



MODULE 5

AGE-FRIENDLY PRODUCT DESIGN

UNIT

2

SAFE AND INCLUSIVE FURNITURE
FOR EVERYBODY

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DESIRE

DESIGN FOR ALL METHODS TO CREATE AGE-FRIENDLY HOUSING

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DESIRE will provide professionals in the building industry and home furnishings sector with the tools and skills to apply Design4All methods as an integral part of the design process, with the aim to create or adapt age friendly housing as a solution for the wellbeing, comfort and autonomy of the older adults or dependents at home.

The DESIRE training platform consists of six modules and 21 units.



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TABLE OF CONTENTS

Age-friendly product design	3
UNIT 2 – Safe and inclusive furniture for everybody	3
2.1 Importance of making safe furniture	3
2.2 Furniture standards	13
2.2.1 What is a standard?	13
2.2.2 Types of furniture testing and assessments	14
2.3 Plural and accessible design	18
2.3.1 Social design	18
2.3.2 Design thinking	21
2.3.3 Strategic design	21
2.3.4 Participatory design	22
2.3.5 Design for all	23
2.3.6 Universal design	24
2.4 Flexible furniture. Versatile systems	26
2.5 Functional dimensions and their measurements methods	28
2.5.1 Seats. Determination of backrest inclination angle, angle between seat and backrest and seat inclination.	28
2.5.2 Office chairs. Determination of dimensions	30
2.5.3 Chairs and tables for educational institutions. Determination of functional dimensions	36
2.5.4 Tables	37
2.5.5 Sofas	37
2.6 Types of furniture	38
2.7 Bathrooms and kitchen elements	40
References	43

AGE-FRIENDLY PRODUCT DESIGN

The goal of this module is to give an overview of product design with a focus on older adults and their household environment. Design matters and is one part of the solution to a more inclusive world in which all people will have equal opportunities for independence, autonomy, and participation.

Within this module, the participant will learn how to incorporate age-friendly product design into their projects given the importance of the group to an ageing or special needs population. The module is designed to involve other types of publics apart from the product designers themselves who may be interested in these issues such as older adults, their relatives or caretakers so that they themselves can create or adapt their homes.

UNIT 2 – SAFE AND INCLUSIVE FURNITURE FOR EVERYBODY

In this unit, we will explain the importance of designing and manufacturing age-friendly furniture products and how to make them safe focusing on the main concepts such as shear and pinch, moving parts, articulated elements, gaps, accessible holes and openings, corners and edges, etc. The topic is broad and covers

many areas of the industry, but we will explain the main regulations that affect seats, tables, support products, beds, outdoor furniture, container furniture, etc. Furthermore, we will talk about plural, accessible and flexible design applied to containers, seated, auxiliary furniture & elements in bathrooms and kitchens.

2.1 IMPORTANCE OF MAKING SAFE FURNITURE

Safety features apply to almost every furniture you can imagine. From chairs, beds, office furniture, to children furniture, the furniture industry manufactures products all the time that surely affects to our safety and quality of life.

For ensuring safety in furniture, manufacturing companies must know about the requirements and considerations regarding the safety, that appears in every furniture standard. These standards include a lot of very different kind of tests, including static, dynamic, and stability. But also, the standards include some

safety requirements. To review the most important concepts about safety concerns in furniture regulations, this list of definitions and requirements is presented:

STANDARD

Security (according to **EN 12520** – Furniture – Strength, durability and safety – Requirements for **domestic seating**)

Requirements of the standard: These are the general safety requirements of this standard:

All the parts of the seat in contact with the user during normal use must be designed so that every damage and physical injury is avoided.

This requirement is fulfilled if:

- Arms, back and seat edges, in contact with the user when sitting, must be rounded or chamfered. All other accessible edges must be free of burrs or cutting zones.
- Ends of hollow components must be closed or covered.

Movable and adjustable parts shall be designed so that injuries and inadvertent operation are avoided.

It shall not be possible for any load bearing part of the seat to come loose unintentionally. All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use.

STANDARD

Shearing and pinching points (according to **EN 12520** – Furniture – Strength, durability and safety – Requirements for **domestic seating**).

Definition: Shearing and pinching points exist if the distance between two accessible parts that move relative to each other is greater than 7 mm or less than 18 mm, in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stop them anytime.
- Shearing and pinching points produced for the action of energy accumulation

mechanisms. Standard says there should be no shear and pinch points in this situation.

- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation.

STANDARD

Security (according to **EN 16139** – Furniture - Strength, durability, and safety - Requirements for **non-domestic seating**).

Requirements of the standard: These are the general safety requirements of this standard:

Seats must be designed so user damage is reduced to the minimum. This requirement is fulfilled if:

- Reachable corners are rounded or chamfered.
- Edges of seat, backrest, and arms, in contact with the user when sitting, are rounded or chamfered.
- Handle edges are rounded or chamfered in the direction of the load application.
- The rest of edges do not have burrs and are rounded or chamfered.
- The ends of the hollow components are closed or covered.

Movable and adjustable parts shall be designed so that injuries and inadvertent operations are avoided.

It shall not be possible for any load bearing part of the seat to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use.

STANDARD

Shearing and pinching points (according to **EN 16139** – Furniture – Strength, durability and safety – Requirements for **non-domestic seating**).

Definition: Shearing and pinching points are produced when distance between two accessible parts that move relative to each other is less than 25 mm and greater than 8 mm, for adults and children up to 3 years old, in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there should be no shear and pinch points in this situation.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation.



Figure 5.2.1 Examples of domestic and non-domestic seating furniture

STANDARD

Security (according to **EN 1129-1** – Furniture – **Foldaway beds** – Safety requirements and testing – Part 1: Safety requirements)

Requirements of the standard: This are the general safety requirements of this standard:

- Construction: all accessible contours and protruding parts shall be rounded and free of burrs or sharp edges. If tubes are used, their ends must be closed.
- Articulated elements: there should be no shear and snag points unless access is protected.

STANDARD

Security (according to **EN 747-1** – Furniture – **Bunk beds and high beds** – Part 1: Safety, strength, and durability requirements)

Requirements of the standard: This are general safety requirements of this standard:

- Accessible edges and corners must be rounded or chamfered and free of burrs and sharps edges.
- There must not be tubes with open ends.
- Manufacturer must perform all connecting and guide holes.
- It must not be possible to disassemble the bed or any of its components without using a tool.

This standard also gives indications (in terms of dimensions) for any part of the bunk bed or high bed that stands out above the top part of the top bed.

- Regarding holes, gaps and accessible openings, the standard gives some dimensions to fulfil, like that any of these must not have a diameter or width more than 7 mm or less than 12 mm, unless the depth is less than 10 mm. Depending on

the analysed zone of the bed, these values will change a little bit.

- Head entrapment on the exterior of the bunk or the high bed. The standard defines a “V” tool needed for checking this safety requirement:

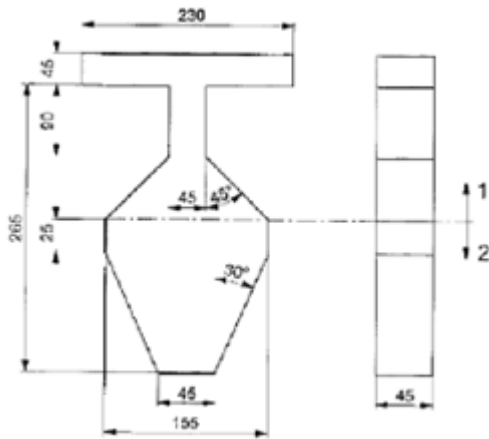


Figure 5.2.2 Template for “V” shaped openings

Finally, this standard gives some safety indications regarding the bed basis, in terms of tests and dimensions to fulfil, as well as for safety barriers and stairs or any mean of access.



Figure 5.2.3 Example of bunk bed

STANDARD

Security (according to **EN 1725** – Domestic furniture. **Beds and mattresses**. Safety requirements and test methods)

Requirements of the standard: These are general safety requirements of this standard:

- All bed components or parts that can contact the user in a normal use, must not have any burr and/or sharp edge, or tubes with open ends.
- When the bed is fully assembled and ready to use, all accessible mechanisms that ease the bed structure movement, must have a safety distance between any two elements that moves relative to each other, of ≤ 8 mm or ≥ 25 mm.
- When there is a specific danger for feet to get trapped in a mobile part, safety distance must be ≥ 100 mm from the floor.



Figure 5.2.4 Bed and mattress



Figure 5.2.5 Example of an office screen

STANDARD

Security (according to **EN 1023** – Office furniture – **Screens** – Part 2: Mechanical safety requirements)

Requirements of the standard: This are general safety requirements of this standard:
Screens must be designed so that the injury risk to the user is reduced.

All parts of the screen the user can contact in normal use conditions must be designed so that the risk of body accident or material damage is minimal. These requirements are fulfilled if:

- Accessible corners are rounded with a minimum radius of 2 mm.
- Edges that can contact the user are rounded with a minimum radius of 2 mm.
- The rest of edges are polished and have no burrs.
- The ends of hollow elements are closed or covered.
- Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

Also, the standard indicates that the manufacturer must suggest in the instructions the way of using screens in combination with additional elements, as well as the admissible charge for each kind of screen.

STANDARD

Security (according to **EN 12521** – Furniture – Strength, durability and safety – Requirements for **domestic tables**)

Requirements of the standard: This are general safety requirements of this standard:
The table must be designed so that the injury of damage to the user is reduced to the maximum.

All those parts of the table that can contact the user in a normal use, must be designed so every physical injury and damage is avoided. These requirements are fulfilled if:

- Edges of the table top in direct contact with the user are rounded or chamfered. All other accessible edges in a normal use must be free of burrs or cutting zones.
- The ends of hollow elements are closed or covered.

Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

It shall not be possible for any structural part of the table to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use of the table.

STANDARD

Shearing and pinching points (according to **EN 12521** – Furniture – Strength, durability and safety – Requirements for **domestic tables**)

Definition: Shearing and pinching points are produced when the distance between two accessible elements that move relative to each other is less than 18 mm or more than 7 mm in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation, or when moving the table.

STANDARD

Security (according to **EN 15372** – Furniture – Strength, durability and safety – Requirements for **non-domestic tables**)

Requirements of the standard: This are general safety requirements of this standard:

The table must be designed so that the injury of damage to the user is reduced to the maximum.

All those parts of the table that can contact the user in a normal use, must be designed so every physical injury and damage is avoided. These requirements are fulfilled if:

- Edges of the table top in direct contact with the user are rounded or chamfered.
- All other accessible edges in a normal use must be free of burrs or cutting zones.
- The ends of hollow elements, with diameter greater than 7 mm and smaller than 12 mm, and accessible depth greater than 10 mm, are closed or covered.

Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

It shall not be possible for any structural part of the table to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use of the table.

STANDARD

Shearing and pinching points (according to **EN 15372** – Furniture – Strength, durability and safety – Requirements for **non-domestic tables**)

Definition: Shearing and pinching points are produced when the distance between two accessible elements that move relative to each other is less than 18 mm or more than 7 mm in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation.

- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation, or when moving the table.

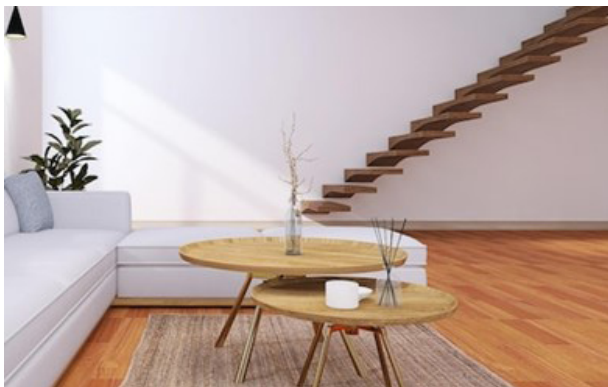


Figure 5.2.6 Domestic tables

STANDARD

Security (according to **EN 16121 – Non-domestic storage furniture** – Requirements for safety, strength, durability and stability)

Requirements of the standard: This are general safety requirements of this standard: The storage furniture must be designed so that the injury of damage to the user is reduced to the maximum.

All those parts of the furniture that can contact the user in a normal use, must be designed so every damage is avoided. These requirements are fulfilled if:

- Accessible parts are rounded or chamfered, and all accessible edges during normal use, do not have burrs or cutting edges.
- Feet of tubular components must be covered or closed in any way.
- Open ends of tubular components, reachable during normal use, must be covered or closed in any way.

Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

It shall not be possible for any structural part to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use of the product.

If they can produce any damage, tambour doors and vertical sliding doors, including those built with hinged elements, must not be able to move by themselves from any position placed at a height above 200 mm measured from the closed position.

To avoid point in where feet can be trapped, safety height for mobile parts of vertical displacement must be greater or equal to 100 mm from the floor.

No removable element or tray can be detached from the furniture when a extraction force of 200 Newtons is applied to the handle of the loaded removable element or tray.

This standard also mentions special requirements for:

- Horizontal hinged covers
- Glass vertical components

STANDARD

Shearing and pinching points (according to **EN 16121 – Non-domestic storage furniture** – Requirements for safety, strength, durability and stability)

Definition: Shearing and pinching points are produced when the distance between two accessible elements that move relative to each other is less than 25 mm or more than 8 mm in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation, except for doors, folding covers and removable elements and their fittings.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation, except for doors, folding covers and removable elements and their fittings.



Figure 5.2.7 Storage furniture

STANDARD

Security (according to **EN 1729 – Furniture – Chairs and tables for educational institutions – Part 2: Safety requirements and test methods**)

Requirements of the standard: These are general safety requirements of this standard:

- Arms, backrest and seat edges, in contact with the user when sitting, must be rounded with a minimum 2 mm radius, or chamfered.
- Edges of handles must be rounded with a

minimum 2 mm radius, in the direction of the application of the force.

- All other accessible edges and corners that can contact the user in a normal use must be soft, rounded, or chamfered, and free of burrs.
- Distance between accessible mobile parts, actuated by the action of energy accumulation mechanisms, like gas cylinder for example, must be always < 8 mm or ≥ 25 mm.
- There must not exist accessible gaps > 8 mm and < 25 mm, produced in normal use, except during colocation and folding of tables and chairs.
- Regulation controls must not be activated inadvertently or accidentally.
- Open edges and ends of tubular components must be covered or closed.
- The different parts of the furniture must not be possible to disassemble without using the proper tools.
- Those parts of the furniture that are lubricated, must be covered to avoid stains.
- The finishing of the work surface must not exceed matt-silky (which is 45 units of brightness or an inferior value of 20 determined by a reflectometer at 60°), in order to reduce to the minimum, the specular reflection according to EN 13722 at 60° .

Standard also defines safety stability, strength and durability tests for both chairs and tables.



Figure 5.2.8 Chairs and tables for educational institutions

STANDARD

Security (according to EN 581-1 – Outdoor furniture – **Seating and tables for camping, domestic and contract use** – Part 1: General safety requirements)

Requirements of the standard: These are general safety requirements of this standard:

For avoiding physical damage when the product is in use configuration, all edges and corners must be rounded, chamfered, or protected in any way. This applies to:

- Seats: Edges of seat, backrest and arms, and any part of the inferior side of the seat positioned at a distance lower than 120 mm of any edge, where a finger can easily access.
- Tables: Top of the table, any part of the inferior side of the top of the table positioned at a distance lower than 500 mm of any edge below the table, where the knee and/or the arm can easily access.

The rest of the furniture parts must be free of burrs and cutting zones.

Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

It shall not be possible for any structural part to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use of the product.

Tubular components. The standard also gives some requirements for these components:

- There must not be accessible holes in the ends of tubular component with diameter between 7 mm and 12 mm, and depth more or equal to 10 mm.
- The end of tubular legs in contact with the floor must be covered or closed. However, holes are allowed if there are not between 7 mm and 12 mm.

The standard defines some test probes so all these requirements can be checked:

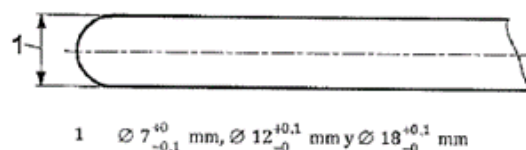


Figure 5.2.9 Definition of measurement test probes

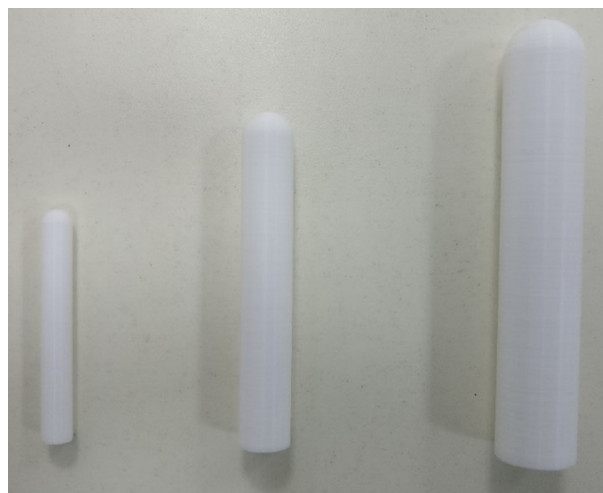


Figure 5.2.10 Example of the three measurement test probes

STANDARD

Shearing and pinching points (according to EN 581-1 – Outdoor furniture – **Seating and tables for camping, domestic and contract use** – Part 1: General safety requirements)

Definition: Shearing and pinching points are produced when the distance between two accessible elements that move relative to each other is greater or equal to 7 mm and lower or equal to 18 mm, in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control

the movements and stopping them anytime.

- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation. Test probes must be used for checking this requirement.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation.



Figure 5.2.11 Outdoor/camping chair

STANDARD

Security (according to **EN 1335-2** – Office furniture – **Office work chair** – Part 2: Safety requirements)

Requirements of the standard: This are general safety requirements of this standard: Chair must be designed so the risk of injuries to the user is minimized.

All those parts of the chair that can contact the user in a normal use condition, must be designed so physical injuries and material damage are

avoided. These requirements are fulfilled if:

- Armrests, backrest and seat edges in contact with the user when sitting are rounded with minimum 2 mm radius.
- Edges of adjustment mechanisms are rounded or chamfered in the direction of the applied force.
- All other edges and corners are free of burrs and are rounded or chamfered.
- Ends of tubular components must be covered or closed.

Mobile or adjustable parts must be designed so injuries or involuntary operation are avoided. It must be possible to actuate the adjustment devices from the sitting position in the chair. It must not be possible to involuntary lose any load support part of the chair.

STANDARD

Shearing and pinching points (according to **EN 1335-2** – Office furniture – **Office work chair** – Part 2: Safety requirements)

Definition: Existing point if the distance between two accessible elements that move relative to each other is lower than 25 mm and greater than 8 mm, in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation.

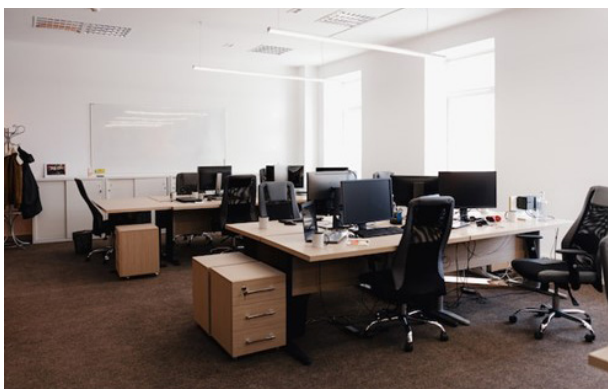


Figure 5.2.12 Office furniture, and office work chairs

2.2 FURNITURE STANDARDS

All kind of furniture are shown in showrooms, retails and fills all kind of commercial and also residential spaces. We use furniture to help our homes, offices, etc. to be more liveable, comfortable and also functional. At the same time, we trust these products meet our expectations of performance, comfort, safety and wellness.

For that, it is necessary to navigate local and national regulatory requirements, meet customer specifications and efficiently respond to market demands. Collectively, these efforts help manufacturers remain competitive and help to make a safer, more sustainable future for the furniture industry.

2.2.1 What is a standard?

IN A NUTSHELL

Definition of standard: A standard is a technical document of repeated or continuous application, which establishes the conditions and characteristics to be

met by a product for its acceptance in the market. In principle, they are not mandatory, but it may be, as they are referred to some directive or regulation.

Furniture contributes to the functionality and usefulness of every inhabited space, including commercial and institutional settings, residential environments, and retail establishments, as well as outdoor recreational areas. As general living standards continue to

improve for billions of people around the world, the global demand for furniture and furniture products is expected to experience continued strong growth and provide important business opportunities for furniture manufacturers.

However, to effectively capitalize on these market opportunities, furniture manufacturers today are required to meet a broad set of compliance challenges that may include safety, product performance and environmental considerations to gain market acceptance. Specific compliance issues may include performance and mechanical requirements, flammability, exposure to potentially harmful chemicals, and product safety. Furniture products intended for specific user groups such as children are often subject to additional testing and evaluation. And specific procurement requirements and buyer expectations may further add to the testing and assessment that furniture manufacturers must address.

The furniture industry produces a wide range of products used in commercial and residential settings. The major categories of furniture include:

- Office Furniture. Including desks, seating, storage units, etc.
- Household furniture
- Bedding and mattresses
- Children furniture. Including beds, cribs, bunk beds, mattresses, etc.
- Commercial displays and retail furniture

IN A NUTSHELL

Organisation in charge of making standards:

- ISO, of international level.
- CEN, for CEE and EFTA countries.
- National organisms for other countries, like AENOR, for Spain.

Among normative texts, ISO standard is the most universal one. Also, there are national organisms for making standards:

- AENOR (Asociación Española De Normalización y Certificación).
- BSI (British Standard Institution).
- AFNOR (Association Française de Normalisation)
- ANSI (American National Standards Institution)
- Etc.

2.2.2 Types of furniture testing and assessments

All the existent furniture standards are referred to one of these aspects: dimensions and shapes, suitable materials, testing (strength, stability, quality, durability...).

The scope of testing and conformity assessment applicable to a specific furniture product is determined by several factors and can vary significantly from product to product. However, there are several important types of testing to which most furniture products are subjected. The following sections describe a little bit each of these tests:

- **Performance:**

This kind of testing is intended to evaluate a furniture product's ability to withstand wear and tear under normal, anticipated use. A good example of these tests can be durability tests.

DO YOU WANT TO KNOW MORE ABOUT...

EN 13759 – Furniture – Operating mechanisms for seating and sofa-beds – Test methods. The scope and field of application of this standard is to establish the test methods

for establish the durability of the tilting, both manual and automatic, of seating for adults, and also the durability for converting sofas into beds.



Figure 5.2.13 Some furniture material tests

- **Mechanical Testing:**

They are intended to evaluate the mechanical aspects of a furniture product and to identify product aspects that could lead to mechanical failure, thereby posing a potential safety risk to consumers. While not a specific regulatory requirement, mechanical testing can demonstrate a manufacturer’s commitment to safety and provide a defense against claims of unsafe products. For example, structural tests can assess a furniture product’s static

and dynamic load-handling ability, deflection characteristics, swivel duration, and general strength and stability.

In this category they are included mechanical safety testing, that assesses risks associated, for example, with sharp points and edges, entrapment of fingers and others, shearing and pinching points, etc.

DO YOU WANT TO KNOW MORE ABOUT...

EN 1022 – Furniture – Seating – Determination of stability. The scope and field of application of this standard is to determine the stability

of all kind of seats for adults up to 110 kg, regardless the use, materials, design or manufacturing process.



Figure 5.2.14 Office chair being mechanically tested

- **Electrical safety:**

Many furniture products incorporate electrical or electronic components to provide more functionality, like illumination, operation, control of features, etc. These products are subject to mandatory testing for electrical safety in most jurisdictions. The goal of electrical safety testing is to identify potential

electrical hazards, and to evaluate how a product's design or construction eliminates or minimizes the risk of fire or shock. Testing for electrical safety is typically conducted in accordance with the requirements of those standards applicable to specific categories of furniture products.

DO YOU WANT TO KNOW MORE ABOUT...

IEC 60335-2-116:2019 – Household and similar electrical appliances – Safety – Part 2-116: Particular requirements for furniture with electrically motorized parts. This part of

IEC 60335 deals with the safety of furniture with electrically motorized parts intended for household and similar purposes, their rated voltage being not more than 250 V.

- **Flammability:**

Furniture products are usually composed of materials that are potentially flammable, such as wood and upholstery fabrics, adhesives, paints and varnishes. As a result, furniture products can serve as a primary ignition point or fuel source for indoor fires. For these reasons, most jurisdictions require flammability testing for fabrics and upholstered furnishings. Flammability testing evaluates the suitability of materials for use in furniture products by assessing their resistance to the effects of heat

or flame as well as their burn and heat release characteristics. Specific types of flammability testing can include:

- Ignition testing. It determines a furniture material's resistance to ignition when exposed to heat or open flame.
- Flame spread testing. It evaluates the speed at which fire spreads from first ignition.
- Heat-release characterization. It assesses the amount of heat build-up contributed by burning furniture.

DO YOU WANT TO KNOW MORE ABOUT...

EN 1021-1 – Furniture – Assessment of the ignitability of upholstered furniture – Part 1: Ignition source smouldering cigarette. This standard describes a test method for

evaluating the flammability of different combinations of materials, when the source of ignition is a smouldering cigarette.

- **Environmental Sustainability:**

Increasingly, product specifiers, procurement specialists and consumers are demanding “green” furniture products, i.e., products made with more sustainable materials, or products that have been produced using methods and processes that have reduced environmental impact. Furniture that has been evaluated for environmental sustainability can contribute qualifying points under several green building certification initiatives. Further, evidence of environmental sustainability can address the interests of consumers and help manufacturers distinguish their furniture products in a competitive marketplace.

containing products manufactured, imported, or sold in the EU.

Given the wide range of furniture products and the complex and sometime confusing and conflicting regulatory process, manufacturers can be confused as to how to evaluate their own furniture. It is highly advised to **understand regulatory requirements and market demands**, because Furniture and furniture products are subject to varying regulatory requirements that differ from jurisdiction to jurisdiction. The regulatory landscape is further complicated by the various types of furniture products and how individual products are categorized under the applicable requirements.

- **Chemical Content and Chemical Emissions:**

The use of chemicals in furniture and the control of chemical emissions from furniture products are tightly regulated in most jurisdictions worldwide. European Union (EU) Regulation (EC) No. 1907/2006, also known as the REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) Regulation, is applicable to most chemicals and chemical

To successfully navigate this complex landscape, furniture manufacturers should develop a thorough understanding of the regulatory requirements applicable to their specific products in any targeted jurisdictions, and continuously monitor regulatory developments to avoid surprises.

It is also important to **know the required and recommended testing when products are being developed**. Identifying applicable tests and assessments at the earliest possible stages of the product development process can result in product design and materials selections that contribute to better test outcomes and reduce the likelihood of unexpected setbacks that require product redesign.

Furniture manufacturers should consider to partnering with independent test laboratories, that are depth involve in furniture testing field.

2.3 PLURAL AND ACCESSIBLE DESIGN

2.3.1 Social design

Since the origins of design as a profession, visions of design as a mode of action focused on solving problems. People and society's needs have been linked to the evolution of the discipline.

The role of design as a social actor has been transformed in parallel with the changes that society has undergone. Design is directly related to the technical and industrial development that has caused profound changes in the social environment and is associated with market forces, but since its beginnings, proposals, orientations and initiatives have emerged that reflect an awareness of the problems and needs of society. Design recognises its responsibility for the future of humanity and the planet's resources, and therefore proposes approaches that go beyond satisfying the needs of the market. Thus, design becomes a social, environmental, cultural and political actor.

This design orientation has been named "social". Different definitions can be attributed to the term social design, as there is no common language to unite ideas among the professionals themselves.

Undoubtedly, design is a social activity as it is intrinsically a collaborative action involving several groups of people among the design team itself, such as clients, users, manufacturers or consultants. Moreover, the aim of designed products is to be of use and to become part of the dynamic structure of our daily activities, but in this perspective, the social is only approached from the materiality or the physical.

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The main objective of social design is to satisfy human needs, as opposed to market design, whose main objective is the creation of products for sale. The term "social" in design

stands for being at the service of society. Therefore, it refers to a design practice or area of design committed to solving social problems.

It should be noted that, although many of the products designed from a market approach may satisfy a social need, this is not their priority, leaving out of their range some groups of people, either because of their income level or because of their specific needs delimited by their conditions of age, health, disability or habitat.

METHODS. HUMAN-CENTERED DESIGN

Since the end of the 20th century, a humanistic vision of design called Human-Centered Design (HCD) has been consolidated. This vision focuses on the design of experiences rather than the design of objects. Its foundation is the deep understanding of people's needs and aspirations to be impacted through design actions in design. According to IDEO.org (2014), HCD is a process and a set of techniques used to create innovative solutions, which include products, services, spaces, organisations and modes of interaction.

The desirability dimension is assumed as a perspective throughout the design process and, based on its identification, proposals are constructed and evaluated in the light of what is technically feasible and economically viable.

It is one of the most common methods when considering a project from a social design perspective by seeking various ways of understanding the members of a community and their needs, creating innovative responses and implementing them, considering financial, technical and social sustainability.

The term social design brings together different approaches that direct their efforts towards the same objective: to find solutions or provide creative responses to the problems that afflict a community, being of a diverse social nature, such as the dissatisfaction of needs or the expression and demand for their rights and freedoms.

The process of this method starts with the identification of a specific challenge to be solved and goes through three main phases: listening, creating and delivering. During the process, it iterates between specific observations, abstract syntheses and the design of concrete solutions.

- In the listening phase, the design team collects stories, anecdotes and inspirations and prepares the research and fieldwork.
- The create phase is the most robust phase of the process and involves gathering what has been observed in people and putting it into theoretical frameworks, opportunities, solutions and prototypes, moving from concrete thinking to more abstract thinking in identifying issues and opportunities, and then back to the concrete through solutions and prototypes.
- In the delivery phase, solutions are defined and evaluated in the light of financial modelling, resource and capacity assessment and implementation planning.

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SOCIAL DESIGN FUNCTIONS

Social Innovation

Generate and strengthen the abilities of people, institutions and societies to perform their functions, solve problems and achieve objectives in a sustainable way, fostering joint learning and the exchange of resources between all the actors involved in social dynamics. It also favours the creation of opportunity structures to empower citizens in the creation and organisation of spaces for dialogue and action that reinforce their basic rights and freedoms.

From a Social Design perspective, it should be about triggering and supporting social change and thus promoting social innovation. Design for social innovation implies a socio-technical transformation driven by social change. The designer must use empathy to recognise and understand the contributions and complexity of the environment in which their reality develops, from their place in a multidisciplinary team, he must contribute his integrating vision and promote the exchange of knowledge.

Social responsibility

From the perspective of social design, one of the main handicaps is to find coherence and balance between the ethics and social and environmental responsibility of the designer's profession, with innovation and technological and scientific development.

On most of occasions, the professional practice is driven by the demand of a client with the aim of obtaining an economic response. However, every designer should have the social awareness to understand that his or her product provides qualities that go beyond marketing, beyond the impulse of a commercial transaction, and must, therefore, provide added value to the product in relation to its usability. The challenge lies in reconciling

and articulating the two qualities of design, the impulse of consumption and the social value of the product.

John Thackara (2005) called this challenge "conscious design". It has the following features:

- Pre-implementation analysis of the consequences of actions, paying particular attention to the natural, industrial and cultural systems present in the context in which the actions are carried out.
- Consider materials and energy resources involved in the systems to be designed.
- Treat content as what we make, not what we sell.
- Work with place, time and cultural differences as positive values.
- Focus on services rather than things, and refrain from flooding the world with meaningless artefacts.

Activism

In this context, activism is understood as the promotion of actions that involve the public expression of criticism, dissatisfaction and dissent against the government, regime or system and that seek to create conditions for change. As a citizen, the designer is called to participate in the political, social and cultural spheres. From the perspective of activism, the designer must influence and intervene in decision-making.

In this case, it is difficult for social design to take on an activist function, as it is a product that is the result of a commission and must build tools for the education and participation of citizens, propose new forms of social welfare, serve as a channel for critical expression and social denunciation, present, comment on and make visible issues that are ignored or blocked by the dominant system or regime.

2.3.2 Design thinking

Design thinking is a process for creative problem solving and solution creation with the intention of achieving a better future outcome. It is a solution-focused (not problem-focused) way of thinking and solving that emerges with the establishment of a goal.

This approach differs from the analytical scientific method, which starts with the definition of the problem's parameters in order to devise a solution. Both known and ambiguous aspects of the current situation are identified and investigated in order to uncover hidden parameters and open up alternative pathways. Design thinking is iterative, as it looks for different starting points and paths to find alternative solutions, including redefining the initial problem.

Design thinking is especially useful for tackling problems that are not defined correctly or are very complex. This definition fits well with the nature of social problems, where it is difficult to determine solution paths and requires much more than specific, technical knowledge about a situation.

According to Amalio Rey (2011), it is an anthropological approach that does not focus on the person or their role as a client, but rather on appreciating them from an integral approach that allows us to understand what they experience, how they experience it and how it affects their lives, what is designed or proposed as a solution.

The process starts with a problem statement and an analysis of the needs, the relationship to the context and the behaviour of the people involved. Then, ideas are developed, and solution paths are proposed without setting limitations. These, once selected, filtered and/or mixed, are expressed through rapid prototypes or sketches where, after successive feedback, an innovative and sustainable solution will be obtained. According to Herbert Simon (1996), this method can be summarised as follows: define, research, devise, prototype, choose, implement and learn.

2.3.3 Strategic design

Strategic design is the application of systematic challenge-oriented design principles, which enhances an organisation's innovative qualities and competence for the future. It redefines how to address problems, identifying opportunities for action and leveraging more comprehensive and resilient solutions.

According to Prodiotec (2009), strategic design is a new way of designing in a mutant context, where the boundaries of disciplines and typologies of problems to be solved are in

permanent hybridisation and interaction. It is based on the analysis of external and internal data and trends, which allows for fact-based design decisions. As such, it is considered an effective way of connecting innovation, research, management and design.

Strategic thinking makes it possible to detect the connections, signs and rituals in the relationships between actors, natural and artificial systems, and thus to mediate and link private, public, political and community

entities. It proposes the establishment of common objectives among the actors involved and a language that allows them to work and cooperate. It is understood as a process that is not only carried out by designers but has a transversal orientation.

These characteristics mean that strategic design is used as an instrument for the development of social projects, as it gives priority to a systemic vision of both the problem and the organisation, and promotes the transfer and exchange of knowledge, cooperation, commitment and sustainability.

2.3.4 Participatory design

Faced with the need to address social problems and needs, participatory design emerges as a way of linking and integrating users in the planning, decision making and implementation of solutions. The opinion of social groups has the power to give meaning to and reflect their needs and thus contribute to the implementation of better solutions based on collective decisions.

Participatory design can be understood as the articulation of factors in favour of the construction of a solution through a process that links design and planning professionals with users or beneficiaries for the collective construction of a solution in which, directly or indirectly, they will be involved or affected.

This work dynamic requires the designer to acquire and implement skills and knowledge that allow him to be a promoter, advisor and negotiator between the members of the community and the entire organisational or productive bureaucratic apparatus.

DIVERSITY OF USERS

The design of a product, system or service is not simply a case of designing to the specifications required for a "standard" person, as there is no exact equality between any human being. Some differences between people are innate and last a lifetime, some may be occasional, while others develop slowly over time. Whatever the reason, differences between individuals must be taken into account in any design.

When creating, designing or proposing a product, object or service, the user is one of its fundamental pillars, since it is up to him to keep it 'alive'. When considering the needs approach, the greatest possible integration of the different groups of people should be the objective. The non-integration of a group of people harms both sides of the system; on the one hand, the company misses the opportunity to generate profits from as many users as possible, on the other hand, there is a group of users who do not benefit from the product or service.

USER RESEARCH

When researching a user group, different techniques can be used to derive the needs of the users. By means of research techniques, habits, behaviours, needs, desires or demands can be found out. The different research techniques can be surveys, interviews, expert analysis, forums or assemblies, where users or specialists discuss within the parameters of the research, social indicators, being these the main ones (Moreno, 2007).

DIFFERENCES BETWEEN PEOPLE

The normal distribution governs most of the quantifiable human attributes (especially physical characteristics). This distribution is found throughout nature and is represented by the figure below:

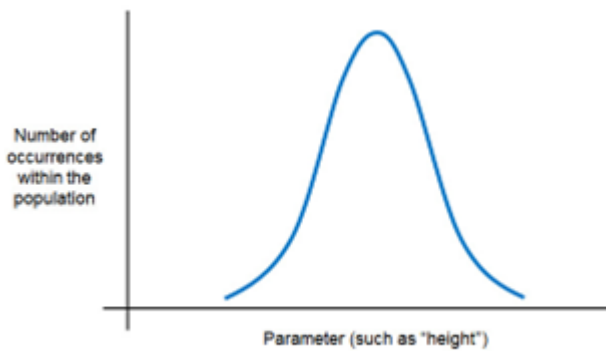


Figure 5.2.15 Average value of the parameter height within the population

This shows that the average value within a population will be the most common, with more extreme values progressively less common. There is no such thing as a so-called "normal person", as it is almost certain that no living being is exactly average in all possible parameters. Instead, the population is made up of individuals who may be above or below in the distribution of some parameters.

AGE-RELATED DIFFERENCES

As people age, their senses and faculties change. Senses such as sight and hearing are affected, but also aspects such as mobility or mental speed. In younger users, senses generally work well, but cognitive abilities may not be at an adequate level, which can affect decision-making.

To learn more about different characteristics that influence our perspective on older people read the Module 1, Unit 2.

SOCIAL AND CULTURAL DIFFERENCES

Such differences are often noticeable and more difficult to quantify than age-related differences. Their impact can be predicted up to a certain level.

DO YOU WANT TO KNOW MORE ABOUT...

CONSIDERATIONS.

WORST-CASE SCENARIO DESIGN

In the design of a door, it would be an absurd mistake to use the average height of the distribution, as it would exclude almost half

of the users. In this case, the door should be designed to accommodate the tallest users, as this does not limit any of them.

2.3.5 Design for all

Sometimes it is not possible to provide a joint solution. A percentile solution is often adopted in order to provide a solution to the largest number of users, trying to find a range centred on the distribution. For example, with a percentile from 5th to 95th that would provide a solution to 90 % of the population, it should be evaluated how it affects the people who have

not been covered and see if they are acceptable or if a complementary solution should be provided or a totally different solution should be sought.

To learn more about different design paradigms, read Module 3 Unit 1.

2.3.6 Universal design

As we have studied in Module 3, unit 1, Universal design is a paradigm for the inclusion of the greatest number of people without the need to adapt or redesign them in a special way, being the access to design for all the society.

Universal Design can be defined as the activity of conceiving or designing environments, processes, goods, products, services or objects so that they can be used by all people, or at least by as many people as possible.

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UNIVERSAL DESIGN PRINCIPLES

Some principles guiding the concept of universal design have been established by the groups involved in products, goods or services design:

- Equality of use: the design should be easy to use and suitable for all people regardless their abilities and skills.
- Flexibility: the design should be adaptable to a wide range of individual preferences and abilities.
- Simple and intuitive: the design should be easy to understand regardless of the user's experience, knowledge, skills or level of concentration.
- Easy-to-perceive information: the design should exchange information with the user, regardless of their sensory capabilities or the environmental conditions.
- Error tolerant: the design should minimise accidental or chance actions that could have fatal or unintended consequences.
- Low physical effort: the design should be used efficiently and with as little effort as possible.
- Appropriate dimensions: sizes and spacing should be appropriate for the user's reach, handling and use, regardless of size, position and mobility.

According to Ron Mace (1990), things that most of the population can use, regardless of ability or disability, can be considered universally usable. Universal design guides the scope of accessibility and suggests making all elements and spaces accessible and usable by all people. Its goal is to simplify daily tasks by making products, services and environments more user-friendly and effortless, considering all ages and abilities, and not by separating people, but by making products suitable for all.



Figure 5.2.17 Variable sink



Figure 5.2.18 U-Wing pen



Figure 5.2.16 Hinged hangers

LINK WITH AGE-FRIENDLY DESIGN

The first link between universal design and age-friendly design is transgenerational design. James Pirk (1984) defines it as the practice of making objects and spaces that do not restrict people with physical and sensory impairments associated with aging in their daily activities.

The main objective of transgenerational design is to improve the quality of life of people of all ages by promoting optimal aging, softening its impacts and extending independent living. In more detail, it seeks to help a broad age group by bridging the different stages of life, offering a variety of means to perform daily activities, helping to maintain self-esteem, enabling social interaction and supporting intergenerational relationships.

5.4 FLEXIBLE FURNITURE. VERSATILE SYSTEMS

Quality multifunctional furniture is versatile in its ability to adapt to many situations. Modular, reconfigurable elements provide freedom in arranging your home's decor.

In this chapter student will learn about flexible and versatile furniture from several practical and real examples. Here are these examples:

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UNIO PROJECT

Unio is the given name to the winner furniture in the International Furniture Industrial Design Award of 2020, organized by CETEM.

Unio is a dynamic and modular furniture system that seeks interaction between the user and the furniture and allows the customization and adaptation of spaces.

Composed of three types of pieces so that users can adapt and personalize their spaces, making Unio a modular, flexible, long-lasting, sustainable, interactive, and up-to-date system.

LEVELS PROJECT

Levels is an individual seat that can be configured to adapt to the needs of the user. This project won the second prize in the International Furniture Industrial Design Award of 2020, organized by CETEM.

It covers the functions of chair and stool, its morphology varies depending on the preferences established by the user (height, footrest, backrest, etc.).

Levels is a fully customizable seat. A single product for up to six different seat versions. It is made by a seat and a backrest, made of pine wood and a metal structure. The structure is divided into four pieces that, joined together, can be adjusted in height and comfort of many types of users.



Figure 5.2.19 How Unio can be used



Figure 5.2.20 Different configurations of "Levels"

Unio components are:

- The main structures, which are large static pieces that do not usually move.
- Complements, which enhance and add functionality to the main bodies.
- The unions, which act as a fastening between the complements and the main bodies. Its 5 varieties allow the user to join and disjoin the complements and adding or modifying the functionalities.

The materials chosen for its production are versatile and easy to handle. All the pieces are manufactured with the same diameters and processes, thus allowing serialization.

TWO BE PROJECT

Two Be is an innovative hybrid concept between a sofa and auxiliary furniture: it is a versatile and flexible piece that allows multiple and functional configurations to be created. It is a modular system made up of a wooden structure that acts as auxiliary furniture and several upholstered modules (seats, poufs and backrests).

The goal of the project was to create a user-adapted product that “can be” what he needs at any time. Thanks to its modular design, different compositions are created by moving the seat and backrest modules.

The solution solves the problem of small spaces, optimizes each room and allows different daily activities to be carried out. It can be a space for leisure, reading, receiving visitors, working, etc. and it allows the creation of flexible and personalized environments.

Two Be also has a wide space for storing and the possibility of adding container accessories.



Figure 5.2.21 Two Be furniture composition



Figure 5.2.22 Different kind of compositions. Versatile and flexible

2.5 FUNCTIONAL DIMENSIONS AND THEIR MEASUREMENTS METHODS

When designing furniture, functional dimensions must be considered, that with other factors, determine the user posture and the ergonomic adequation.

For measure functional dimensions in furniture, it is needed a standard procedure that allow to obtain repeatable measurements. That implies that furniture is measure in use conditions, so dimensions are taken like the user is experimenting them. And it also implies to have some unmistakable reference points, for knowing exactly where to measure. For that, it is used, according to standards, some chair charge simulator and similar

equipment. Problems appear once the chair is charged: to know where to measure is not always easy, because the shape of chairs and their elements, for example.

So, according to several European, but also International Standards, there are methods for taking measurements on some specific furniture. Normally, if any standard indicates dimensions and so on, it will also indicate how to perform the measurements.

Here there are some examples of measurements methods and functional dimensions.

2.5.1 Seats. Determination of backrest inclination angle, angle between seat and backrest and seat inclination.

This measurement method appears in EN 1728 standard, Furniture – Seating – Test methods for the determination of strength and durability. It also appears in some other standards, such as EN 1022.

For doing some tests it is necessary to measure these angles with some special equipment.

It should weight 20 kg. It is also used for determining the points in which loads and forces are applied to seat and backrest.

This is a solution for this equipment:



Figure 5.2.23 Loading points template. Solution for the equipment

The inclination angle of the backrest is measured by determining the inclination of the right part of the template, like this:

As it can be seen on the figure, the angle between seat and backrest is also measured with this method. Also, seat inclination may be measure.

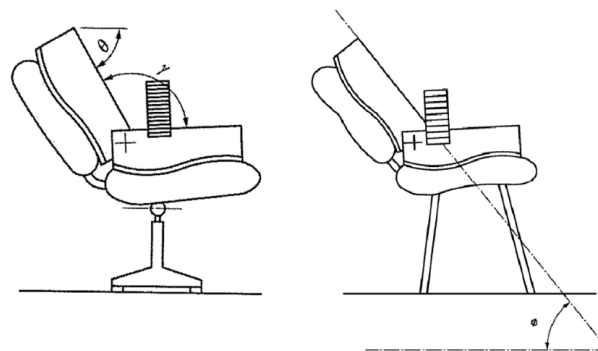


Figure 5.2.24 Chairs with the template on them, and the angle to measure

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RECOMMENDED VALUES

For multipurpose chairs, some recommended values for the angle between seat and backrest are:

- Between 105° and 110°, for the posterior-middle posture.
- Between 100° and 105°, for the anterior-middle posture.

For multipurpose chairs, some recommended values for the seat inclination are:

- Between 7° and 10°, for the posterior-middle posture.
- Between 3° and 5°, for the anterior-middle posture.

For relax furniture, the recommended relations between seat inclination and the angle between seat and backrest are:

- Seat inclination: 0°. Minimum seat-backrest angle: 125°.
- Seat inclination: 5°. Minimum seat-backrest angle: 123°.
- Seat inclination: 10°. Minimum seat-backrest angle: 120°.
- Seat inclination: 15°. Minimum seat-backrest angle: 115°.
- Seat inclination: 20°. Minimum seat-backrest angle: 110°.

For resting armchairs, for more upright postures, recommended values are:

- Seat inclination: between 8° and 15°.
- Seat-backrest angle: between 105 and 115°.

For relax armchairs:

- Seat inclination: between 15° and 25°.
- Seat-backrest angle: greater than 115°.

For armchair with regulable angles:

- Seat inclination: between 5° and 25°.
- Seat-backrest angle: between 105 and 140°.

For armchairs for elderly:

- Seat inclination: 10°
- Backrest inclination: 20°

2.5.2 Office chairs. Determination of dimensions

EN 1335-1 – Office furniture – Office work chair – Part 1: Dimensions – Determination of dimensions, specifies the dimensions of 4 different office chairs and the test methods for its determination.

To implement this standard to an office chair, it is necessary to have available the following standard: ISO 24496 – Office furniture. Office chairs. Methods for the determination of dimensions, that specifies methods for the determination of the dimensions of office chairs.

ISO 24496 defines the test equipment for doing all measurements in any office chair. It is needed just one equipment, which name is the Chair Measurement Device or just CMD.

The completed CMD, installed and well positioned in an office chair looks like this:

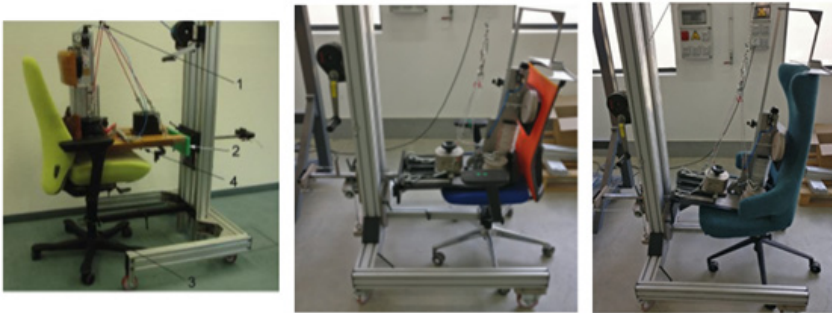


Figure 5.2.25 Examples of CMD placement fixture with chair and CMD

It is necessary to implement some steps for setting-up the chair correctly. It is also necessary to implement some steps for placing the CMD on the office chair correctly, before starting measures:

With the CMD correctly positioned in the office chair, it is possible to start measurements, which are supposed to be in this order:

1. Lumbar support protrusion and height. Distance from the backrest line to the most prominent segment (or segments) of the lumbar support as determined by the measuring indicators on the CMD, measured perpendicular to the backrest line.

It is possible to measure maximum horizontal protrusion, minimum horizontal protrusion, maximum vertical height and minimum vertical height, and vertical lumbar adjustment mechanism travel.

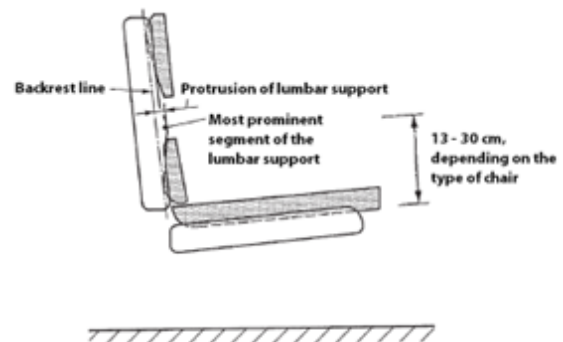


Figure 5.2.26 Lumbar support. Protrusion



- Key
- 1 pressure gauge
 - 2 pressure pump
 - 3 lumbar support protrusion and height measurement vertically stacked segments
 - 4 lumbar support protrusion scale
 - 5 lumbar support height scale

Figure 5.2.27 Lumbar support protrusion and height measurement (overall view)

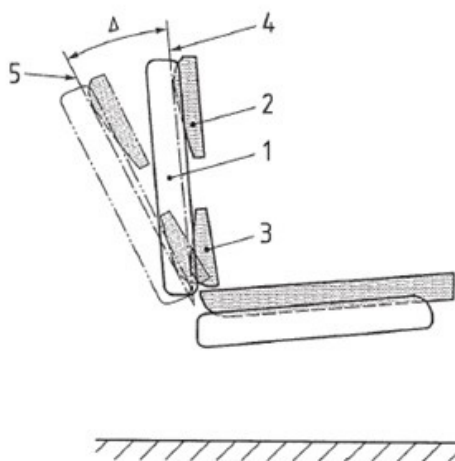
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RECOMMENDED VALUES

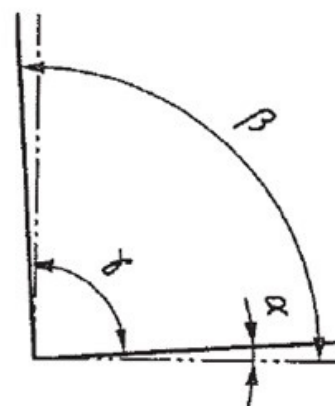
Some recommended values for lumbar support height are:

- For simple office chair: 15 – 25 cm if regulable, 19 – 21 cm if not.
- For computer office chair: 15 – 30 cm if regulable, 20 – 23 cm if not.
- For multipurpose chairs, for the posterior-middle posture: 13 – 15 cm.
- For multipurpose chairs, for the anterior-middle posture: 15 – 17 cm.
- For resting armchairs: 13 – 18 cm.

2. Inclination of seat, and backrest and angle between seat and backrest.



- Key
- 1 backrest
 - 2 CMD thoracic pad
 - 3 CMD pelvic pad
 - 4 forward most tilt backrest line
 - 5 rearward most tilt backrest line
 - Δ range of backrest inclination



α is read from the protractor positioned on the buttocks pad of the CMD.

β is read from the protractor positioned on the front of the vertical member of the CMD.

γ can be read directly from the angle indicator on the vertical member of the CMD or can be calculated from protractor readings.

Figure 5.2.28 Angles of the office chair

3. Back to seat movement ratio. This measurement applies only to chairs that have angles between the seat and back that vary as the chair tilts.

4. **Seat height and sitting height.** Measure the seat height as the vertical distance from the underside of the CMD to the floor on a measuring scale placed through the seat height slot of the CMD at the front of the seat. Measure the sitting height (3.24) by measuring the height of the top of the CMD buttocks pad at the sitting height point marked on the buttocks pad to the floor, and then subtract 60 mm from the measurement to obtain the sitting height value.

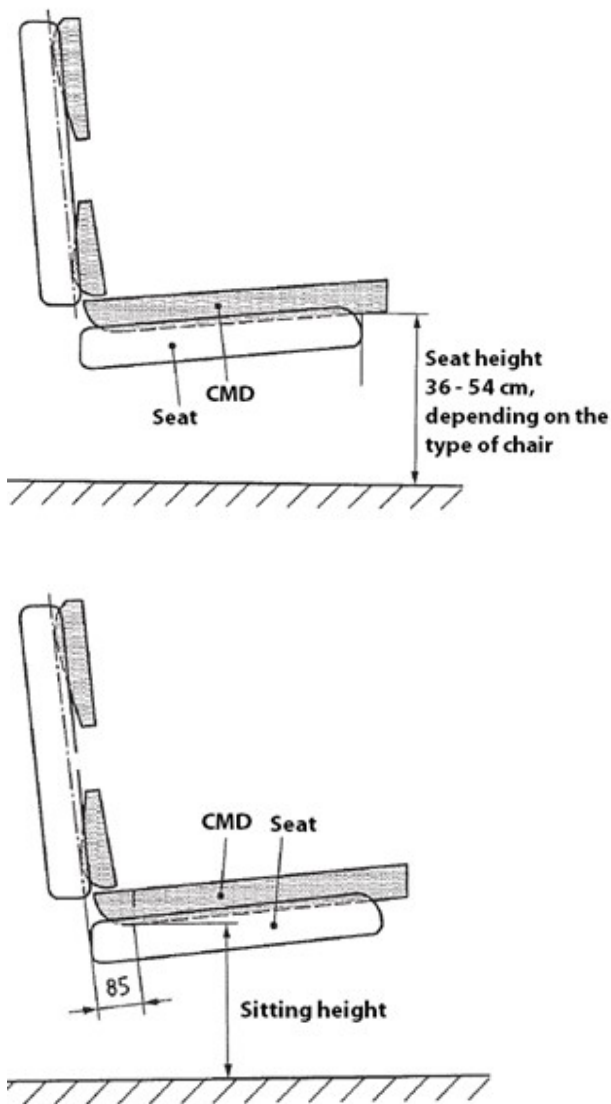


Figure 5.2.29 Seat height and sitting height

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RECOMMENDED VALUES

Some recommended values for seat height are:

- For simple and computer office chair: 38 – 54 cm if regulable, 41 – 43 cm if not.
- For multipurpose chairs, for the posterior-middle posture: 39 – 41 cm.
- For multipurpose chairs, for the anterior-middle posture: 41 – 43 cm.
- For resting armchairs: 36 – 40 cm.
- For elderly armchairs: 38 – 44 cm.

5. **Seat depth.** Read the seat depth from the measuring scale on the top of the buttocks pad.

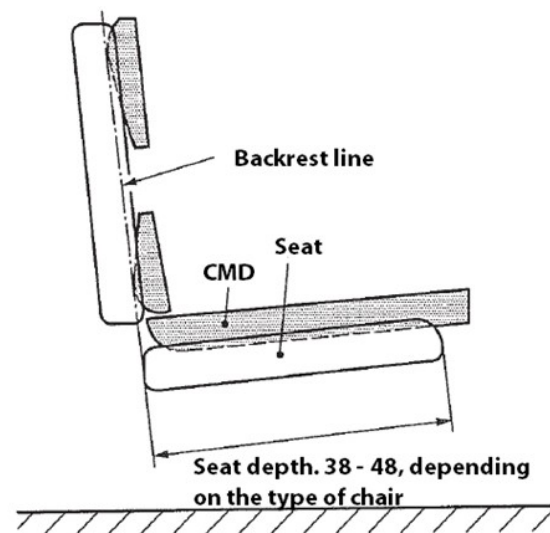


Figure 5.2.30 Seat depth

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RECOMMENDED VALUES

Some recommended values for seat depth are:

- For simple and computer office chair: 40 – 44 cm.
- For multipurpose chairs, for the posterior-middle posture: 42 – 44 cm.
- For multipurpose chairs, for the anterior-middle posture: 42 – 47 cm.
- For resting armchairs: 45 – 48 cm.
- For elderly armchairs: 38 – 44 cm.

6. Backrest height. Slide the backrest height gauge until it touches the top of the backrest. Read the height on the scale.

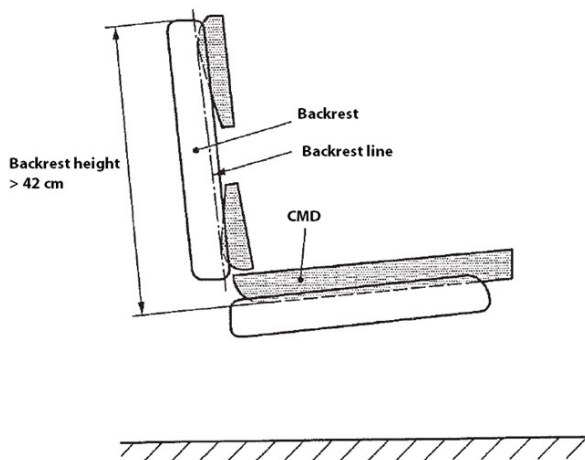


Figure 5.2.31 Backrest height

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for backrest height are:

- For simple office chair: > 45 cm
- For computer office chair: > 50 cm
- For multipurpose chairs > 42 cm
- For resting armchairs: > 55 cm
- For elderly armchairs: 50 – 80 cm

7. Front of armrest position.

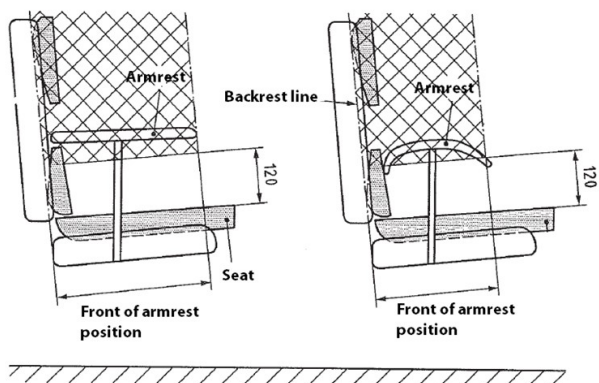


Figure 5.2.32 Front of the armrest position and how to measure it

8. Armrest set back. Calculate the armrest set back by subtracting the front of armrest position value from the seat depth value.

9. Armrest height.

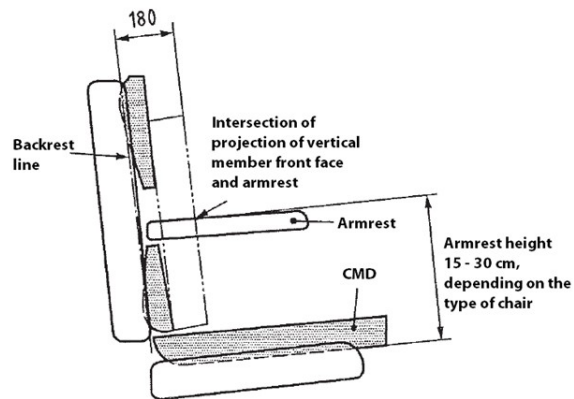


Figure 5.2.33 Armrest height and how to measure it

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for armrest height are:

- For simple office chair: 19 – 25 cm if regulable, 21 – 23 cm if not.
- For computer office chair: 18 – 30 cm if regulable, 23 – 25 cm if not.
- For multipurpose chairs, for the posterior-middle posture: 22 cm.
- For multipurpose chairs, for the anterior-middle posture: 24 cm.
- For resting armchairs: 15 – 23 cm.
- For elderly armchairs: 19 – 23 cm.

10. Neck/head rest height and protrusion.

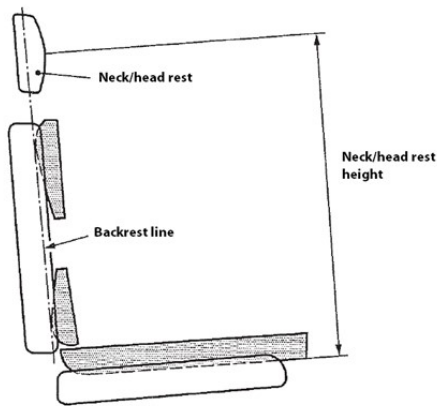


Figure 5.2.34 Neck/head rest height and protrusion and how to measure them

All these measures must be taken with the chair components adjusted to their minimum positions, as well as in their maximum positions, so it is possible to establish ranges.

Then, it is necessary to remove the CMD equipment from the chair, and do some more measurements:

11. Seat surface width. Measure the narrowest seat surface width within the seat surface plane width zone.

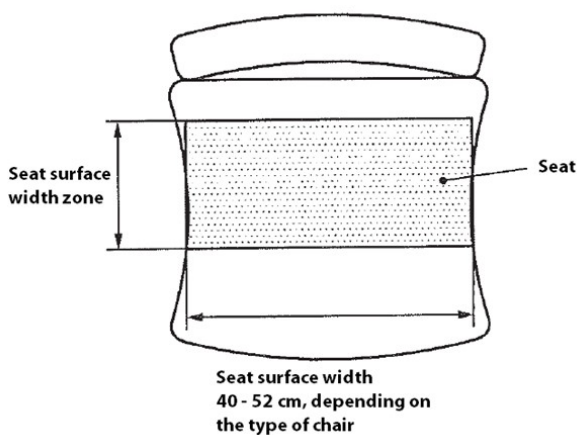


Figure 5.2.35 Seat surface width

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for seat width are:

- For simple and computer office chair: > 40 cm.
- For multipurpose chairs: 46 – 52 cm.
- For resting armchairs: 48 – 52 cm.
- For elderly armchairs: 45 – 51 cm.

12. Seat surface depth. Measure the least seat surface depth within the span, 115 mm either side of the median plane.

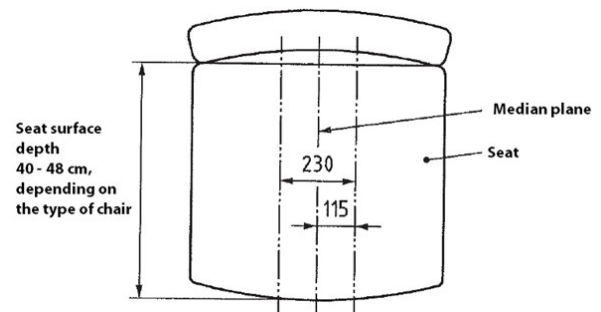


Figure 5.2.36 Seat surface depth

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for surface depth are:

- For simple and computer office chair: 40 – 44 cm.
- For multipurpose chairs, for the posterior-middle posture: 42 – 44 cm.
- For multipurpose chairs, for the anterior-middle posture: 40 – 42 cm.
- For resting armchairs: 45 – 48 cm.
- For elderly armchairs: 42 – 47 cm.

13. Backrest width. Measure the narrowest backrest width within the lumbar zone.

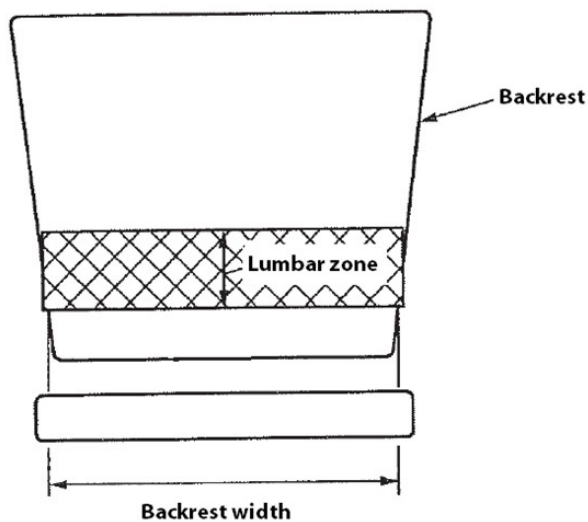


Figure 5.2.37 Backrest width

14. Backrest horizontal radius. Measure the backrest radius of the chair at the lumbar zone. For office chairs, 40 cm is the recommended value.

15. Armrest length. With the armrest pad surface in the most horizontal position, measure the greatest length in the fore and aft direction of the armrests horizontally within 20 mm below the top surface using callipers with jaws 20 mm long.

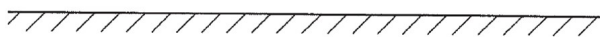
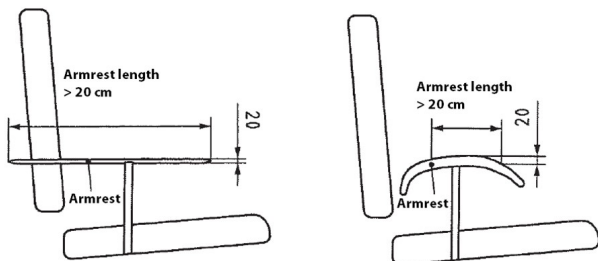


Figure 5.2.38 Armrest length and how to measure it

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for armrest length are:

- For simple office chair: 22 cm.
- For computer office chair: > 22 cm.
- For multipurpose chairs: 20 cm.
- For resting and elderly armchairs: > 35 cm.

16. Width of armrests. With the armrest pad surface in the most horizontal position, measure the greatest width in the side-to-side direction of the armrests horizontally within 5 mm below the top surface using callipers with jaws 5 mm long.

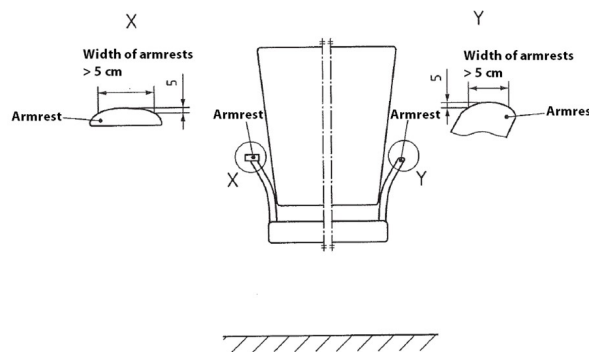


Figure 5.2.39 Width of armrests and how to measure it

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for armrest width are:

- For simple office chair: 5 cm.
- For computer office chair: > 5 cm.
- For multipurpose chairs: > 5 cm.
- For resting armchairs: > 5 cm.
- For elderly armchairs: > 8 cm.

17. Hip breadth clearance.

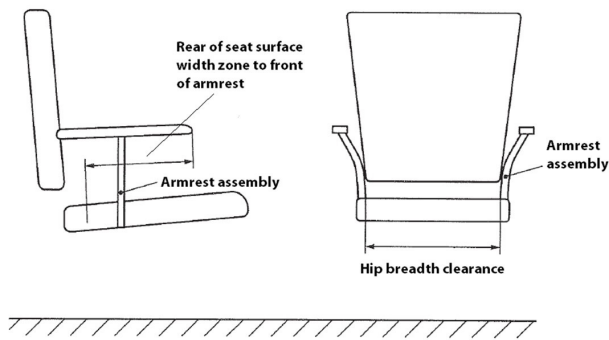


Figure 5.2.40 Hip breadth clearance

18. Distance between armrests.

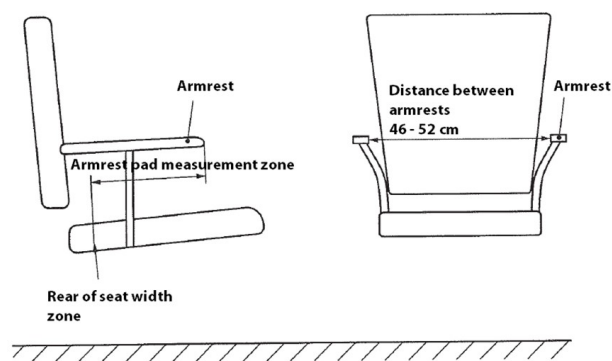


Figure 5.2.41 Distance between armrests

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for distance between armrests are:

- For simple and computer office chair: 46 – 52 cm.
- For multipurpose chairs: 46 – 52 cm.
- For resting armchairs: 46 – 52 cm.
- For elderly armchairs: 45 – 51 cm.

19. Maximum offset of the underframe. Measure the maximum offset of the underframe as the distance from the axis of chair rotation to the outermost point of the base/castor/glide.

2.5.3 Chairs and tables for educational institutions. Determination of functional dimensions.

EN 1729-1 – Furniture – Chairs and tables for educational institutions – Part 1: Functional dimensions, establish the functional dimensions for chair, stools and tables in educational institutions.

For doing most measurements in chairs, the standard defines an equipment, called in Device for Measuring Scholar Chairs, or DMSE. This is the DMSE:

There are several functional measurements performed using the DMSE, but there are out of the scope of this project.



Figure 5.2.42 DMSE in a scholar chair

2.5.4 Tables

There are several functional measurements to implement regarding tables. Some recommended values for tables in general are given:

1. **Table height.**
It is measured from a point of the upper plane to the floor. 69–73 cm is adequate. For office tables, it is advisable to be adjustable.
2. **Seat – chair height.**
It is measured from the upper face of the table plane to the most pressed point of the chair seat. 30 – 32 cm is fine.
3. **Width and depth of the table plane.**
They are the dimension of the accessible space of the user. In rounded tables it's the diameter.
4. **Free height under the table.**
There should be enough space for leg and armrest's chairs under the table. This dimension should be greater than 65 cm.
5. **Free width under the table.**
The minor width under the table should be measured.
6. **Free depth under the table.**
It should be taken into account the depth at knee height. This dimension should be greater than 45 cm.

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values, specifically for office tables, are:

- 65 – 72 cm for the table height.
- > 60 cm for the depth.
- > 120 cm for the width.
- > 65 cm for the free height under the table.
- > 60 cm for the free width under the table.
- > 45 cm for the free depth under the table (knees).
- > 60 cm for the free depth under the table (feet).

Some recommended values, specifically for computer tables, are given. As it can be seen, a lot of them are the same that above.

- 70 – 72 cm for the table height.
- > 60 cm for the depth.
- > 120 cm for the width.

2.5.5 Sofas

The sofa is a piece of furniture intended to seat two or more people, so when sizing the widths, not only the acceptable anthropometric width for chairs and armchairs must be considered, but also a higher value, that allow freedom of movement for users, without interferences.

Minimum width for each user must be 55 cm. As an example, width of sofa or seating bench, for 2, 3 and 4 users must be: 100, 155 and 210 cm.

2.6 TYPES OF FURNITURE

Standards, both national, European, or global, also defines the types and different kind of furniture. Here in this chapter, some definitions regarding types of furniture will be given. It is important to take into account that inside a category of furniture, for example, seats, it is possible to find different kind of furniture. For example: office chairs, outdoor seating, swivel chairs, loungers, etc.

Definitions given here are directly taken of European standards. They are also available in terminology database from ISO and IEC.

- **Lounger:** Seat intended for the user to be reclined, in which in at least one position, the backrest forms an angle less or equal to 45° , and that is provided with a leg rest that is part of the product, and that can withstand all the weight of the user body.

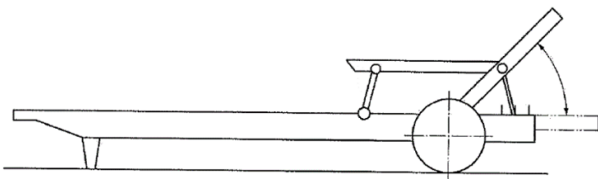


Figure 5.2.43 Example of lounger

- **Swivel chair:** Seat whose upper part, which includes the seat and backrest, rests on a single column and can rotate in the horizontal plane.
- **Office chair:** Swivel chair, with or without arms, for intended use in an office for a adult person, whose upper part, that includes a seat and a backrest, rests on a single column and can rotate in the horizontal plane, and can be regulated in height at least. Some definitions, like included in EN 1335-1 may add that an office chair is normally used along a working surface. Also, an office chair may have or not elements such as armrests and/or headrests.
 - **“Ax” type office chair:** Office chair with the greatest variety of adjustments.

- **“A” type office chair:** Office chair with great variety of adjustments.
- **“B” type office chair:** Office chair with a variety of adjustments.
- **“C” type office chair:** Office chair with limited adjustments.
- **High office chair:** Office chair with a greater seat height, measured from the ground, than 540 mm, and provided with a with a foot support.
- **Working chair:** Chair, with or without arms, for intended use in a company office or in a private home (for example, for working with a computer), whose upper part, that includes seat and backrest, rests on a simple column and can rotate in the horizontal plane and can be regulated in height at least.

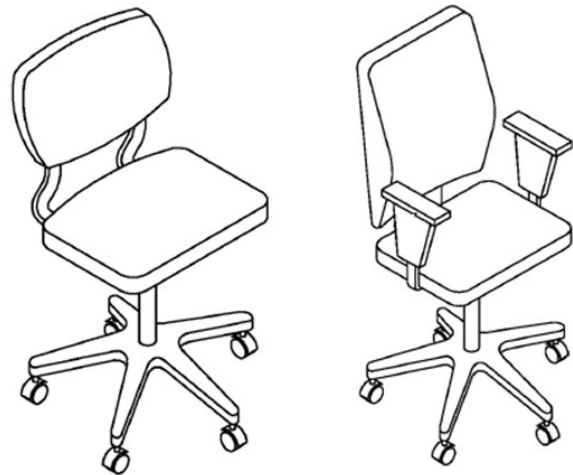


Figure 5.2.44 Examples of working chairs

- **Confidant chair:** Individual seat that is used as a complement of the working chair, in an office environment. It is used for meetings or consulting, as well as reading, writing, listening, or waiting.
- **Reclinable chair:** Seat provided with a backrest that can be adjusted from a normal vertical position to a reclined position.
- **Reclinable and liftable chair:** Seat that, in addition to its tilting function, is provided with mechanism for lifting so it is easy to stand up.

- **Dual tilt seat:** Seat that can be used for sitting, either in the front part of the seat (forward inclination), either in the back part of the seat (rearward inclination), resting feet in a footrest or in the ground.
- **Stool:** Seat without backrest and arms, intended for being used in short spaces of time.
- **High chair:** Chair which seat height from the ground is greater than 510 mm, and with a footrest.

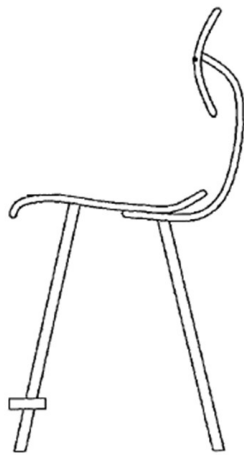


Figure 5.2.45 Example of a high chair, with footrest

- **Outdoor seating for public use:** Outdoor seat intended for a non-private use in public-accessible places, such as restaurants, swimming pools, beaches, and leisure and professional spaces.
- **Outdoor seating for domestic use:** Outdoor seat intended for a private use, in non-accessible places for public, like gardens, terraces, balconies, etc.
- **Outdoor seating for camping:** Outdoor seat, foldable or demountable and light, intended for using in camping and journeys.
- **Work table or desk (“A” Type):** Fully height-adjustable table; user can change the height during use.
- **Work table or desk (“B” Type):** Height-adjustable table; height can be adapted to the user during installation.
- **Work table or desk (“C” Type):** Fixed-height table.
- **Work table or desk (“D” Type):** Table that can be height-adjustable in a limited way.
- **Work table or desk for standing or sitting:**

Height-adjustable table that allow working in different positions, from sitting to standing.

- **Foldaway beds:** Bed in which its surfaces undergo a rotation, in the horizontal axis at least, for achieving its use position.
- **Bunk bed:** Set of elements that can be assembled to form beds, one on the top of the other, so the upper face of the basis of the high bed is at 600 mm or greater from the ground.
- **High bed:** Set of elements that can be assembled to form a bed, so the upper face of its basis is at 600 mm or greater from the ground, regardless the use of the space below.
- **Medical bed:** Device for which the intended use is sleeping/resting that contains a mattress support platform and intended to assist in diagnosis, monitoring, prevention, treatment, alleviation of disease or compensation for an injury or handicap.
- **Bed-lift:** Height adjustable mechanism on which a mattress support platform can be mounted. The combination of a bed lift and a compatible non-medical bed as specified by the manufacturer is considered to be a medical bed.
- **Mattress support platform:** Structure which supports a patient surface, for example mattress.

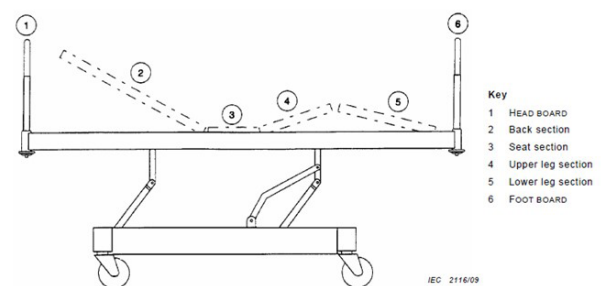


Figure 5.2.46 Example of medical bed, and its parts

- **Frameless sheet base:** Bed base composed by separated flexible sheets, connected by a textile, rubber or plastic tape.
- **Base with frame:** Bed base composed by sheets, springs, etc., connected by a frame.
- **Spring mattress with rigid frame:** Upholstered bed base composed by filled springs, over a rigid frame, for being used

on a bed frame or single.

- **Divan:** Upholstered bed base used without the need for a bed with crossbars. It can be done with springs filling or with a solid surface, and it can include drawers or storage space.
- **Convertible sofa-bed:** Seat that uses a mechanism for turning into a bed.
- **Storage furniture:** Complete furniture unit that includes structure and all components, such as doors, wardrobes, and the rest of storage elements.
- **Regulable furniture:** Furniture that the user can regulate without the need of using tools.

- **Variable-size furniture:** Furniture that can be regulated during its installation (not by the user), so its dimensions go from a size type to other.
- **Urban furniture:** Outdoor furniture for using in public spaces, permanently attached to the ground or to a structure (like bus stop, wall, etc.), or that can not be detached by hand.
- **Kitchen module:** Each of the independent furniture that integrates the fully furniture of a kitchen, and that are designed for working connected between them and/or the building elements.

2.7 BATHROOMS AND KITCHEN ELEMENTS

Accessible, functional, usable and safe furniture can of course be applied to environments such as bathrooms and kitchens. By reducing barriers, making it easier, safer, and more convenient for people of all ages with varying abilities or with different equipment requirements to perform everyday tasks and activities.

There are some basic considerations. There are minimum measures to be respected to ensure for example accessibility in kitchens and bathrooms. For allowing free access and movement of wheelchairs, the areas of circulation must have a minimum width of 80 cm, but it is recommended to increase this value.

Objects and utensils must be at the direct reach of users, incorporating handles or opening systems easy to use, like faucets with levers instead of valves.

The main lighting must be stable and uniform; mixing natural and artificial light if possible, plus the addition of directed light bulbs in specific zones while installing programmable automated systems and movement sensors would be ideal. The installation of anti-slip floors and choosing safe, easy to clean, and antibacterial materials is also advised.

Kitchens and bathrooms are wet environments, which makes it very easy to slip, trip and fall due to spills or simply lingering condensation. So, reducing the accident risk is key here: choose safe surfaces is crucial. Vinyl is a good floor covering for a surer step, as it is naturally slip resistant, but porcelain tiles often also come with anti-slip properties.

For bathrooms, there are a series of elements that will make these spaces safer, like seats, handles, support bars, etc.:



Figure 5.2.47 Accessories for a bathroom

Coming back to kitchens, it is a great idea to install adjustable countertops. There are systems capable to be adjusted according to each user's needs. They incorporate elevation columns that can stand up to 60kg of weight, allowing effective freedom throughout that space.

The extensible tables make it possible to increase the useful and habitable space of the kitchen, also easing the access for people in wheelchairs, for example. From perfectly hidden in a drawer, some of them can get attached and adjusted to the height of the countertop, while others unfold into dining room tables.

For both bathrooms and kitchens, it is also possible to incorporate cabinets that are closer within the reach of the user with just a simple movement and/or with a switch or button. One option for this could be to install it as a structure screwed to the wall, allowing the cabinet to move diagonally, downwards, and upwards. Another option is using columns of elevation that move the cabinet only in a vertical fashion.

Another good advice for both kitchens and bathrooms is to incorporate and consider sliding drawers in the lower furniture. Although these elements are used normally for keeping different utensils, in this way fixed cabinets that are too deep and difficult to reach are avoided.

It is also possible to eliminate doors with hinges of upper furniture and replace them with lift doors, which gives easy access to the artifacts and utensils while using the kitchen.

This system also helps to clear the area, allowing free movement without the need to close the cabinets. This applies also for bathrooms and kitchens.



Figure 5.2.48 Adjustable countertop

Integration of all these elements and some more others allows to construct multifunctional kitchens and bathrooms, capable of being very safe and also adapting and adjusting to different users, and at the same time brings versatility, that can be increased by adding electronic systems that control movements in different directions and heights, and allowing to customize tables, storage spaces, etc.

Other interesting aspect for kitchen and bathrooms may be to go further into domotics and home automation. Through centralized control panels, motion sensors, etc., is possible to support older adults, disabled people, etc. It is possible to turn on lights at certain time of the day, or by presence sensors, among others.



Figure 5.2.49 On the left: fixed cabinets, deep and difficult to reach. On the right: sliding drawers, easy to reach



Figure 5.2.50 Lift door in a kitchen

An adapted kitchen or bathroom is designed so anyone can use it independently, which is best for households with mixed abilities or multi-generational homes. For example, a good choice for kitchens, for holding handy supplies or groceries, is the following pull-down cupboard. It has two levels of shelving to organise items and comes with two resistance settings to make the shelves easier to pull-down – great for multi-generational homes.



Figure 5.2.51 Pull-down cupboard.

Another example of kitchen element may be this pull-out worktop runner:



Figure 5.2.52 Pull-out worktop runner

These runners offer added convenience by ensuring a counter can be pulled toward the user for easier access to the items on top. They can be fitted with standard sizes and can be used to pull out individual sections in cooking towers to make transferring heavy roasting dishes safe and simple.

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LIST OF PICTURES

- Figure 5.2.1 Examples of domestic and non-domestic seating furniture. (Source: Freepik)
- Figure 5.2.2 Template for “V” shaped openings. (Source: CETEM)
- Figure 5.2.3 Example of bunk bed. (Source: Freepik)
- Figure 5.2.4 Bed and mattress. (Source: Freepik)
- Figure 5.2.5 Example of an office screen
- Figure 5.2.6 Domestic tables. (Source: Freepik)
- Figure 5.2.7 Storage furniture (Source: Freepik)
- Figure 5.2.8 Chairs and tables for educational institutions (Source: Freepik)
- Figure 5.2.9 Definition of measurement test probes. (Source: CETEM)
- Figure 5.2.10 Example of the three measurement test probes. (Source: CETEM)
- Figure 5.2.11 Outdoor/camping chair. (Source: Freepik)
- Figure 5.2.12 Office furniture, and office work chairs. (Source: Freepik)
- Figure 5.2.13 Some furniture material tests. (Source: CETEM)
- Figure 5.2.14 Office chair being mechanically tested. (Source: CETEM)
- Figure 5.2.15 Average value of the parameter height within the population.
- Figure 5.2.16 Hinged hanger. (Source: Decoratrix)
- Figure 5.2.17 Variable sink. (Source: Desingboom)
- Figure 5.2.18 U-Wing pen. (Source: Tripod Design)
- Figure 5.2.19 How Unio can be used. (Source: CETEM)
- Figure 5.2.20 Different configurations of “Levels”. (Source: CETEM)
- Figure 5.2.21 Two Be furniture composition. (Source: CETEM)
- Figure 5.2.22 Different kind of compositions. Versatile and flexible. (Source: CETEM)
- Figure 5.2.23 Loading points template. Solution for the equipment. (Source: CETEM)
- Figure 5.2.24 Chairs with the template on them, and the angle to measure. (Source: CETEM)
- Figure 5.2.25 Examples of CMD placement fixture with chair and CMD. (Source: CETEM)
- Figure 5.2.26 Lumbar support. Protrusion. (Source: CETEM)
- Figure 5.2.27 Lumbar support protrusion and height measurement (overall view). (Source: CETEM)
- Figure 5.2.28 Angles of the office chair. (Source: CETEM)
- Figure 5.2.29 Seat height and sitting height. (Source: CETEM)
- Figure 5.2.30 Seat depth. (Source: CETEM)
- Figure 5.2.31 Backrest height. (Source: CETEM)
- Figure 5.2.32 Front of the armrest position and how to measure it. (Source: CETEM)

Figure 5.2.33 Armrest height and how to measure it. (Source: CETEM)

Figure 5.2.34 Neck/head rest height and protrusion and how to measure them. (Source: CETEM)

Figure 5.2.35 Seat surface width. (Source: CETEM)

Figure 5.2.36 Seat surface depth. (Source: CETEM)

Figure 5.2.37 Backrest width. (Source: CETEM)

Figure 5.2.38 Armrest length and how to measure it. (Source: CETEM)

Figure 5.2.39 Width of armrests and how to measure it. (Source: CETEM)

Figure 5.2.40 Hip breadth clearance. (Source: CETEM)

Figure 5.2.41 Distance between armrests. (Source: CETEM)

Figure 5.2.42 DMSE in a scholar chair. (Source: CETEM)

Figure 5.2.43 Example of lounger. (Source: CETEM)

Figure 5.2.44 Examples of working chairs. (Source: CETEM)

Figure 5.2.45 Example of a high chair, with footrest. (Source: CETEM)

Figure 1.1.46 Example of medical bed, and its parts. (Source: CETEM)

Figure 1.1.47 Accessories for a bathroom. Source: <https://duchamania.es/banos-seguros/>

Figure 1.1.48 Adjustable countertop. Source: <http://www.home-designing.com/2014/05/25-unique-kitchen-countertops/17-height-adjustable-kitchen-countertop>

Figure 1.1.49 On the left: fixed cabinets, deep and difficult to reach. On the right: sliding drawers, easy to reach. (Source: CETEM)

Figure 1.1.50 Lift door in a kitchen. (Source: CETEM)

Figure 5.2.51 Pull-down cupboard. Source: <https://www.howdens.com/kitchens/kitchen-storage/wall-storage/pull-down-shelf/600mm-pull-down-light-grey-oak-wall-unit-obj-sku-family-25352929>

Figure 5.2.52 Pull-out worktop runner. Source: <https://www.howdens.com/kitchens/kitchen-surfaces/worktop-accessories/worktop-rise-and-fall-systems/hke0062-pull-out-worktop-runners-obj-sku-family-hke006>