BRITISH STANDARD

BS EN ISO
9241-5:1999

Ergonomic requirements for office work with visual display terminals (VDTs) —

Part 5: Workstation layout and postural requirements

The European Standard EN ISO 9241-5:1999 has the status of a British Standard

ICS 13.180; 35.180

National foreword

This British Standard is the English language version of EN ISO 9241-5:1999. It is identical with ISO 9241-5:1998. It supersedes BS 7179-5:1990 which is withdrawn.

Attention is drawn to National annex NA which provides numerical data for use with this part of BS EN ISO 9241.

The UK participation in its preparation was entrusted by Technical Committee PH/9, Applied ergonomics, to Subcommittee PH/9/6, User system interfaces, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

Attention is drawn to the fact that CEN and CENELEC standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN ISO title page, page 2, the ISO title page, pages ii to iv, pages 1 to 24, an inside back cover and a back cover.

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March 1999

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English version

Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements

(ISO 9241-5:1998)

Exigences ergonomiques pour travail de bureau avec terminaux à écrans de visualisation (TEV) — Partie 5: Aménagement du poste de travail et exigences relatives aux postures (ISO 9241-5:1998)

Ergonomische Anforderungen für Bürotätigkeiten mit Bildschirmgeräten — Teil 5: Anforderungen an Arbeitsplatzgestaltung und Körperhaltung (ISO 9241-5:1998)

This European Standard was approved by CEN on 26 September 1998.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Foreword

The text of the International Standard from Technical Committee ISO/TC 159 “Ergonomics” of the International Organization for Standardization (ISO) has been taken over as an European Standard by CEN/CS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 1999, and conflicting national standards shall be withdrawn at the latest by September 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 9241-5:1998 has been approved by CEN as a European Standard without any modification.

NOTE Normative references to International Standards are listed in Annex ZA (normative).

INTERNATIONAL STANDARD

ISO 9241-5

First edition
1998-10-01

Ergonomic requirements for office work with visual display terminals (VDTs) —

Part 5:
Workstation layout and postural requirements

Exigences ergonomiques pour travail de bureau avec terminaux à écrans de visualisation (TEV) —

Partie 5: Aménagement du poste de travail et exigences relatives aux postures

Reference number
ISO 9241-5:1998(E)

Contents

Descriptors: Ergonomics, office machines, computer peripheral equipment, text processing, data terminal equipment, display devices, workplaces, specifications, layout, working conditions.

Foreword

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

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9241-5 was prepared by Technical Committee ISO/TC 159, *Ergonomics,* Sub-committee SC 4, *Ergonomics of human-system interaction,* Working Group WG 3, *Control, workplace and environmental requirements.*

ISO 9241 consists of the following parts, under the general title *Ergonomic requirements for office work with visual display terminals (VDTs)*;

— *Part 1: General introduction;*
— *Part 2: Guidance on task requirements;*
— *Part 3: Visual display requirements;*
— *Part 4: Keyboard requirements;*
— *Part 5: Workstation layout and postural requirements;*
— *Part 6: Guidance on the work environment;*
— *Part 7: Requirements for display with reflections;*
— *Part 8: Requirements for displayed colours;*
— *Part 9: Requirements for non-keyboard input devices;*
— *Part 10: Dialogue principles;*
— *Part 11: Guidance on usability;*
— *Part 12: Presentation of information;*
— *Part 13: User guidance;*
— *Part 14: Menu dialogues;*
— *Part 15: Command dialogues;*
— *Part 16: Direct-manipulation dialogues;*
— *Part 17: Form filling dialogues.*

Annex A of this part of ISO 9241 is for information only.

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Introduction

The purpose of this part of ISO 9241 is to promote and enhance performance and comfort while minimizing risks to users' safety and health. Users of visual display terminals (VDTs) in office work typically adopt a range of postures (seated with leaning, upright or reclining torso, standing or a combination of both). Workplaces which accommodate such usage can encourage movement, promote comfort and reduce physical, mental and visual problems.

This part of ISO 9241 is intended for use by product and workstation designers and implementers.

While drafting the text, the concept concerning the Frankfurt Plane was discussed but not included. The concept will be considered in a revision of this part of ISO 9241 in due course.

1 Scope

This part of ISO 9241 specifies ergonomic guiding principles which apply to the user requirements, design, and procurement of workstation equipment for office tasks using VDTs.

In particular, the general principles and requirements specified in this part of ISO 9241 apply to the standards specifying technical design of furniture and equipment constituting the workplace.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9241. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9241 are encouraged to investigate the possibility applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6385:1981, *Ergonomic principles in the design of work systems.*

ISO 9241-2:1992, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 2: Guidance on task requirements.*

ISO 9241-3:1992, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 3: Visual display requirements.*

ISO 9241-6:—, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 6: Guidance on the work environment*[1)].

3 Definitions

For the purposes of this part of ISO 9241, the following definitions apply.

3.1
angle of view

angle between the line-of-sight and the line orthogonal to the surface of the display at the point where the line-of-sight intersects the image surface of the display

[ISO 9241-3:1992]

3.2
anthropometry

study and measurement of the physical dimensions of the human body

3.3
armrest

support for the lower arms

3.4
back rest

part of a work chair which provides support for the back

3.5
castor

wheeled component on the bottom of furniture to facilitate appropriate movement on the floor surface

3.6
design reference posture

posture specified for the purpose of workstation design to define relative positions and dimensions

3.7
deviation

alteration from the neutral position

3.8
dynamic posture

body position which changes, with relative movements of the limbs or other parts of the human body in relation to one another or with respect to a fixed object (such as a workstation)

3.9
extension

movement that increases the angle between two adjacent bones; hand extension is the movement of the hand in the dorsal direction

NOTE Dorsal pertains to the back of the hand, palmar to the palm.

[1)] To be published.

3.10
flexion

movement that decreases the angle between two adjacent bones; hand flexion is the movement of the hand in the palmar direction

NOTE Palmar pertains to the palm of the hand.

3.11
gloss

the mode of appearance by which reflected highlights of objects are perceived as superimposed on the surface due to the directionally selective properties of that surface

[CIE Publ. 17.4:1987; IEC 845-04-73]

3.12
gloss unit

measure for quantifying the gloss of a surface

3.13
kyphosis

convex curvature of the thoracic spine

3.14
intended user population

group of human beings for which a product or a workstation is designed

EXAMPLE Male and female workers of South-East Asian origin aged between 45 and 65 years.

3.15
line-of-sight angle

the angle between a horizontal line and the visual axis of the eye (the line connecting the point of fixation and the centre of the pupil)

3.16
lordosis

concave curvature of the spine

3.17
lumbar

region of the back between the thorax and the pelvis

3.18
popliteal

of or pertaining to the back of the knee

3.19
posture

overall position of the body, or body parts in relation to each other, with respect to the workplace and its components

3.20
reference plane

surface designed to support the feet

NOTE If not otherwise indicated, the reference plane is the ground. Any other level higher or lower than the ground level may be used as a reference plane for the calculation of the height of support surfaces.

3.21
static posture

adoption of a body position which is fixed over time and where there is muscle contraction without motion

3.22
task analysis

analytical process employed to determine the specific behaviours required of people when operating equipment or doing work

NOTE The task analysis is not a risk assessment of the workplace according to legal requirements.

3.23
workplace

arrangement of workstations allocated to one person to complete a work task

3.24
work space

volume of space allocated to one or more persons in the work system to complete a work task

3.25
worksurface

surface on which equipment and task materials are used

3.26
workstation

assembly comprising display equipment with or without a central processing unit, which may be provided with a keyboard and/or input device and/or software determining the operator/machine-interface, optional accessories, peripherals and the immediate work environment

4 Guiding principles

4.1 General considerations

Workplace design should be preceded by an analysis of the tasks that it is to support. Such an analysis should give information about the different tasks and sub-tasks which are performed and about the use of related equipment. It should also identify the relative priority given to different information sources within the user's task with respect to placement of displays, equipment location and job aids. For example, in many data-entry tasks, viewing of the hard copy has greater priority than viewing of the display.

The task analysis should include consideration of

a) **major tasks and their inter-relationships:** frequency, importance, position of visual objects, duration and type of use of all associated equipment and their interrelationships, (see ISO 9241-2);

b) **the position and use of the hands:** implications for posture, reach, and device manipulation by the relative positioning of VDT equipment and task materials, frequency, duration and complexity of movements.

For the design and selection of workplaces for VDT office tasks the following five interrelated principles apply:

— versatility-flexibility;

— fit;

— postural change;

— user information;

— maintainability-adaptability.

The statements of this clause are intended to provide general principles and guidelines underlying the requirements and recommendations given in Clause **5**.

4.2 Versatility and flexibility

Workstations should enable the intended user population to perform a range of tasks comfortably and efficiently. In addition, workstation design should be appropriate for the range of tasks to be performed at the workstation, taking into account user characteristics (e.g. keyboard skills, anthropometric variation and user preferences). It should also be dependent upon usage times such that the longer the time spent at the VDT, the more important is the observance of good workstation design.

4.3 Fit

Selection and design of furniture and equipment requires a fit to be achieved between a range of task requirements and the needs of users. The concept of fit concerns the extent to which furniture and equipment (work chairs, work surfaces, visual display units, input devices, etc.) can accommodate individual users' needs.

Good fit is needed for the intended user population including users sharing workstations and users with special needs, e.g. handicapped persons. Fit can be accomplished by furniture built for a specified use (or user), or be provided in a range of sizes and forms or by adjustability and combinations thereof.

Since, except under special circumstances, workstations cannot be custom-made for individual users, some alternative forms of ensuring a good fit are required. The extent to which the workstation provides a good fit between the requirements of users and their work should be of primary consideration.

4.4 Postural change

The workplace organization, the task and the furniture should encourage voluntary postural changes.

Postures adopted by users and the need for changes in posture are very markedly influenced by work organization and in particular, task requirements.

4.5 User information

The users should be informed why and how the furniture and other devices (e.g. support for the visual display unit) should be adjusted.

Where specific skills are required for achieving a comfortable and efficient workplace, for example in adjusting work chair or worksurface heights or finding a satisfactory viewing distance, adequate user information and training in such skills should be provided. It is desirable that the design of furniture should minimize the need for training and for user information.

Guidance and training on the above factors should be given to users to ensure that they are fully acquainted with the design and functioning of the workplace and feel competent and confident to use the workplace properly. In particular, training should ensure that users are familiar with the mechanisms of adjustment and how to decide when furniture adjustment for the individual user and task is needed.

4.6 Maintainability-adaptability

Requirements for task performance, in addition to workplace design, should also take into account factors such as maintenance, accessibility, and the ability of the workplace to adapt to changing requirements.

Workstation designers should consider that access for maintenance can be accomplished easily and that disruption to ongoing task performance is minimized.

Workstation design should also facilitate adaptation of furniture and equipment in response to changing requirements and circumstances.

5 Design requirements and recommendations

5.1 General

This clause contains requirements and recommendations for the configuration of VDT workstations that will facilitate comfortable and efficient operation. Subclauses **5.2**, **5.3**, **5.4**, **5.5**, **5.6** and **5.7** identify the parameters aimed at accommodating an individual user in terms of performance requirements, body clearance, acceptable and preferred postures and comfort.

The main factors in determining appropriate workstation arrangements are seat and worksurface, line-of-sight angle, worksurface and keyboard height, knee clearance, forearm inclination and elbow height.

Furniture, equipment, and work environment may be designed for use in the seated or standing position and where sitting and standing alternate. Workstations need to be capable of supporting several tasks (screen viewing, keyboard input, non-keyboard input device usage, writing, etc.) and should therefore be designed with such functions in mind. The philosophy taken in this part of ISO 9241 is that work organization, job content and furniture design should encourage user movement. This means that prolonged static sitting posture is minimized and that more or less continuous voluntary adjustments of the posture can be made.

5.2 Postures

5.2.1 *Design reference posture*

In order to be able to articulate acceptable requirements for comfort and performance with respect to body dimensions it is important to specify a design reference posture for purposes of specifying anthropometric data. While empirical evidence has indicated that the posture so specified could be comfortable for users carrying out certain tasks over short periods, it does not represent the optimum posture or the posture to strive for.

For purposes of referring to relevant anthropometric data, the following reference posture should be used (see Annex A):

a) the thighs positioned approximately in a horizontal position and the lower legs vertical; the seat height should be at, or a little below, the popliteal height of the user;

b) the upper arms hanging vertically with the forearms horizontal;

c) no deviation or extension of the wrists;

d) an erect spine;

e) the sole of the foot making an angle of 90° with the lower leg;

f) no twisting of the upper torso;

g) the line-of-sight between horizontal and 60° below the horizontal.

The design reference posture is shown in Figure 1.

NOTE 1 The distance between the forearms and the thighs depends on body dimensions and body proportions and varies in a wide range between humans. For a substantial percentage of persons, it is smaller than the distance shown in Figure 1.

The line-of-sight in the relaxed seated position is inclined approximately by 35° below the horizontal (see Figure 1). The optimum position for the most important visual display is within ± 15° in the vertical and horizontal direction from the line-of-sight.

NOTE 2 Placing a visual display in this position can cause glare problems if certain types of luminaires are used.

In the standing position, the inclination of the line-of-sight is about 30° (see Figure 2).

5.2.2 *Sitting postures*

The purpose of well-designed seating is to provide stable support which allows movement, comfort, and task accomplishment. The workstation design should allow dynamic sitting (see **5.5.3**).

5.2.3 *Standing and sit/stand postures*

The standing posture is recommended if it can alternate with a sitting position. This can be achieved if the workplace comprises either workstations or worksurfaces for sitting and standing postures or an adjustable workstation that can accommodate the same person in the seated and standing position (see Figure 3).

For chairs used at sit/stand workstations, stability aspects apply in both the seated and standing positions.

5.3 Ease of adjustment

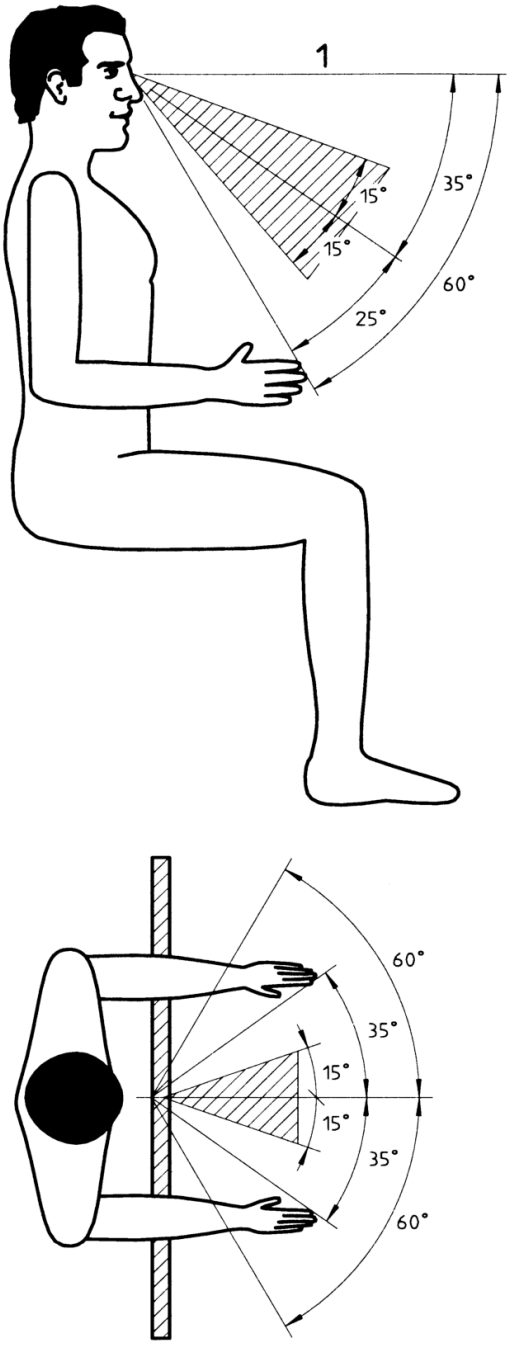
Furniture adjustment controls should be convenient and designed so that they encourage correct use (see **4.5**). For the design and placement of controls, the principles described in ISO 6385 apply:

— they should preferably be operable from the usual working position;

— they should not require undue force for actuation;

— they should not require any special training or special tools before adjustment can be made;

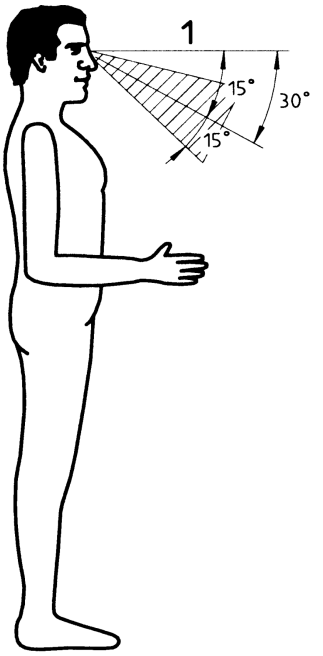
— controls should be designed to prevent unintentional actuation.



Key
1 Horizontal

This posture serves solely for design purposes, it is **not** the optimum posture for sedentary work!

Figure 1 — Design reference posture for sitting position



Key
1 Horizontal

Figure 2 — Design reference posture for standing position

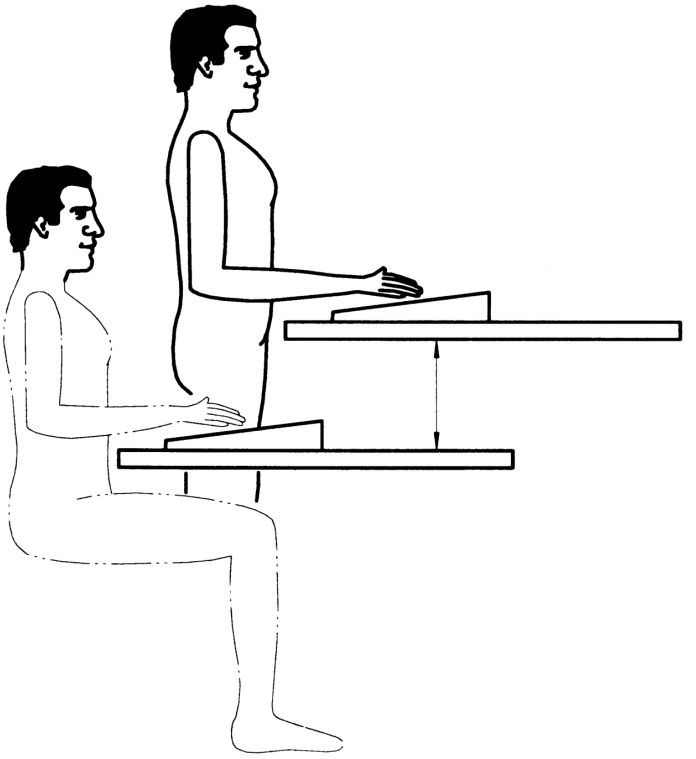


Figure 3 — Sit/stand posture and one way a workstation may support the postural change

The following criteria should be considered for placing adjustment controls:

— system engineering factors, e.g. nature and frequency of use;

— placement of the equipment;

— location(s) for the performance of task elements;

— placement of the furniture with relation to walls and partitions;

— ambient environmental conditions;

— placement of additional items (filing cabinets etc.).

The controls should be designed so as not to pose a safety problem during actuation. When the controls are not in use, they should not violate the clearance envelopes under worksurfaces specified in **5.4.2**.

5.4 Support surfaces

5.4.1 *General recommendations*

The worksurface should provide support for the display and input devices and associated equipment and material, as well as for the hands and arms of the user.

Support surfaces for displays and input devices and associated equipment and materials should allow adequate clearance for the user's anthropometric characteristics and postural changes.

For input device use, the height of the support surface should allow comfortable and efficient posture of the upper arms, forearms and hands. The furniture should therefore be sufficiently flexible to allow postural changes and to provide sufficient comfort to conduct the tasks efficiently. The work surface should be height adjustable, and, when required by the task, also tiltable.

5.4.2 *Clearances under worksurfaces*

For seated and standing work, sufficient vertical, horizontal and lateral clearance between the torso and lower limbs of users (legroom height, width and depth) and workstation components (underside of worksurface, desk drawers, table legs, etc.) is needed. The considerations are for

— postural changes and comfort;

— ease of use of VDT equipment and associated tasks;

— safety (stability, structural integrity, lack of injury); and

— ease of standing and sitting.

These considerations apply to both single workstations and combinations of workstations. The main considerations are for clearance for thighs, knees, lower legs, and feet. Furniture designed to accommodate a specified user population shall achieve fit for the range suitable for the intended user population. This range can be covered by applying the concept of fit. If fit (in vertical, lateral and horizontal directions) is to be achieved by adjustable surfaces only, it shall be able to accommodate a minimum range from the 5th percentile female (at the lower setting) to the 95th percentile male (at the upper setting) of the intended user population. While designing non-adjustable furniture as industrial products, the clearance envelope for 95th percentile males shall be used. Where particularly tall or particularly short individuals are not accommodated by such requirements, and depending upon task and criticality factors, they can often require other approaches to fit (e.g. custom built). General guidance is given for information in Annex A.

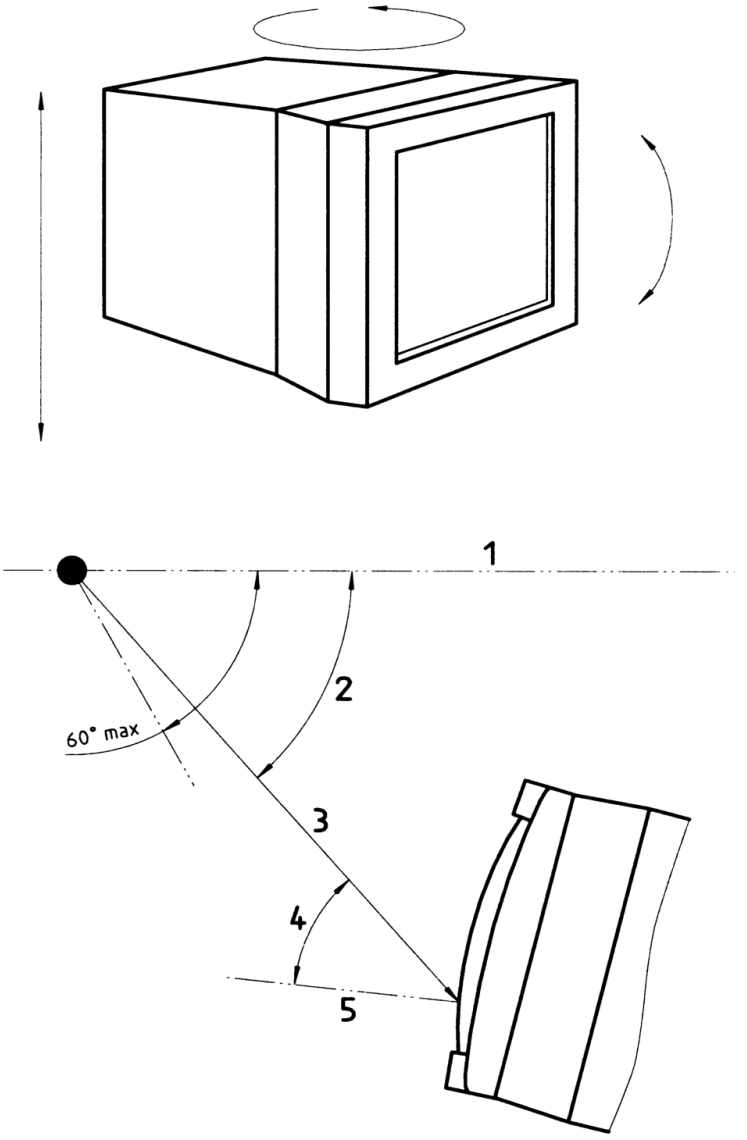
5.4.3 *Viewing distances and angles of view*

The user should be able to angle, tilt, or swivel the visual display unit in such a way that she or he maintains a relaxed working posture regardless of the eye height, minimizes accommodative effort, and avoids disturbing reflections and glare. Height adjustment is also preferred (see Figure 4). Adjustability should be achieved by mechanisms built into the visual display unit or by special device(s) which form part of the furniture or the display itself. It should not be dependent upon the user propping up the unit with objects such as books or manuscripts. Mechanisms of adjustment should be intelligible, unambiguous, and easy to operate.

The angle of view (optimum 0°) should not exceed 40° anywhere on the active display area. Specific constraints over viewing distances and angles should be considered in relation to users' visual correction and age. More importantly, viewing distances and angles should be related to task requirements and support a neutral working posture.

5.4.4 *Finish of the work surface*

The finish of the work surfaces should not exceed silky matt (corresponding to 45 gloss units or to a 60°-reflectometer value of less than 20) to minimize specular reflections. Reflectance values for the visible parts of the worksurfaces should be selected to avoid undue luminance contrast to the equipment and other items within the field of view.



Key

1 Horizontal
2 Line of sight angle
3 Line of sight
4 Angle of view 40° max.
5 Surface normal

Figure 4 — Recommendations for adjustability and for angles of view

There should be no sharp edges or corners on work surfaces and their supporting framework which could cause injury or discomfort to users. The minimum radius on edges and corners should be 2 mm. However, a larger radius is recommended.

5.4.5 ***Safety and stability aspects of workstations***

The level of inherent or transmitted vibrations should be as low as possible, suitable to the task and to ensure safe and comfortable use of the workstation and equipment.

The worksurface, loaded with intended equipment, should not tip over if a person leans on any side or sits on the edge. Parts of the equipment should not tip over when loaded with intended work items (paper, visual display units, etc.) and operated as intended.

NOTE In many countries, there are safety and stability requirements for workstations which are mandatory and which therefore take precedence over the recommendations in this part of ISO 9241. The methods for testing such requirements are governed by local safety regulations.

If tables are height adjustable, the adjustment shall be stable and safe.

If drawers are part of the workstation, it shall not be possible to pull a drawer out unintentionally so that it falls.

5.4.6 ***Energy loss to contact surfaces***

The worksurface and parts of the supporting framework which come into contact with the user during the intended use should not allow undue loss of energy from the body or feel cold to the touch.

5.5 Work chair

5.5.1 ***General considerations***

The purpose of good seating is to provide stable body support in a dynamic posture which is comfortable over a period of time, physiologically satisfactory and appropriate to the task or activity which is to be performed. The main considerations are that

a) blood circulation in the lower limbs is not restricted;

b) it is easy to maintain and change posture;

c) it provides support for the spine;

d) the surface is one with a sufficient level of friction to avoid sliding off the seat; and

e) for comfort, the surface is permeable.

Subclauses **5.5.2**, **5.5.3**, **5.5.4** and **5.5.5** specify requirements and recommendations to achieve these aims.

5.5.2 ***Parameters related to fit***

5.5.2.1 *Relevant design parameters*

Fit is required for the following design properties:

— seat height;

— seat depth;

— seat width;

— back support;

— arm support, if provided.

Table 1 — Design properties and relevant reference parameters

Design property	Relevant reference parameters (see Annex A)
Seat height	Popliteal height, sitting
Seat depth	Buttock-popliteal length
Seat width	Maximum hip breadth, sitting
Back support	Height of the mid lumbar area over the seat

5.5.2.2 *Seat height*

The appropriate seat height for a user for sitting in the upright position is the popliteal height plus the thickness of footwear. Work chairs designed to accommodate a specified user population shall achieve fit for the range suitable for the intended user population. This range can be covered by applying the concept of fit.

Within a selected range of adjustability, the seat height shall be user adjustable.

5.5.2.3 *Seat depth*

The fit for seat depth is achieved if the depth is less than the buttock-popliteal length of the user. Work chairs designed to accommodate a specified user population, can achieve fit by either adjustability or by using different sizes of the seat pan for the range suitable for the intended user population.

Adjustable seat depth can be achieved either by adjusting the back rest in relation to the seat or by moving the seat pan in relation to the back rest. If the seat depth is fixed, priority should be given to proper back support since proper back support is more important than the support of the whole length of the thighs.

5.5.2.4 *Seat width*

For seat width, fit is achieved when the seat width is wider than the width of the hips. Work chairs with armrests designed to accommodate a specified user population should achieve fit for the maximum width of the hips.

5.5.3 ***Dynamic aspects of seating***

5.5.3.1 *Relevant design parameters*

Together with job content and the design of other furniture elements, seating design plays an important role in encouraging movement. Thus, seat design should allow frequent posture adjustments by the user.

Four major aspects of seat design contribute directly to this goal: seat angle, movement of the seat pan and back support, castors and swivel.

5.5.3.2 *Seat angle*

The seat angle should allow users to vary their posture forward and backward. The benefit of changing postures in these directions is to ensure a good blood flow.

Seats may be designed with a fixed or adjustable seat angle. Adjustable seat pans may incorporate a forward as well as a rearward tilt.

5.5.3.3 *Movements of the seat pan and back support*

The movements of the seat pan and the back support should allow users to vary their posture to suit user comfort and changes to task requirements. The movements of the seat pan and the back rest can occur independently from each other with one of the two elements fixed, or the angle can open up by simultaneous movement of the seat pan and the back rest in a preset ratio greater than one.

The design should take into account that users should be able to set and change positions at any time.

5.5.3.4 *Castors*

Castors are generally recommended for work chairs used at VDT workstations to enable users to easily and safely move for short distances within the workstation to facilitate desired proximity to equipment that supports changing task requirements.

The type of castor shall suit the properties of the floor surface. The work chair shall not travel unintentionally when occupied or unoccupied. The work chair shall not move away easily when unoccupied. Castors with a low resistance cannot be used safely on a hard floor surface.

5.5.3.5 *Swivel*

The swivel should enable users to easily and safely rotate their body orientation without rotating the spine or twisting the torso in order to facilitate desired proximity to equipment that supports changing task requirements.

5.5.4 ***Back support***

The back rest should be capable of providing support to the back of the user in all sitting positions. Back rests can be designed to give support for different parts of the back.

Back rests should be designed to give support particularly for the lumbar region of the body. Postural changes should also be supported by movement of the back rest and seat-pan (see Figure 5).

A low-level back rest should commence at a level which clears the major protuberances of the buttocks, have a maximum prominence in the mid-lumbar region (to aid lordosis and to prevent kyphosis); and conclude below the level of the shoulder blades, so as not to inhibit upper body movement.

For some types of work where reclining posture is essential, higher back rests which also provide support for the shoulder blades are recommended.

Higher back rests should have a forward convexity in the lumbar region which gently merges into a plane surface or concavity.

5.5.5 ***Arm support***

For special working tasks and for moments when work is interrupted, armrests can support the muscular system of neck and shoulders and can be an aid to standing up and sitting down. For armrests with height and width adjustability, the range should cover the range from 5th percentile female to 95th percentile male of the intended user population. Where armrests are provided they:

a) should not restrict the VDT user's preferred working posture; if armrests obstruct the user they should be adjustable or detachable;

b) should not restrict ease of access to the workplace; in particular the height should not prevent the work chair being slid under the worksurface.

5.6 Additional support elements

5.6.1 ***Document holders***

In tasks where the VDT user works from hard copy, a document holder is recommended. It allows the source document to be positioned at a height, visual distance and plane similar to that of the display itself. The document holder reduces the amount of head, neck and eye movement required when scanning between different visual objects. To accommodate variations in legibility of source documents and visual requirements of individual users, the document holder should be adjustable both in angle and distance. Document holders that are to be placed at the same height as the visual display unit should be height adjustable.

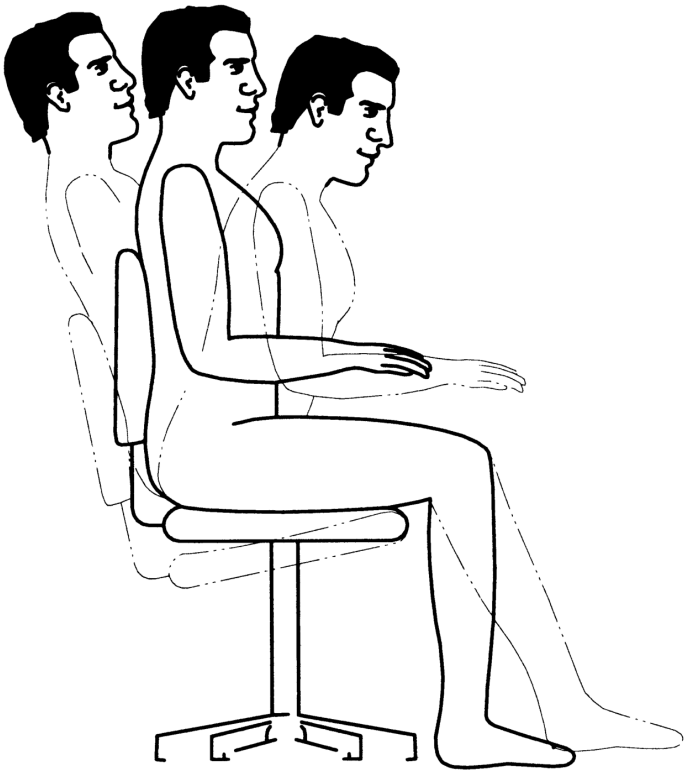


Figure 5 — Support for postural changes by movement of back rest and seat-pan

The document holder should be of a size that comfortably accommodates the size of the documents, preferably slightly smaller than the size of the documents in both directions to allow easy access. The surface of the document holder and ruler should be non-glossy. No light should be transmitted through the document holder to avoid impairments of the readability of source documents. The document holder should be stable so that it is unaffected by movement of the worksurface and sufficiently robust to support heavy documents where they are needed.

5.6.2 ***Footrest***

A footrest can be an additional support to obtain a comfortable angle between legs and feet and a means to create variations in the work postures. A foot support is necessary in cases where the work chair height is to be set in a position which does not allow a VDT user's feet to rest flat on the floor.

It should be possible to position the footrest on the floor where required and it should not move unintentionally while in use. Its surface should be nonslip and of sufficient size to allow some freedom of movement. The inclination of the support surface should be adjustable.

5.6.3 ***Support for the hands/wrists/forearms***

Positioning of keyboards and of other input devices and provision of support for the hands, wrists, and forearms should aim to reduce static loading of the upper limbs, reduce the work of neck and shoulder muscles, and reduce the need for undue flexion, extension and deviation of the wrist.

Support can be accomplished by

a) the provision of a free space of sufficient depth (at least 100 mm) on the support surface immediately in front of the input device. Care should be taken that the leading edge of the work surface is designed so as not to cut into the wrist;

b) incorporating a hand support into the design of the device;

c) providing a hand/wrist support separately from the input device. The usefulness of such a device will depend upon the characteristics of the workstation (especially keyboard design), the keying skill of the user, and preferred posture.

The design of a separate hand/wrist support should incorporate the following features:

1) since the hand/wrist support is used only occasionally or intermittently while the hands are resting, the design should minimize static posture and should not restrict the keying action or preferred working posture of the user in any way;

2) the surface geometry should match the height and slope of the keyboard surface;

3) the depth should be 50 mm to 100 mm, depending on the design of the specific input device;

4) the leading edges should be designed so as not to cut into the wrist or hand;

5) the width should be at least that of the keyboard or adequate for the task;

6) the support should be stable during use.

5.6.4 *Workstations with swivel arm for the visual display unit and height adjusting accessories*

From an ergonomics point of view the use of swivel arms is not generally recommended because their use can contradict other recommendations of this part of ISO 9241 (e.g. viewing angles).

However, under special circumstances their use can be helpful (e.g. where worksurface space is constrained).

Where a swivel arm is installed, it is important to ensure that, apart from the other requirements given above, the following are met:

a) the height of the top line on the display is not higher than eye-height;

b) the design mechanism and height adjustment ensures mechanical stability;

c) the dimensions of the display support on the swivel arm are commensurate with the size of the visual display unit and provide a secure footing for the equipment on the display support e.g. in the form of recesses for the feet or raised edges;

d) when not in use, the keyboard can be positioned on the swivel arm in a stable easily reachable location. For operation, it should be placed on the work surface.

5.7 Layout of workstations within the work space

5.7.1 *General considerations*

The layout of workstations within a work space should be planned and carried out taking the relevant factors as described in ISO 6385 into account. Special attention should be paid to:

a) **access for the user:** the design of the workstation and its position within the workspace should not restrict or hamper user's access to their workstations;

b) **access for maintenance purposes:** the design of the workstation and its position within a room should not hamper access to parts of the equipment, positions of wiring, and plug sockets for maintenance purposes;

c) **working groups:** work flow, task requirements, and social aspects;

d) **space availability:** constraints (e.g. caused by artificial and natural lighting) and local legal requirements for minimum space;

e) **the need for shared workstations;**

f) **lighting** (see ISO 9241-6);

g) **access for cleaning purposes.**

For detailed guidance see ISO 9241-6.

5.7.2 *Cable management*

Cable management shall be planned and carried out taking the layout of the workstations within a work environment into account.

The distribution of wiring and cables (mains, data, telephone, etc.) should be very carefully considered in relation to user's needs. Cable management should be arranged so that the following recommendations are met.

a) Safety — connections should be securely fastened so that they do not represent a hazard by trailing across worksurfaces or floors. These should be carried in horizontal or vertical ducting to the required point.

b) Length — the length of the cables should be sufficient to accommodate actual and foreseeable user needs, taking particular note of a likely rearrangement of room layout. This includes the provision of excess space capacity in ducting for new cables.

c) Accessibility — the workstation should allow easy access for maintenance and cleaning without undue disruption to work activities.

d) Adjustable worksurfaces — the cabling should be capable of covering the total adjustment range if adjustable surfaces are provided.

6 Conformance

Conformance with this part of ISO 9241 can be achieved by meeting all requirements of clause **5**.

Conformance with this part of ISO 9241 can only be achieved in relation to a specified user population, the "intended user population". Unless otherwise declared, the intended user population is not restricted to certain user groups.

Current design practice for industrial products takes the relevant anthropometric dimensions of the 5th percentile of female to 95th percentile male working population into account. The relevant anthropometric dimensions are contained in Annex A.

Local safety regulations should also be considered.

7 Measurement

7.1 Support surfaces

Compliance with **5.4.2** at a workstation is given if the height of the legroom is greater than thigh clearance height, sitting + popliteal height, sitting + allowance for footwear (see Annex A). For the design of industrial products, calculate the clearance using the statistical values for the intended user population. For furniture with fixed height, use thigh clearance height and popliteal height, sitting for the 95th percentile, male of the intended user population.

7.2 Safety and stability aspects of workstations

Compliance with **5.4.5** is given if all user adjusted positions of support surfaces remain unchanged.

Determine whether the drawers are protected against being pulled out completely during intended use (pulling force exerted in the direction of movement).

7.3 Seat height

Compliance with **5.5.2.2** is given if the variability of the seat height is sufficient to allow persons from 5th percentile of female to 95th percentile male of the intended user population to adopt the design reference posture.

7.4 Castors

Compliance with **5.5.3.4** is given if castors for the specific type of floor surface (hard or soft) are used. The testing of resistance to unintentional travel is usually part of local safety testing of work chairs.

7.5 Layout of workstations within the workspace

Compliance with **5.7.2** requires a report stating how cable management has been planned taking the layout of the workstation within the environment into account.

Annex A (informative)
Anthropometric data needed for workstation design and selection

A.1 Selecting an anthropometric data set

When selecting anthropometric data sources, it is important to know how they have been derived and what factors govern their relevance to the required use.

In the context of International Standards, it is important that the anthropometric data set chosen should adequately reflect the body sizes and shapes of the intended user population.

If the anthropometric data have been collected from a small number (e.g. a sample of less than 1 000) or highly specific group of people, it is not likely to be appropriate for use in designing for the general population. A number of data sets are available, however, which avoid these problems either by being collected from very large samples or by the careful use of statistical techniques to extrapolate from smaller, but representative, data sets. The data used in furniture design should therefore be chosen to be representative of a group closely related to the group being designed for and preferably from a large sample. In relationship to furniture design, this should be the adult population. In defining "adult", it should be remembered that young people are not fully grown until the age of about 21, so it is necessary to include an age range of 16 to 65 to accommodate the working population.

Anthropometric data are usually separated into gender and age groups. This can be extremely useful if the design is specifically for use by a single sex group or for a specific age range. However, if this is not relevant, the data from different groupings can be combined.

Most anthropometric data have been collected from nude, or near-nude, subjects so some allowance needs to be made for clothing. Some data sources, however, already include clothing allowance on certain dimensions; it is therefore extremely important to read the information provided with the data very carefully before using it. Table A.1 shows some useful indicators of the type of allowance.

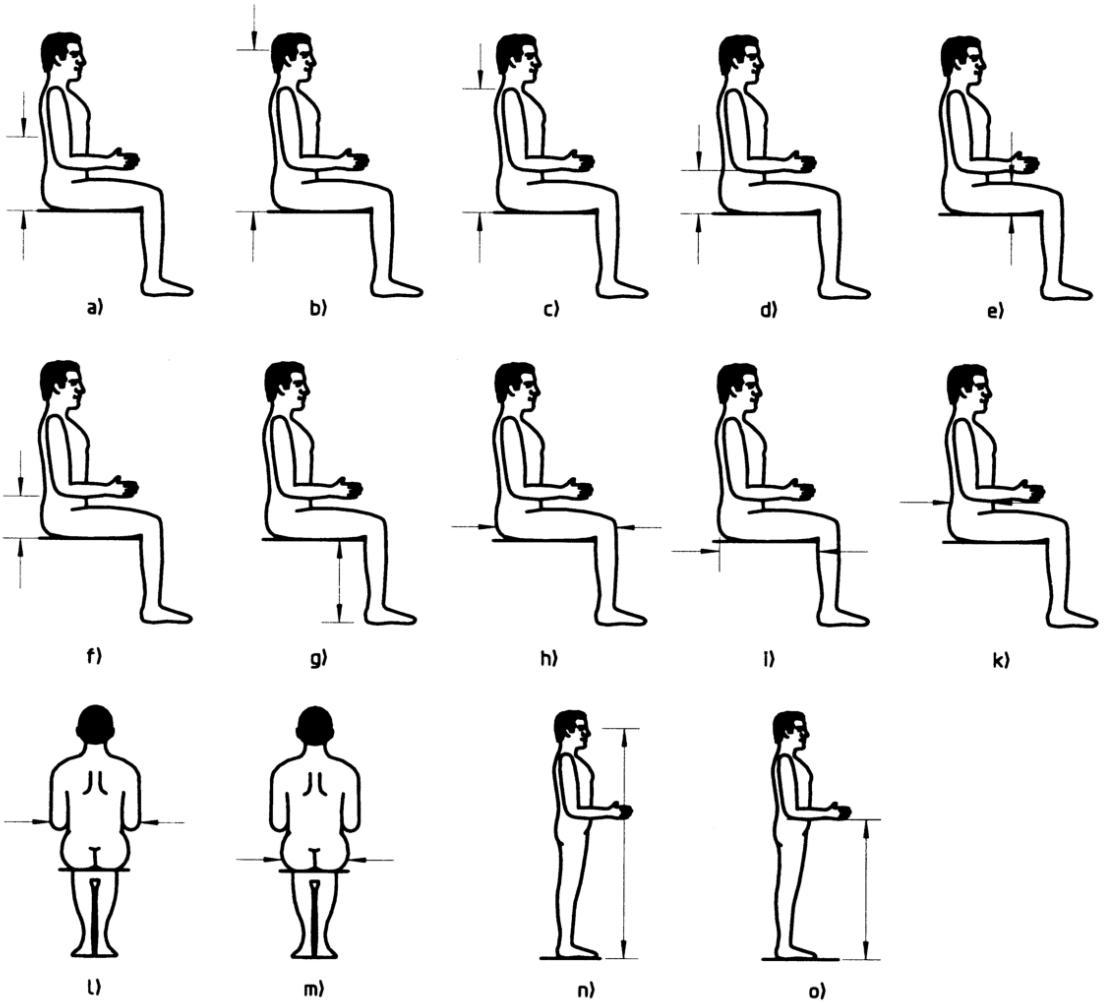
Another allowance that is often found in anthropometric data is the "slump factor". This is a correction made to the data collected from people adopting the classic "dummy" or erect posture. The "slump" convention is an attempt to simulate more natural postures. Data which state clearly that a "slump" factor has been included are preferable for applications such as the design of furniture.

Table A.1 — Clothing and related allowances

	Dimension	Allowance
1	Floor — Underside of thigh	30 mm footwear
2	Width between hips	10 mm for light clothing 25 mm for medium clothing
3	Sitting eye height	reduction of up to 65 mm (40 mm for slump and 25 mm for seat compression)
4	Shoulder height	reduction of up to 65 mm (40 mm for slump and 25 mm for seat compression)
5	Seat-back rest height	$\leqslant$ 25 mm for seat compression

Clothing and related allowances for other dimensions are minimal for indoor clothing under moderate temperature ranges.

For the purpose of workstation design, there are only a small number of external body dimensions of primary importance to be considered, as shown in Figure A.1. Definitions are derived from ISO 7250. For each dimension given, the relevant letter from Figure A.1 is shown.



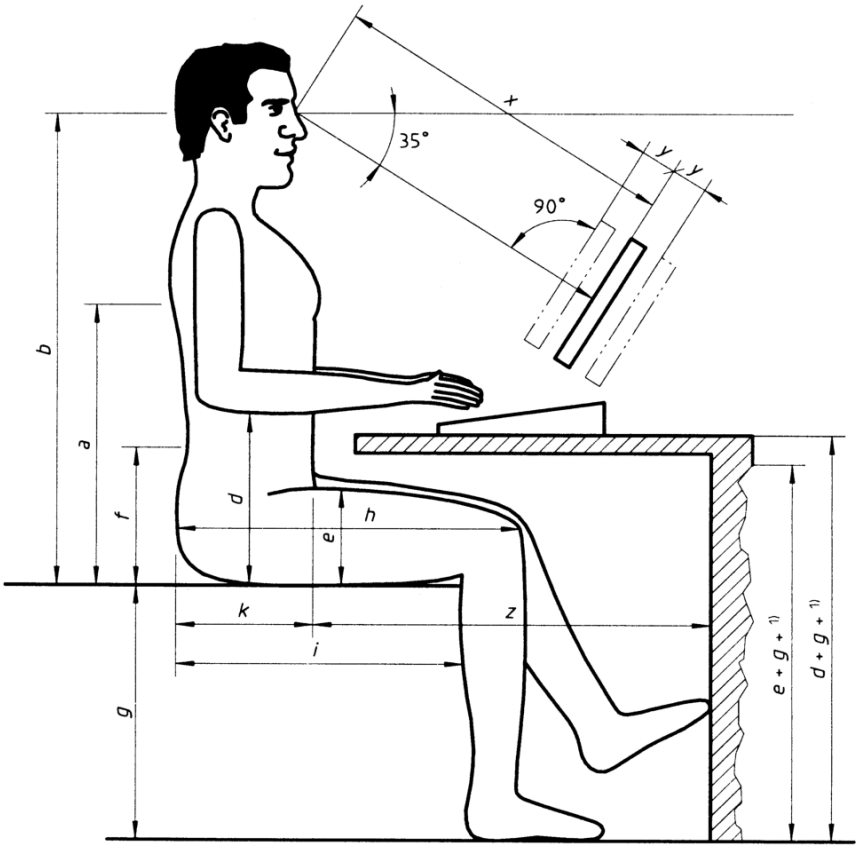
Key

a) height of bottom corner of scapula
b) eye height, sitting
c) shoulder height, sitting
d) elbow height, sitting
e) thigh clearance height, sitting
f) buttock height above seat level
g) popliteal height, sitting
h) buttock knee length
i) buttock popliteal length
k) buttock abdomen depth, sitting
l) elbow-to-elbow breadth
m) hip breadth
n) eye height, standing
o) elbow height, standing

Figure A.1 — Important anthropometric dimensions for determining design of sitting and standing VDT workplaces

A.2 Use of selected anthropometric dimensions: seated posture

The relationship between anthropometric dimensions and some specified design parameters is summarized in Figure A.2. For actual workplace specifications, anthropometric data based upon the intended user population should be used.



1) Allowance

Figure A.2 — Dimensioning of a workstation using anthropometric data of the intended user population (sitting position)

A.2.1 *Seat height*

This dimension is defined as the maximum height of the undersurface of the thigh behind the knee and is described technically as the POPLITEAL HEIGHT, sitting (*g*) (lower leg length).

This dimension is important in ensuring comfort of the lower limb avoiding pressure on the underside of the thigh caused by too high a seat height or unnecessary spinal lean if too low. It is also of importance in setting the hand position and, given that it dictates sitting eye height, it is also a critical factor in determining lines of sight.

The range of seat height adjustability needs to cater for the lower to the higher percentile of the population for which the design is being prepared. The measures found in anthropometric data are usually for a vertical lower leg. In addition, allowance should be made for footwear and variation in sitting postures. Furthermore, it is not acceptable to assume that people should be expected to stay permanently with their legs in a vertical position; this means that the lower leg should also be able to reach the floor forward of the knee, giving the benefit of a knee joint angle greater than 90°.

A.2.2 *Seat depth*

This dimension is defined as the maximum depth of the seat front to back rest and is described technically as the BUTTOCK-POPLITEAL LENGTH (*i*) seat depth.

This dimension is important both to ensure that the legs can be positioned without compression at the back of the knee and to enable the buttocks to be positioned to enable full use of the back rest.

The back of the knee has relatively sensitive skin and little padding over the tendons and so the seat depth should be slightly shorter than the buttock to back of knee dimension to allow for this. Allowances for clothing of the buttocks and the popliteal should be included.

For designing industrial products, usually the seat depth is determined by the smallest person in the design range if no adjustability is provided. The effect of having the seat too long is to prevent the back rest from being used to support the low back. This gives the back a pronounced rearward curvature (kyphosis) and will lead to discomfort.

A.2.3 *Seat width*

This dimension is defined as the width across the hips and is described technically as HIP BREADTH, sitting (*m*).

Apart from the obvious need to ensure that a reasonable range of the intended user population (95th percentile) can get into and out of the work chair easily, this dimension is one of the most crucial in ensuring that the user will have the flexibility to adjust, at will, his/her posture to relieve postural loading.

Hip breadth is not the widest part of the body on the seat but is a commonly available dimension. Seat width should exceed the seated hip width of the largest individual in the design range. Because of the spread of the legs when sitting, the anthropometric dimension across the hips is less than should be allowed for when calculating seat width. Allowances for clothing should be added to each side of the body, and extra width for movement if arms are fitted to the seat.

A.2.4 *Eye height, sitting*

This dimension is defined as the erect eye height (specifically the outer corner of the eye) from the plane of the seat pan and is described technically as EYE HEIGHT, sitting (*b*).

The eye height is important to ensure that the visual elements of the task can be accommodated without undue load on the neck shoulder and upper spine. It can also be of importance in maintaining visual contact between workers, or, alternatively, visual privacy (especially in relation to system furniture and similar concepts).

The dimensions used should either be the erect eye height or the slumped posture eye height, depending upon the feature to be designed.

A.2.5 *Armrest height*

This dimension is defined best (though not absolutely correctly) by the height of the elbow above the seat and is described technically as ELBOW HEIGHT, sitting (*d*).

The armrest height is related to the operator's elbow position, thickness of work surface top in conjunction with thigh height, and armrest separation. The armrest height interacts with the width of the seat and the separation of the armrest because a small user will have to raise the upper arm to the side to reach the armrest, or lean over to one side. This complex relationship needs more detail to be resolved than can be provided by simple linear anthropometric data.

A.2.6 *Armrest length*

The anthropometric measurement used to define this dimension is the depth of the trunk or stomach regions of the body and is described technically as BUTTOCK-ABDOMEN DEPTH, sitting (*k*).

This dimension is important in maintaining the ability of the user to get as close as possible to the work surface while maintaining the effective use of the back rest.

The armrest length determines how close to the work surface the seat back rest can be for a small seated user. In designing armrests, their maximum length, if they are higher above the seat than the thigh thickness of the small user (and therefore will not go into the kneehole), is determined by the body thickness of the small operator. If the armrest is too long, the small user is unable to sit close to the work surface and gain support from the back rest of the seat.

A.2.7 ***Inside distance between armrests***

This dimension is described as ELBOW TO ELBOW BREADTH (*l*).

It is relevant in ensuring that the armrest does offer a comfortable resting position for the arms without being too cramped. It is also important in ensuring that the hips clear the armrests when getting into and out of the work chair. Bearing in mind these two factors, the choice should always be towards the maximum dimension. As mentioned in **A.2.5**, this dimension should always be considered in conjunction with armrest height, as the two interact significantly.

A.2.8 ***Shoulder height***

This dimension is relevant to maintaining the comfort of the upper body, and can be used in conjunction with arm length to define the position of a number of elements in the workstation. It is defined as either the sitting shoulder height from the floor (reference plane) or as the shoulder height from the seat plane and is described as SHOULDER HEIGHT, sitting (*c*).

This dimension establishes an approximate shoulder height above the work surface. If the length of the arm is known, the shoulder height can then be used to determine the minimum acceptable height of drawer handles, drawer interiors, or the approximate position of seat adjustment mechanisms. To some extent, it can also be used to determine the size of a work surface if the whole area is to be reached by the hand, or the position of shelving in a workstation.

A.2.9 ***Seat to underside of work surface***

This dimension dictates the degree of movement, crucial to enable varied posture, available to the lower legs. It can also have an important influence on the height at which the hands will be expected to work.

The anthropometric measurement which is of most use in defining this dimension is the maximum thickness of the thigh above the seat, although in this case it is, in itself, incomplete without an allowance for movement. This dimension is described technically as THIGH CLEARANCE HEIGHT, sitting (*e*).

The thickness of the work surface is related to the difference between the elbow height above the seat and the maximum height of the thigh of the user. Care should be taken to consider a small user with relatively large thighs. The seat height that users adopt is related to the under work surface height and the thigh thickness, such that small users tend to elevate a seat to bring them as high as possible without the thigh being in contact with the underside of the work surface. This can be higher than the seat height determined by the popliteal to floor height of the large user. In many instances, small users will need to use a footrest to maintain a satisfactory leg support at that height. Maximum thigh thickness is also used, together with popliteal to floor height, to determine the clearance for the legs of large users.

A.2.10 ***Kneehole depth***

The relevant anthropometric dimension is described technically as BUTTOCK-KNEE LENGTH (*h*).

This dimension is significant in providing sufficient room to allow the user freedom to vary lower body posture.

The minimum dimension is defined anthropometrically by the distance between the back of the buttocks and the front of the knees, although obviously, if freedom of movement is to be provided, an allowance beyond this is required. This is the minimum distance under the work surface that needs to be kept clear for the legs of large users. In this application, users with relatively small trunk thicknesses and large thigh lengths should be considered. Room is also needed to allow for leg movement and stretching.

The kneehole depth should be selected to allow sufficient movement of the legs while working in the seated position. The dimension (*z*) can be calculated using the dimensions (*h*) and (*k*) (see **A.2.6**) and by assuming an extension of the knees by 30° from the design reference posture, and by adding an allowance for the length of the foot.

A.2.11 ***Seat back rest height***

The height of the back rest of the seat needs to be defined to ensure adequate support for the back and an acceptable curvature to the spine, thereby minimizing static loading and reducing the likelihood of back pain. Two dimensions need to be specified.

a) the minimum lower boundary, described technically as BUTTOCK HEIGHT ABOVE SEAT LEVEL (*f*).

This indicates where the solid mass of the pelvic bones ends and the flexible portion of the spinal column starts. This dimension should be used to provide room for the buttocks in back rest design;

b) the maximum upper boundary, described technically as HEIGHT OF THE BOTTOM CORNER OF THE SCAPULA (*a*).

NOTE This dimension is not defined in ISO 7250.

This dimension indicates the position of the shoulder blade. To prevent the seat back rest interfacing with forward arm movement, when the shoulder blade moves, the seat back rest should be lower than height *a*. However, in jobs with prolonged seated operation, as, for example, in computer-based operations, a higher back rest can have many advantages. The need for freedom of movement of the shoulder blade depends on the type of job being done. In many instances, the upper body leans forward when the arms are being used and the shoulder blades are not in contact with the back rest. In circumstances where the operator has to turn to the side or the rear without the seat being able to rotate (i.e. the seat is in the kneehole) the back rest needs to be lower than the shoulder blades, as most of the rotation takes place in the chest area.

A.2.12 *Viewing distance (x) and its variation (y)*

The optimum distance between the visual display and the user's eyes depends on various factors. The design viewing distance, i.e. the distance specified by the manufacturer of the display is set to $\geqslant$ 400 mm (see ISO 9241-3). The optimum viewing distance for office work in the seated position is 600 mm. However, individual users tend to prefer settings between 450 mm and 750 mm ($y = \pm$ 150 mm). Viewing distances in this range require character heights that subtend between 20′ and 22′ (see ISO 9241-3).

Some technologies require longer viewing distances in order to display an image with a given quality. For example, the minimum visual distance for television screens is four times the diagonal of the viewing area. Visual symbols, composed of elements with different colours, can also require a minimum viewing distance. If a workstation comprises visual displays of different technologies, the viewing distances under which optimum visual conditions can be achieved should be determined before organizing and dimensioning the workstation.

A.2.13 *Distance (z)*

The distance (*z*) between the user and the closest obstruction in the horizontal direction can be selected such that the lower legs can be moved without hitting the obstruction, assuming an angle of 30° (convention) from the vertically oriented lower legs.

A.3 Use of selected anthropometric dimensions: Standing posture

As with the seated posture, there are a small number of external body dimensions to be considered when designing or selecting VDT workplaces for use when standing.

The relationship between anthropometric dimensions and some specified design parameters is summarized in Figure A.3.

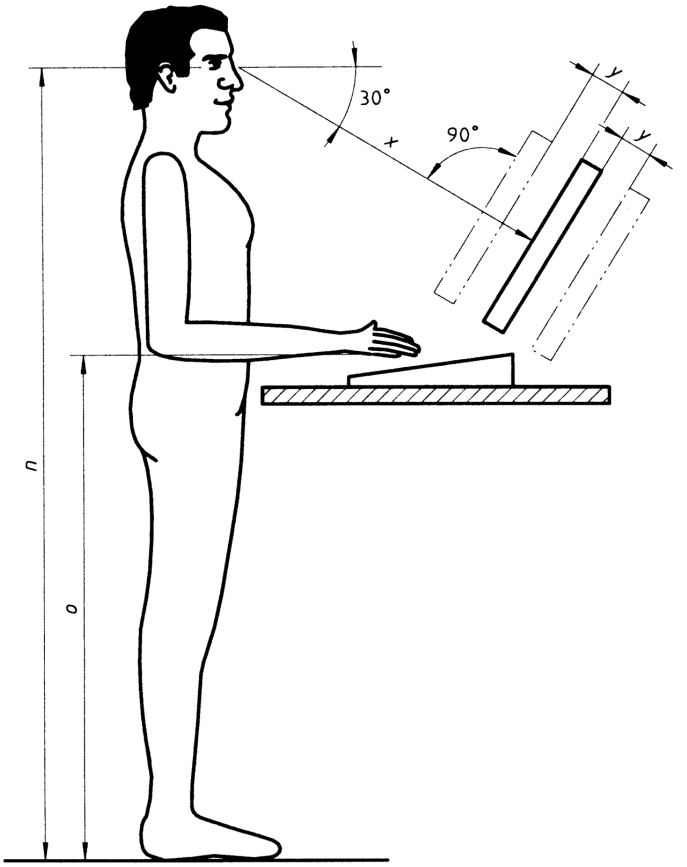


Figure A.3 — Dimensioning of a workstation using anthropometric data of the intended user population (standing position)

A.3.1 ***Eye height, standing***

This dimension is usually defined as the vertical distance from the floor to the inner corner of the eye and is described technically as EYE HEIGHT, STANDING (*n*). Depending upon the application, the dimension used should either be the erect eye height or the slumped posture eye height. For comfortable viewing of visual display terminals and related visual material, it should be remembered that, in the relaxed seated position, the head is tilted forward.

This dimension is important in determining that the visual elements of the task can be accommodated without undue load on the neck, shoulder, upper spine and lower limbs. It can also be important in maintaining visual contact between other users and customers or, alternatively, visual privacy.

A.3.2 ***Elbow height, standing***

This dimension is important in determining worksurface heights for office tasks carried out in a standing position. It is defined as the vertical distance from the floor to the lowest bony point of the bent elbow with the subject standing fully erect, the upper arm hanging freely and the forearm bent at right angles, ELBOW HEIGHT, STANDING (*o*).

Bibliography

[1] ISO 7250:1996, *Basic human body measurements for technological design.*

[2] CIE Publication 17.4:1987, *International lighting vocabulary* (IEC/CIE joint publication).

Annex ZA (normative)
Normative references to international publications with their relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

Publication	Year	Title	EN	Year
ISO 6385	1981	*Ergonomic principles of the design of work systems*	ENV 26385	1990
ISO 9241-2	1992	*Ergonomic requirements for office work with visual display terminals (VDTs) — Part 2: Guidance on task requirements*	EN 29241-2	1993

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National annex NA (informative)
Measurements

NA.1 General

This national annex provides numerical data which should be used in order to conform to this part of BS EN ISO 9241.

NA.2 Design

Further detailed information on general office furniture including safety and stability requirements and test methods is given in BS 5459, BS 5940-1, prEN 527[2)], and prEN 1335[2)]. Anthropometric data for use in the design and verification of dimensions of furniture can be obtained from either the BSI publication PP 7317:1987, *Ergonomics: Standards and guidelines for designers,* by S. T. Pheasant or the DTI publication *Adult data: The Handbook of Adult Anthropometric and Strength Measurements — Data for Design Safety,* DTI/Pub 2917/3K/6/98/NP.URN 98/736 [1].

NA.3 Heights of fixed work surfaces

Where the height of the work surface is not adjustable, the height of a fixed height work surface for sitting postures only should be 720 mm ± 15 mm.

The height of a fixed height work surface for standing postures should be 1 000 mm.

NOTE With a fixed height work surface, smaller users may need to adjust the height of the chair and use a footrest.

NA.4 Height-adjustable work surfaces

If a height-adjustable work surface is intended for sitting use only, the working height of the top surface should be adjustable from 660 mm to 770 mm.

If a height-adjustable work surface is intended only for standing use, the working height of the top surface should be adjustable from 900 mm to 1 200 mm.

If a height-adjustable work surface is intended for sitting and standing use, the working height of the top surface should be adjustable from 660 mm to 1 200 mm.

NA.5 Size of the work surface

The size of the work surface provided should be determined by the requirements of the whole task.

The depth of work surface depends mainly on the size and type of monitor [flat or cathode ray tube (CRT)]. It is important that eye-to-monitor distance, as defined in **A.2** of this standard, can be maintained. Hence, a simple method of calculating the depth of work surface is:

depth of work surface = eye-to-monitor distance + depth of monitor.

This calculation should provide sufficient free space, as defined in **5.6.3** of this standard, between the front edge of the work surface and the keyboard.

The back of monitors and cables may overhang the back edge of the work surface as long as they do not interfere with other user's work space or protrude into walkways.

NA.6 Clearance under the work surfaces

At the front edge of a fixed height work surface, the distance from the floor to the underside of the work surface should be not less than 650 mm. As long as the overall thickness of height-adjustable work surfaces is less than 60 mm sufficient legroom for users should be provided.

The clearance across the kneehole underneath the work surface should be at least 600 mm, but the preferred minimum dimension is 1 000 mm.

A clear minimum depth of 600 mm is the preferred depth for the kneehole. However, if for technical reasons, it is not possible to maintain a clear depth of 600 mm, the kneehole should have the following height clearances at depths of 200 mm, 450 mm and 600 mm:

a) 620 mm measured 200 mm from the front edge of the work surface;

b) 550 mm measured 450 mm from the front edge of the work surface;

c) 150 mm (200 mm preferred) measured 600 mm from the front edge of the work surface.

See Figure NA.1.

[2)] To be published

In order to allow users to stretch their legs forward (to an angle of 30° between lower leg and the vertical) and have an unobstructed area for their feet the measurement from the front to the rear of the kneehole at floor level should not be less than 750 mm.

NA.7 Chair

Chairs should only be of the swivel type and have five or more castors. See BS 5940-1 (prEN 1335-1) for requirements for chairs.

NA.8 Footrests

Footrests may have either a fixed or adjustable height and angle. The non-slip surface should have a minimum size of 450 mm in length and 350 mm in width. See BS 5940-1 (prEN 1335-1) for requirements for footrests.

NA.9 Cable management

Workstations with built-in cable management should conform to BS 6396.

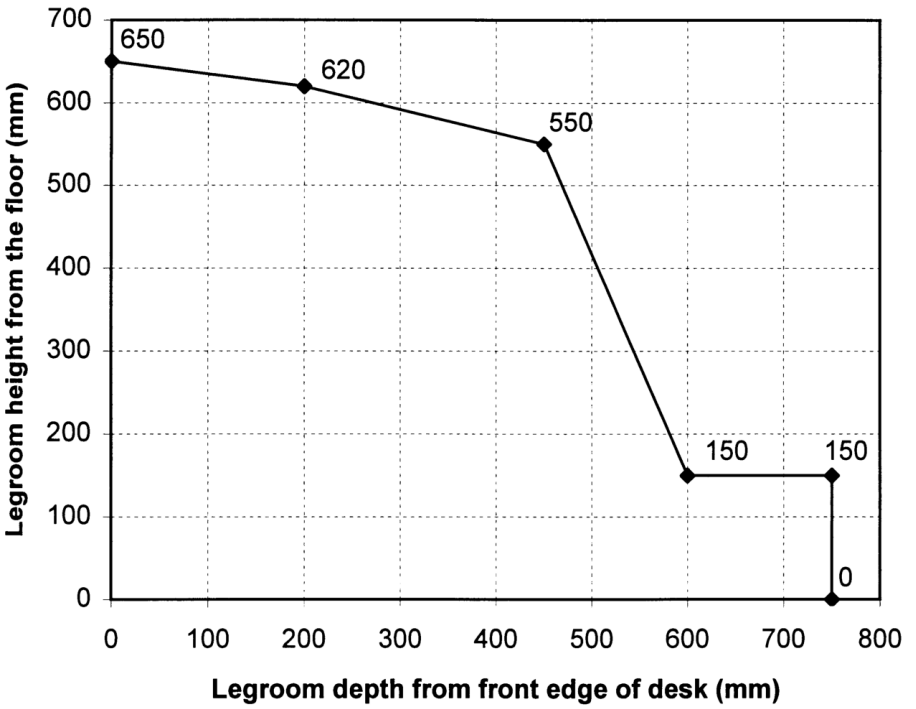

Figure NA.1 — Legroom height and depth under desks

NA.10 Publications

Standards publications

BS 5940-1, *Office furniture — Specification for design and dimensions of office workstations, desks, table and chairs.*

BS 5459-1, *Specification for performance requirements and tests for office furniture — Desks and tables.*

BS 5459-2, *Specification for performance requirements and tests for office furniture — Office seating.*

BS 6396, *Specification for electrical systems in office furniture and office screens.*

PP 7317, *Ergonomics: Standards and guidelines for designers* by S. T. Pheasant.

prEN 527-1, *Office furniture — Tables and desks — Dimensions.*

prEN 527-2, *Office furniture — Tables and desks — Safety requirements.*

prEN 527-3, *Office furniture — Tables and desks — Physical and mechanical characteristics of the structure — Test methods.*

prEN 1335-1, *Office workchair — Dimensions, determination of dimensions.*

prEN 1335-2, *Office workchair — Safety requirements.*

prEN 1335-3, *Office workchair — Safety test methods.*

NOTE BS 5459-2:1990 will be partially superseded by prEN 1335-2 and prEN 1335-3, when published. Details of other supersessions are not yet available.

Other documents

[1] GREAT BRITAIN. *Adult data: The Handbook of Adult Anthropometric and Strength Measurements — Data for Design Safety*. Pub 2917/3K/6/98/NP.URN 98/736. DTI. London. The Stationery Office.

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