The overall tool dimensions might not necessarily align with the anatomical characteristics and physical abilities of users, which might vary extensively.

Transparency

The standard is only partly transparent because it does not cite the anthropometric dataset used to define the test finger and the arm probe. Instead, it refers to other anthropometric-related standards (EN ISO 13857 'Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs') when dealing with apertures and safety distances. That standard shall be analysed.

Data representativeness

Aspects of the human body, such as hand size, grip strength and dexterity, play a crucial role in ensuring that users can securely and effectively hold and manipulate the tool during operation. While this is generally acknowledged, the standard does not account for the fact that these anthropometric measures might be very different among European individuals.

IMPACT ON THE EUROPEAN POPULATION

50636-2-100:2014 has a potentially high impact on the health of the European population.

Severity of the impact

Improper considerations of anthropometrics in designing standards for handheld mains-operated garden blowers, vacuums and blower vacuums can pose significant risks of illness or injuries. It may lead to musculoskeletal disorders (strains, sprains). Additionally, insufficient attention to hand-grip size and vibration control can contribute to hand-arm vibration syndrome, causing discomfort, numbness, and potentially long-term damage to the hands and arms of operators.

Reference population

The requirements set out in the standard apply specifically to handheld mains-operated garden blowers, vacuums and blower vacuums used in both residential and professional gardening environments. These devices are designed to cater to the needs of individuals operating them in various settings, ranging from homeowners using them for personal garden maintenance to professional gardeners. This implies that, apart from children, the entire population might be potentially affected.

EN 60335-1:2012

Household and similar electrical appliances - Safety - Part 1: General requirements

Machinery Directive; Low Voltage Directive

CLC/TC 61 - Safety of household and similar electrical appliances

EN 60335-1 deals with the safety of electrical appliances for household and commercial purposes whose rated voltage is not more than 250 V for single phase appliances and 480 V for other types of appliances.

ANTHROPOMETRIC ADEQUACY

EN 60335-1:2012 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

The standard considers the human composition, specifying that handles should be constructed in a way that minimizes contact between the user's hand and parts of the appliance that exceed specified temperature limits. This ensures thermal safety, especially for appliances that generate heat.

Statistical inclusiveness

The standard provides maximum temperature limits for surfaces like handles, knobs and grips that are continuously held during normal use. However, thermal safety can be affected by anthropometric variations in body composition that determine the sensitivity to temperature and heat. Further analyses are needed to assess whether the selected upper-bound values are safeguarding the entire population.

Transparency

The standard is not transparent because it does not provide references to the data sources employed to set the upper-bound limits.

Data representativeness

The standard states that children and persons with severe disabilities are excluded from the scope of the standard. Instead, it does not include considerations, not even qualitatively, on the fact that adult individuals with thinner or more sensitive skin may be more susceptible to burns or discomfort from higher surface temperatures.

IMPACT ON THE EUROPEAN POPULATION

EN 60335-1:2012 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human composition can have safety implications, increasing the risk of injury.

Reference population

The requirements set out in the standard apply to all household and similar electrical appliances that the entire European population could potentially use.

EN 13087-6:2012

Protective helmets - Test methods - Part 6: Field of vision

Personal Protective Equipment Regulation

CEN/TC 158 - Head protection

EN 13087-6 specifies test methods for the field of vision of protective helmets. These tests aim to assess the helmet's performance as specified in the appropriate helmet standard.

ANTHROPOMETRIC ADEQUACY

EN 13087-6:2012 has an overall low level of anthropometric adequacy.

Anthropometrics coverage

While the standard considers head sizes, it does not mention the relevance of the distance between the eyes and the position of the eyes in the skull. The latter unconsidered dimension plays a key role in defining the field of vision.

Statistical inclusiveness

The standard proposes a graphical representation of how to perform the field of vision test in relation to a generic headform. It states that 'a series of angle templates or other means of assessing angles of visions' without indicating the actual number of tests to be carried out. As far as the size(s) of headforms are concerned, the standard refers to EN 960:2006.

Transparency

The standard is only partly transparent because it does not cite underlying studies regarding the measurement of the field of vision and refers to another standard (EN 960:2006) regarding the size of headforms.

Data representativeness

The standard provides generic considerations on the field of vision without mentioning that it depends on anthropometric measures that might vary across individuals. The visual representation provided shows a generic head without references to age or gender.

IMPACT ON THE EUROPEAN POPULATION

EN 13087-6:2012 has a potentially high impact on the health of the European population.

Severity of the impact

An improper field of vision can have potential safety implications, which could indirectly risk death or injury. Improper field of vision can lead to hazards, such as reduced awareness, impaired depth perception, inadequate hazard detection and decreased reaction time.

Reference population

The requirements set out in the standard apply to all protective helmets that the entire European population could potentially use. Protective helmets might indeed be used in a wide range of human activities, from sport and recreational activities to professional activities.

EN 361:2002

Personal protective equipment against falls from a height - Full body harnesses

Personal Protective Equipment Regulation

CEN/TC 160 - Protection against falls from height including working belts.

EN 361 specifies the requirements, test methods, marking, information supplied by the manufacturer and packaging for full body harnesses.

ANTHROPOMETRIC ADEQUACY

EN 361:2002 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human size and structure are explicitly considered in the standard. Height, weight and body proportions play a crucial role in determining the appropriate harness size. The standard mentions that full body harnesses have to be adapted to the user's body.

Statistical inclusiveness

The standard provides minimum values for determining the breaking strength of the synthetic fibres used for the body harness as well as for the ergonomics of the primary belt. Variations in weight and body structure can, however, affect these factors. Further analyses on the selected lower-bound statistics might be needed to assess their inclusiveness.

Transparency

The standard is only partly transparent because it does not cite underlying studies on the measurement of the field of vision and refers to Section 4.1 of EN 363:2002 for the general requirements for design and ergonomics.

Data representativeness

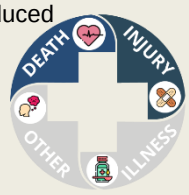
The standard does not include considerations on the diversity of human bodies. However, the relevant anthropometric dimensions may widely vary across users and affect how body harnesses perform.

IMPACT ON THE EUROPEAN POPULATION

EN 361:2002 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human size and structure can have potential safety implications, increasing the risk of injuries and death. It can result in hazards, such as risk of inadequate fitting, restricted range of motion, load distribution issues, anchor-point misalignment and reduced accessibility. An ill-fitting harness can lead to discomfort, breathing difficulties and restricted movement.



Reference population

The standard covers full body harnesses that might be used by a large share of the population. They are used in a wide range of working environments, such as construction and industrial settings, utilities, telecommunications, rescue operations and speleology. They can also be used in recreational activities, such as rock climbing, mountaineering, zip-lining and adventure sports.

EN ISO 20346:2022

Personal protective equipment - Protective footwear (ISO 20346:2021)

Personal Protective Equipment Regulation

CEN/TC 161 - Foot and leg protectors

EN ISO 20346 specifies basic and additional (optional) requirements for protective footwear used for general purposes. It includes, for example, mechanical risks, slip resistance, thermal risks and ergonomic behaviour.

ANTHROPOMETRIC ADEQUACY

EN ISO 20346:2022 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

The standard explicitly considers the human structure. Foot form, toe shape, arch support and impact resistance play a crucial role in determining the effectiveness of protective footwear.

Statistical inclusiveness

The standard uses minimum values for determining the length and height of different components of protective footwear as well as a range of shoe sizes. Human variations in foot size and shape plays a significant role in determining the fit and comfort of protective footwear. Therefore, further analyses shall be performed to assess the adequacy of the selected limit values.

Transparency

The standard is partly transparent because it does not cite the anthropometric dataset used to set the values indicated in the text. However, it refers to Section 5.3.2.1 of ISO 20344:2021, which regulates the 'Test methods for footwear', as toecap requirements are part of the standard.

Data representativeness

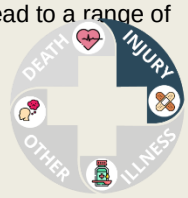
The standard includes statistical measures that do not differentiate between men and women but instead refer to a generic user.

IMPACT ON THE EUROPEAN POPULATION

ISO 20346:2022 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure can lead to an increased risk of injuries. Neglecting the crucial aspects of foot dimensions, comfort and ergonomics in the design process may result in ill-fitting footwear that fails to provide adequate protection and support. This can lead to a range of issues, including blisters, calluses and foot deformities (caused by prolonged friction or pressure points), sprains and fractures.



Reference population

The standard covers protective footwear used for general purposes, implying that they might be potentially used by the entire population in many different settings.

EN 14058:2017

Protective clothing - Garments for protection against cool environments

Personal Protective Equipment Regulation

CEN/TC 162 - Protective clothing including hand and arm protection and lifejackets

EN 14058 specifies requirements and test methods for the performance of garments for protection against the effects of cool environments above −5 °C. These effects comprise not only low air temperatures but also humidity and air velocity.

ANTHROPOMETRIC ADEQUACY

EN 14058:2017 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

The standard explicitly considers the human size and composition. It states that protective garments designed for cool environments need to consider factors such as body surface area. If the garments are too loose or too tight, they may compromise thermal insulation.

Statistical inclusiveness

The standard provides a range of values for determining the thermal resistance of garments under the scope of the standard. The standard also specifies that 'the resulting effective thermal insulation shall be measured with a moving manikin calibrated according to EN 342:2017'.

Transparency

The standard does not cite the specific anthropometric measures used or provide references to the data sources employed to determine the range.

Data representativeness

The standard does not include considerations or data that account for the different human sizes and composition that characterise the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 14058:2017 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure and composition can have potential safety implications that can result in hazards, such as inadequate insulation, restricted movements and even overheating. When the anthropometric differences are overlooked, the safety and effectiveness of these types of garments are jeopardised, potentially leading to discomfort and injuries.

Reference population

The requirements set out in the standard apply to garments against cool environments that the entire European population could potentially use.

EN 14328:2005

Protective clothing - Gloves and armguards protecting against cuts by powered knives - Requirements and test methods

Personal Protective Equipment Regulation

CEN/TC 162 - Protective clothing including hand and arm protection and lifejackets

EN 14328 specifies the requirements for the design, cut resistance, ergonomic characteristics, innocuousness, fixings, construction materials, marking and user instructions for chain mail gloves and armguards providing protection against powered knives. Appropriate test methods are also specified.

ANTHROPOMETRIC ADEQUACY

EN 14328 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

The standards explicitly consider the human structure. The standard specifies that 'gloves shall be marked with their size to the nearest half size and with their length, based on the hand size they are designed to fit'.

Statistical inclusiveness

The standard outlines minimum values for assessing the upward movement allowance of armguards from the wrist when exposed to pulling forces. Therefore, further analyses shall be performed to assess the adequacy of the selected limit values.

Transparency

When providing the definitions of gloves and armguards and the requirements for the sizes of gloves and their marking, the standard refers to part 1 (Chain mail gloves and arm guards) and 2 (Gloves and arm guards made of material other than chain mail) of EN 1082. That standard regulates gloves and arm guards protecting against cuts and stabs by hand knives.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 14328 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of hand and arm structure can have potential safety implications. These can result in hazards, such as inadequate fit, restricted movements or inadequate protection. When the anthropometric differences are overlooked, the safety and effectiveness of these type of garments are jeopardised, potentially leading to discomfort and injuries.

Reference population

The requirements set out in the standard apply to chain mail gloves and armguards that the entire European population could potentially use in daily life.

EN 1827:1999

Respiratory protective devices: Half masks without inhalation valves and with separable filters to protect against gases or gases and particles or particles only-Requirements, testing, marking

Personal Protective Equipment Regulation

CEN/TC 79 - Respiratory protective devices

EN 1827 specifies performance requirements, test methods and marking requirements for half masks (reusable) without inhalation valves and with separable filters (designed for a maximum of single shift use) to protect against gases, gases and particles or particles.

ANTHROPOMETRIC ADEQUACY

EN 1827 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human structure and composition are explicitly considered. Generally speaking, the size and structure of an individual's face play a crucial role in determining the fit and seal of a half mask. It is also important to consider neck strength and respiratory systems.

Statistical inclusiveness

The standard outlines minimum values for assessing breath resistance. The structure of the respiratory system, including lung capacity and airway size, affects the breathability and airflow within the half mask. Therefore, further analyses shall be performed to assess the adequacy of the selected limit values and the extent to which breathing resistance should be adjustable.

Transparency

The standard does not provide references to the data sources employed in its framework.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 1827 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure and composition can have potential safety implications, causing discomfort and increasing the risk of injuries and deaths. It can result in hazards, such as risk of inadequate fit, reduced filtration efficiency, discomfort, impaired breathing and occupational health risks.

Reference population

The requirements set out in the standard apply to half masks that the entire European population could potentially use. The requirements set out are also particularly relevant for workers in certain sectors, such as the chemical sector.

EN 140:1998

Respiratory protective devices - Half masks and quarter masks - Requirements, testing, marking

Machinery Directive

CEN/TC 79 - Respiratory protective devices

EN 140 specifies minimum requirements for half masks and quarter masks for use as part of respiratory protective devices, except escape apparatuses and diving apparatuses.

ANTHROPOMETRIC ADEQUACY

EN 140 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human structure and composition are explicitly considered. Generally speaking, the size and structure of an individual's face play a crucial role in determining the fit and seal of a half mask. It is also important to consider respiratory systems.

Statistical inclusiveness

The standard outlines maximum values for assessing breath resistance. The structure of the respiratory system, including lung capacity and airway size, affects breathability and airflow within the half mask. Therefore, further analyses shall be performed to assess the adequacy of the selected limit values and the extent to which breathing resistance should be adjustable.

Transparency

The standard does not provide references to the data sources employed in its framework.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 140 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure and composition can have potential safety implications, causing discomfort and increasing the risk of injuries and death. It can result in hazards, such as risk of inadequate fit, reduced filtration efficiency, impaired breathing and occupational health risks.

Reference population

The standard specifies provisions for half masks and quarter masks that might be used in different working environments (e.g. industrial and commercial settings, healthcare and medical environments, construction and renovation, laboratories and research facilities, DIY outlets). They serve as a barrier between the user's airway and potential respiratory hazards, increasing personal safety and reducing the risk of respiratory illnesses and occupational hazards.

EN ISO 4007:2018

Personal protective equipment - Eye and face protection - Vocabulary (ISO 4007:2018)

Personal Protective Equipment Regulation

CEN/TC 85 - Eye protective equipment

EN ISO 4007 defines and explains the principal terms used in the field of personal eye and face protection.

ANTHROPOMETRIC ADEQUACY

EN ISO 4007 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

The human structure is explicitly considered in the standard. It refers to the distance between the tangents of the top and bottom of the lens, pupil diameter and the position of the eyes relative to the head.

Statistical inclusiveness

The standard provides a graphical representation of the as-work position, specifying that for testing purposes, 'in absence of any specific instruction, the default headform for adults is 1-M, the interpupillary distance is 64 mm for protectors intended to be used by adults and 54 mm for protectors intended to be used by persons with small heads'.

Transparency

The standard does not provide references to the anthropometric data sources that have been used.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN ISO 4007 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure can lead to several hazards resulting from exposure to optical radiation. For example, it may lead to retinal injury, thermal injury to the crystalline lens and chronic adverse effects to the skin and eye.

Reference population

The requirements set out in the standard define and explain the principal terms used in the field of personal eye and face protection that the entire European population could potentially benefit from.

EN 12778:2002

Cookware - Pressure cookers for domestic use

Pressure Equipment Directive

CEN/TC 194 - Utensils in contact with food

EN 12778 defines terms, establishes manufacturing, safety and functional requirements and corresponding tests, and specifies data for pressure cookermarking, labelling and manuals.

ANTHROPOMETRIC ADEQUACY

EN 12778 has an overall low level of anthropometric adequacy.

Anthropometrics coverage

The standard considers the human structure and composition. As stated in the standard, pressure cookers should have gripper elements so that they can be safely held and used with two hands.

Statistical inclusiveness

The standard provides generic considerations on how anthropometrics should be taken into account (see Anthropometrics coverage). No statistical measures are provided.

Transparency

The standard does not mention studies or other standards supporting the anthropometric considerations included in the text.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 12778 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure and composition can have safety implications, leading to accidents and jeopardising the safety of users. It can result in hazards, such as risk of accidental contact, compromised thermal safety and reduced accessibility.

Reference population

The requirements set out in the standard apply to pressure cookers that are commonly used in European households. This implies that the entire population might be potentially exposed to the identified risks.

EN 50465:2015

Gas appliances - Combined heat and power appliance of nominal heat input inferior or equal to 70 kW

Gas Appliances Regulation

CEN/CLC/JTC 17 - Gas Appliances with Combined Heat and Power

EN 50465 specifies the requirements and test methods for the construction, safety, fitness for purpose, rational use of energy and the marking of a micro combined heat and power (micro-CHP) appliance.

ANTHROPOMETRIC ADEQUACY

EN 50465 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human composition is explicitly considered. Generally speaking, the size, weight and dimensions of a micro-CHP appliance should be designed in relation to human size and composition.

Statistical inclusiveness

The standard provides maximum temperature limits for surfaces, such as knobs, and all the parts that have to be touched during normal use. However, different body sizes, shapes and composition may have varying levels of sensitivity to temperature and heat. Therefore, further analyses shall be performed to assess the adequacy of the selected limit values.

Transparency

The standard is not transparent as it does not cite the specific anthropometric data sources used or provide references to complementary anthropometric-related standards or studies.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 50465 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human composition can have potential safety implications, increasing the risk of accidents and injuries. It can result in hazards, such as electrical physical injuries, electrical shocks, compromised thermal safety and reduced accessibility.

Reference population

The requirements set out in the standard apply to micro-CHP appliances that the entire European population could potentially use. Micro-CHP appliances covered by the standard might be used in household and commercial environments, such as small office buildings.

EN 15502-1:2021

Gas-fired heating boilers - Part 1: General requirements and tests

Gas Appliances Regulation

CEN/TC 109 - Central heating boilers using gaseous fuels

EN 15502-1 specifies the common requirements, test methods, classification, marking and energy labelling for gas-fired central heating boilers that are fitted with atmospheric burners, fan-assisted atmospheric burners or fully premixed burners.

ANTHROPOMETRIC ADEQUACY

EN 15502-1 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human composition is explicitly considered. According to the standard, the size, weight and dimensions of boilers should be considered in relation to human capabilities during installation and placement. The design of user interfaces and controls should align with human capabilities.

Statistical inclusiveness

The standard provides maximum temperature limits for surfaces, such as knobs, and all the parts that have to be touched during normal use. However, thermal safety can be affected by anthropometric variations. Different body sizes, shapes and composition may have varying levels of sensitivity to temperature and heat. Therefore, further analyses shall be performed to assess the adequacy of the selected limit values.

Transparency

The standard is not transparent as it does not cite the specific anthropometric data sources used or provide references to complementary anthropometric-related standards and studies.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 15502-1 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human composition can have potential safety implications, increasing the risk of accident and injury. It can result in hazards, such as electrical physical injuries, electrical shocks, compromised thermal safety and reduced accessibility.

Reference population

The requirements set out in the standard apply to gas-fired central heating boilers that the entire European population could potentially use. Boilers covered by the standard might be used in household and commercial environments, such as small office buildings.

EN 676:2020

Forced draught burners for gaseous fuels

Gas Appliances Regulation

CEN/TC 131 - Gas burners using fans

EN 676 specifies the terminology and general requirements for the construction and operation of forced draught gas burners, the provision of control and safety devices and the test procedure for these burners.

ANTHROPOMETRIC ADEQUACY

EN 676 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human structure and composition are explicitly considered. Generally speaking, the dimensions of the human body play a role in determining the ergonomics, accessibility and safety clearances around these burners. The standard states that 'the design of the burner shall be such that it can be handled safely'.

Statistical inclusiveness

The standard provides generic considerations on how the product should be designed in relation with human structure (see Anthropometrics coverage). Moreover, it also refers to EN ISO 13857 concerning safety distances.

Transparency

The standard is partly transparent because it cites a complementary anthropometric-related standard. On adequate clearance, it refers to EN ISO 13857:2019, which regulates the 'safety distances to prevent hazard zones being reached by upper and lower limbs'. This ensures safe access to the burner components without the risk of accidental contact or injury.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

The EN 676 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure and composition can have potential safety implications, increasing the risk of injury. It can result in hazards, such as risk of accidental contact, compromised thermal safety and reduced accessibility.

Reference population

The requirements set out in the standard apply to gas burners that are commonly used in residential heating systems and commercial settings. Gas burners are used in industrial settings for many applications, including heating in manufacturing processes, industrial boilers and drying operations.

EN 89:2015

Gas-fired storage water heaters for the production of domestic hot water

Gas Appliances Regulation

CEN/TC 48 - Domestic gas-fired water heaters

EN 89 defines the specifications and test methods for the construction, safety, rational use of energy and fitness for purpose, environment and classification and marking of gas-fired storage water heaters for domestic hot water uses.

ANTHROPOMETRIC ADEQUACY

EN 89 has an overall low level of anthropometric adequacy.

Anthropometrics coverage

The standard considers the human composition. Generally speaking, proper consideration of human composition is crucial when designing all the parts that have to be touched during normal use, including the heating of water.

Statistical inclusiveness

The standard provides maximum temperature limits for the surface temperature of control knobs. However, thermal safety can be affected by anthropometric variations. Different body sizes, shapes and composition may have varying levels of sensitivity to temperature and heat. Therefore, further analyses shall be performed to assess the adequacy of the selected limit values.

Transparency

The standard lacks references to studies or data on the anthropometric dimensions of potential users.

Data representativeness

The standard does not include considerations or data that account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 89 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human composition can have safety implications. When the characteristics and limitations of human composition are overlooked, this type of water heater can pose risks, leading to injuries and jeopardising the safety of users in domestic environments. Getting burnt is one of the more common risks.

Reference population

The requirements set out in the standard apply to gas-fired storage water heaters for the production of domestic hot water. This implies that the entire population is potentially exposed to safety risks.

EN 81-22:2021

Safety rules for the construction and installation of lifts - Lifts for the transport of persons and goods - Part 22: Passenger and goods passenger lifts with inclined travel path

Lift Directive

CEN/TC 10 - Lifts, escalators and moving walks

EN 81-22 specifies the safety rules for the construction and installation of permanently installed new electric lifts, with traction or positive drive, serving defined landings levels, having a vehicle designed to convey passengers or passengers and loads, suspended by ropes or chains.

ANTHROPOMETRIC ADEQUACY

EN 81-22 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human size and structure are explicitly considered. According to the standard, the height, width and depth of the lift car need to be calculated to accommodate passengers. Generally speaking, human structure plays a role in determining the required safety clearances in the lift car and around its moving components.

Statistical inclusiveness

The standard uses absolute values for determining the dimensions of the machine room, doors, steps, and guardrails, as well as the intensity of lighting and the strength required to operate controls. Moreover, to define the maximum load the lift can support, it is assumed that each passenger's weight is 75 kg. Distance measures are defined according to EN 13857:2019.

Transparency

The standard is only partly transparent because it does not provide references to data, studies or other standards for most measures included. However, on safety distances between passengers and obstacles, it refers to EN ISO 13857:2019, which regulates the 'safety distances to prevent hazard zones being reached by upper and lower limbs'.

Data representativeness

The standard does not include considerations or data that specifically account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 81-22 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human composition, structure and size can have potential safety implications. It can result in hazards, such as insufficient space, overloading, entrapment, ergonomic challenges and unequal accessibility. By disregarding anthropometric inclusiveness, the likelihood of accidents and injuries increases, while the accessibility and comfort for many users diminish, limiting their mobility and restricting their rights to equal access.

Reference population

The requirements set out in the standard apply to electric lifts that the entire European population could potentially use.

EN IEC 62040-1:2019

Uninterruptible power systems (UPS) - Part 1: Safety requirements

Low Voltage Directive

CLC/TC 22X - Power electronics

EN IEC 62040-1 applies to movable, stationary, fixed or built-in UPS for use in low-voltage distribution systems. They are intended to be installed in an area accessible by an ordinary person or in a restricted access area as applicable.

ANTHROPOMETRIC ADEQUACY

EN IEC 62040-1 has an overall low level of anthropometric adequacy.

Anthropometrics coverage

Human composition, including electrical conductivity and body impedance, is relevant to ensure electrical safety. However, the standard does not consider these dimensions.

Statistical inclusiveness

Not applicable since no anthropometric dimensions are considered.

Transparency

Not applicable since no anthropometric dimensions are considered.

Data representativeness

Not applicable since no anthropometric dimensions are considered.

IMPACT ON THE EUROPEAN POPULATION

EN IEC 62040-1 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human composition can have potential safety implications, increasing the risk of accidents and injuries. It can result in hazards, such as lack of accessibility, risk of fatigue, strain and other injuries.

Reference population

The requirements set out in the standard apply to UPS and switching elements that the entire European population could potentially use in households.

EN 60335-2-27:2013

Household and similar electrical appliances - Safety - Part 2-27: Particular requirements for appliances for skin exposure to ultraviolet and infrared radiation

Low Voltage Directive

CLC/TC 61 - Safety of household and similar electrical appliances

EN 60335-2-27 deals with the safety of electrical appliances incorporating emitters for exposing the skin to ultraviolet (UV) or infrared (IR) radiation for household use and similar uses. It covers appliances whose rated voltage is not more than 250 V for single-phase appliances and 480 V for other appliances.

ANTHROPOMETRIC ADEQUACY

EN 60335-2-27 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human size, structure and composition are explicitly considered. Generally speaking, composition, including skin type and pigmentation, affects an individual's sensitivity and reaction to UV or IR radiation. Human size and structure influence the dosage of UV or IR radiation received by the skin.

Statistical inclusiveness

The standard includes generic considerations on how certain electrical appliances should be designed taking into account the human body. For instance, it states that ‘parts of the appliance that are intended to support a person shall have adequate mechanical strength’.

Transparency

The standard is not transparent because it does not cite the specific anthropometric data sources used or provides references to complementary anthropometric-related standards or studies.

Data representativeness

The standard includes generic considerations acknowledging distinct groups of individuals for whom appliances with UV emitters cannot be safely used. This is due to their anthropometric characteristics, including age, skin type, presence of moles and health conditions.

IMPACT ON THE EUROPEAN POPULATION

EN 60335-2-27 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human composition, structure and size can result in hazards, such as illness and injuries, compromised access to safety measures and reduced accessibility. When anthropometric inclusiveness is neglected, products that provide controlled and safe exposure to UV or IR radiation can increase the risk of skin damage, leading to severe illness and jeopardising the accessibility for many users.

Reference population

The requirements set out in the standard apply to a specific type of electric appliance that the entire European population could potentially use. Electric appliances under the scope of the standard might be used in household and commercial environments, such as tanning salons, beauty parlours and similar premises.

EN 60335-2-14:2006

Household and similar electrical appliances - Safety - Part 2-14: Particular requirements for kitchen machines

Low Voltage Directive

CLC/TC 61 - Safety of household and similar electrical appliances

EN 60335-2-14 deals with the safety of electric kitchen machines for household and similar purposes. These can include bean slicers, berry-juice extractors, blenders, can openers, centrifugal juicers, churns, citrus-fruit squeezers, coffee mills, cream whippers, eggbeaters, food mixers, food processors, grain grinders, graters and ice-cream machines.

ANTHROPOMETRIC ADEQUACY

EN 60335-2-14 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human structure has been explicitly considered. According to the standard, the ergonomics of these machines must account for the dimensions of various body parts, including factors such as their length, reach and physical capabilities.

Statistical inclusiveness

The standard includes generic considerations on how electric kitchen appliances should be designed taking account of the human structure. For example, for slicing machines, it states that 'the thumb guard shall screen the full height of the open sector and be constructed so that the other fingers remain at least 30 mm away from the knife'.

Transparency

The standard is not transparent because it does not cite the specific anthropometric data sources used or provide references to complementary anthropometric-related standards or studies.

Data representativeness

While children are explicitly not covered by the standard, the differences in adults' bodies is not considered in qualitative terms or by any data.

IMPACT ON THE EUROPEAN POPULATION

EN 60335-2-14 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure can potentially lead to safety implications and increase the risk of injuries, jeopardising the accessibility for many users. It can result in hazards, such as injuries, compromised access to safety measures and reduced accessibility.

Reference population

The requirements set out in the standard apply to a specific type of electric appliance that the entire European population could potentially use. Electric appliances under the scope of the standard might be used in household and commercial environments, such as bars, hotels and similar premises.

EN 61058-2-1:2011

Switches for appliances - Part 2-1: Particular requirements for cord switches

Low Voltage Directive; Electromagnetic Compatibility Directive

CLC/SR 23J - Switches for appliances

EN 61058-2-1 applies to cord switches (mechanical or electronic) activated by hand, foot or by other human action to operate or control electrical appliances and other equipment for household or similar purposes. The standard applies to cord switches with a rated voltage not exceeding 250 V and a rated current not exceeding 16 A.

ANTHROPOMETRIC ADEQUACY

EN 61058-2-1 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human structure has been explicitly considered. This is a relevant dimension because properly designed switches enable individuals with varying hand/foot sizes and abilities to conveniently turn appliances on or off.

Statistical inclusiveness

The standard requires a standard test finger to test the switches. However, finger size influences the design of cord switches to ensure accessibility and ease of use. Therefore, the adoption of absolute value statistics may not ensure the accessibility and safety of all users.

Transparency

The standard is partly transparent because it cites a complementary anthropometric-related standard. The standard refers to IEC 61032, which regulates the Protection of persons and equipment by enclosures - Probes for verification, when dealing with the safety of the switches.

Data representativeness

The standard does not include considerations or data that specifically account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 61058-2-1 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure can have potential safety implications, increasing the risk of accidents and injury. It can result in hazards, such as electrical shocks, inaccurate use and lack of accessibility.

Reference population

The requirements set out in the standard apply to cord switches that the entire European population could potentially use in households.

EN 60730-1:1995

Automatic electrical controls for household and similar use - Part 1: General requirements

Low Voltage Directive; Electromagnetic Compatibility Directive

CLC/TC 72 - Automatic electrical controls

EN 60730-1 applies to automatic electrical controls for use in, on or with equipment for household and similar uses, including controls for heating, air-conditioning and similar applications. The equipment may use electricity, gas, oil, solid fuel, solar thermal energy, etc, or a combination thereof.

ANTHROPOMETRIC ADEQUACY

EN 60730-1 has an overall low level of anthropometric adequacy.

Anthropometrics coverage

Human structure and composition are explicitly considered. According to the standard, controls should be designed with considerations for hand size, grip strength, finger and nail strength and a range of movements to allow for comfortable use.

Statistical inclusiveness

The standard provides a standard value for finger and nail strength. Different human structure and composition may have varying levels of strength. Therefore, the adoption of an absolute statistic may not guarantee accessibility and safety for all users.

Transparency

The standard is not transparent because it does not cite the specific anthropometric data sources used or provides references to complementary anthropometric-related standards or studies.

Data representativeness

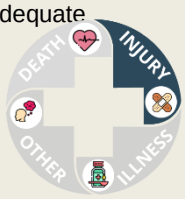
The standard does not include considerations or data that specifically account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 60730-1 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure and composition in ensuring the safety of electric controls can potentially lead to safety issues and increase the risk of injuries, jeopardising the accessibility for many of users. It can result in hazards, such as user errors, inadequate accessibility and safety risks.



Reference population

The requirements set out in the standard apply to a specific type of electric control that the entire European population could potentially use. Electric appliances under the scope of the standard might be used in household and commercial environments.

EN IEC 62368-1:2020

Audio/video, information and communication technology equipment - Part 1: Safety requirements

Low Voltage Directive; Radio Equipment Directive

CLC/TC 108X - Safety of electronic equipment within the fields of Audio/Video, Information Technology and Communication Technology

EN IEC 62368-1 applies to the safety of electrical and electronic equipment in the field of audio, video, information and communication technology, and business and office machines with a rated voltage not exceeding 600 V

ANTHROPOMETRIC ADEQUACY

EN 62368-1 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

Human structure and composition have been explicitly considered through test probes. Generally speaking, the body part dimensions play a significant role in the design of user interfaces, accessibility and ergonomics. Human composition, such as electrical conductivity and thermal comfort, affects electrical and thermal safety.

Statistical inclusiveness

The standard defines accessible parts using standard test probes. However, considerations such as button placement, control accessibility and overall user comfort need to be aligned with human anatomical characteristics, which might vary extensively among individuals. Therefore, the adoption of the standard test probes may not ensure the accessibility and safety of all users.

Transparency

The standard is partly transparent because it cites a complementary anthropometric-related standard. (IEC 62471), which regulates the Photobiological safety of lamps and lamp systems, when dealing with the permitted level of radiation energy. However, no data sources are referenced to support the other statistical measures used.

Data representativeness

The standard includes generic considerations on the diversity of interests among Europeans and acknowledges distinct groups of individuals.

IMPACT ON THE EUROPEAN POPULATION

The EN 62368-1 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human structure can have potential safety implications, increasing the risk of injuries. It can result in hazards, such as electrical shocks, inaccurate use and lack of accessibility. When anthropometric differences are overlooked, electric and electrical equipment can pose risks, leading to accidents or illness.

Reference population

The requirements set out in the standard apply to this type of electrical and electronic equipment that are used in residential houses and working environments.

EN 60825-1:2014

Safety of laser products - Part 1: Equipment classification and requirements

Low Voltage Directive; Radio Equipment Directive

CLC/TC 76 - Optical radiation safety and laser equipment

EN 60825-1 is applicable to the safety of laser products emitting laser radiation in the wavelength range of 180 nm to 1 mm.

ANTHROPOMETRIC ADEQUACY

EN 60825-1 has an overall medium level of anthropometric adequacy.

Anthropometrics coverage

The standard considers the human composition in the main text. Generally speaking, the composition of skin, eyes and other body tissue determines the susceptibility to different wavelengths of laser radiation.

Statistical inclusiveness

The standard includes accessible emission limits that were derived from maximum permissible exposure (see Transparency for more details).

Transparency

Accessible emission limits (AELs), mentioned in the standard, are derived from the maximum permissible exposures (MPEs) whose values are stated in IEC 6 0825, which regulates ‘Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)’. MPE values are based on the best available information from experimental studies.

Data representativeness

The standard does not include considerations or data that specifically account for the diversity of the European population.

IMPACT ON THE EUROPEAN POPULATION

EN 60825-1 has a potentially high impact on the health of the European population.

Severity of the impact

Improper consideration of human composition in ensuring the safety of laser products can potentially lead to safety implications and increase the risk of injuries. It can result in hazards, such as eye damage, skin burns and other biological effects.

Reference population

The requirements set out in the standard apply to laser products that the entire European population could potentially use. Devices under the scope of the standard might be used in industry, business, entertainment, research, education, medicine and in consumer products.

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