
**Ergonomic design of control centres —
Part 4:
Layout and dimensions of workstations**

Conception ergonomique des centres de commande —

Partie 4: Agencement et dimensionnement du poste de travail

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11064-4 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

ISO 11064 consists of the following parts, under the general title *Ergonomic design of control centres*:

- *Part 1: Principles for the design of control centres*
- *Part 2: Principles for the arrangement of control suites*
- *Part 3: Control room layout*
- *Part 4: Layout and dimensions of workstations*
- *Part 5: Human-system interfaces*
- *Part 6: Environmental requirements for control centres*
- *Part 7: Principles for the evaluation of control centres*

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Introduction

This part of ISO 11064 establishes ergonomic requirements, recommendations and guidelines for the design of workplaces in control centres.

All types of control centres are covered, including those for the process industry, transport and dispatching systems or emergency services. Although this part of ISO 11064 is primarily intended for non-mobile control centres, many of the principles are relevant to mobile centres such as those found on ships, locomotives and aircraft.

User requirements are a central theme of this part of ISO 11064 and the processes described are designed to take into account the needs of users at all stages. The overall strategy for dealing with the user requirements is presented in ISO 11064-1. ISO 11064-2 provides guidance on the design and planning of the control room in relation to its supporting areas. Requirements for the layout of the control room are covered by ISO 11064-3. Displays and controls, human computer interaction and the physical working environment are presented in ISO 11064-5 and ISO 11064-6. Evaluation principles are dealt with in ISO 11064-7.

The ultimate beneficiaries of this part of ISO 11064 will be the operator within the control room and other users. It is the needs of these users that provide the ergonomic requirements that are addressed by the International Standards developers. Although it is unlikely that the end user will read this International Standard, or even know of its existence, its application should provide the user with interfaces that are more usable, and a working environment which is more consistent with operational demands and result in a solution which will improve system performance and will minimize error and enhance productivity.

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Ergonomic design of control centres —

Part 4: Layout and dimensions of workstations

1 Scope

This part of ISO 11064 specifies ergonomic principles, recommendations and requirements for the design of workstations found in control centres. It covers workstation design with particular emphasis on layout and dimensions. This standard covers primarily seated, visual-display-based workstations although sit/stand workstations are also addressed. These workstations are to be found in applications such as transportation control, process control and security installations.

2 Normative references

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

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

ISO 9241-5:1998, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 5: Workstation layout and postural requirements*

ISO 9355-2:1999, *Ergonomic requirements for the design of displays and control actuators — Part 2: Displays*

ISO 11064-3:1999, *Ergonomic design of control centres — Part 3: Control room layout*

ISO 11428:1996, *Ergonomics — Visual danger signals — General requirements, design and testing*

3 Terms and definitions

For the purposes of this part of ISO 11064, the following terms and definitions apply.

3.1

control workstation

single or multiple working position, including all equipment such as computers and communication terminals and furniture at which control and monitoring functions are conducted

[ISO 11064-3:1999, definition 3.7]

3.2

cone of fixations

angular extend to which the line of sight can be swept by rotating the eyeball in the skull while the head rests

3.3

legibility

visual properties of a character or symbol that determine the ease with which it can be recognized

[ISO 9241-3:1992, definition 2.17]

3.4

line-of-sight

line connecting the point of fixation and the centre of the pupil

[ISO 9241-3:1992, definition 2.18]

3.5

nearpoint

nearest viewing distance to which the eye accommodates

3.6

normal line-of-sight

inclination of the line-of-sight with respect to the horizontal plane, when the muscles assigned for the orientation of the eyes are relaxed

3.7

percentile

percentage of population of which specific characteristics fall below or are equal to a given value in a cumulative distribution

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3.8

reach envelope

three-dimensional space in which an operator can comfortably reach and manipulate controls by either hand while assuming a posture normally anticipated for the task

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3.9

task zone

space determined by the equipment and activities required for the conduct of a particular task

3.10

visual angle

angle subtended at the eye by the viewed object, e.g. a character or symbol

3.11

visual field, field of vision

physical space visible to an eye in a given position

[ISO 8995:1989, definition 3.1.10]

NOTE 1 In this standard the use of both eyes is assumed for visual field considerations.

NOTE 2 The position of the visual field depends on the direction of the line-of-sight.

NOTE 3 Separate, distinct stimuli in the visual field will be detected even if they appear simultaneously.

NOTE 4 While the extent of the visual field is approximately $\pm 35^\circ$ around the line-of-sight, only $1^\circ \dots 2^\circ$ of these are for sharp vision.

3.12

work environment

physical, chemical, biological, organizational, social and cultural factors surrounding a person in his or her work space

[EN 614-1:1995, definition 3.5]

3.13**work space**

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

[EN 614-1:1995, definition 3.4]

3.14**workstation**

combination of work equipment for a particular person in a work space

[ISO 11064-2:2000, definition 3.5]

NOTE It is possible that several persons share a particular control workstation, or that several persons alternate several workstations within any period of time (i.e., on an hourly, daily, weekly basis).

3.15**work task****task**

activity or activities required to achieve an intended outcome of the work system

[EN 614-1:1995, definition 3.2]

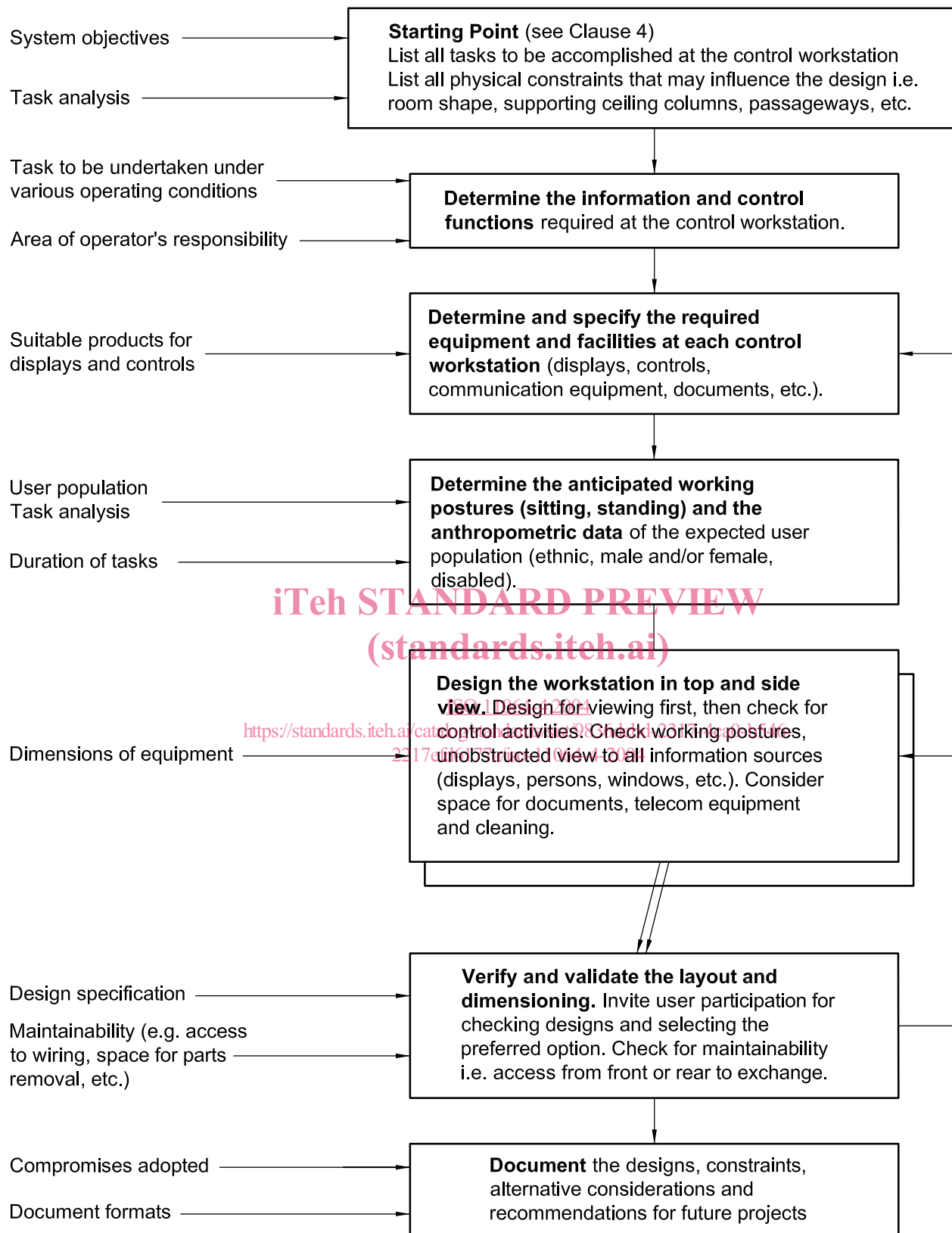
4 Initial workstation layout considerations

The starting point for control workstation design (shape and dimensions) is a list of work tasks and related work characteristics. The human operator may need certain facilities, such as displays, input devices, and communication equipment. Work space may also be required for special control-room-related tasks such as paper work. For each task, a compilation of the requirements of the associated devices is needed. By taking account of job designs, task zones are combined together into control workstation arrangements. The grouping of control workstations into control room layouts is discussed in ISO 11064-2 and ISO 11064-3.

Requirements identified for each task zone are inputs for detailed engineering of workstations.

The following iterative procedure, outlined in Figure 1, can be used as a systematic approach to designing workstations. The order of stages may vary according to the design situation.

A systematic approach to designing workstations is presented in Figure 1. The sequence of stages involved in this process may vary as a result of iterations and this may have an impact on the appropriate tasks, which need to be undertaken at each stage.



NOTE Each design stage in the process may result in a feedback loop to one of the earlier steps.

Figure 1 — Control workstation design steps

5 Factors determining control workstation design

This clause is mainly concerned with control workstations with one or more visual displays, communication tools and space for administrative functions and documentation.

5.1 User population

Workstations shall be designed to accommodate from the 5th to the 95th percentiles of the intended user population. When considering the user population, account shall be taken of all features likely to be exhibited by the intended users including gender, age, ethnic backgrounds and disabilities, e.g. if users are expected from both genders, consider the anthropometric data of the 5th percentile women up to 95th percentile men.

5.1.1 General user considerations

Workstations shall be designed according to human capabilities, limitations and needs. Consequently, the design shall take into consideration the characteristics of the user population including working postures, visual and aural needs, reach envelopes and their collective influences on workstation layout and dimensions.

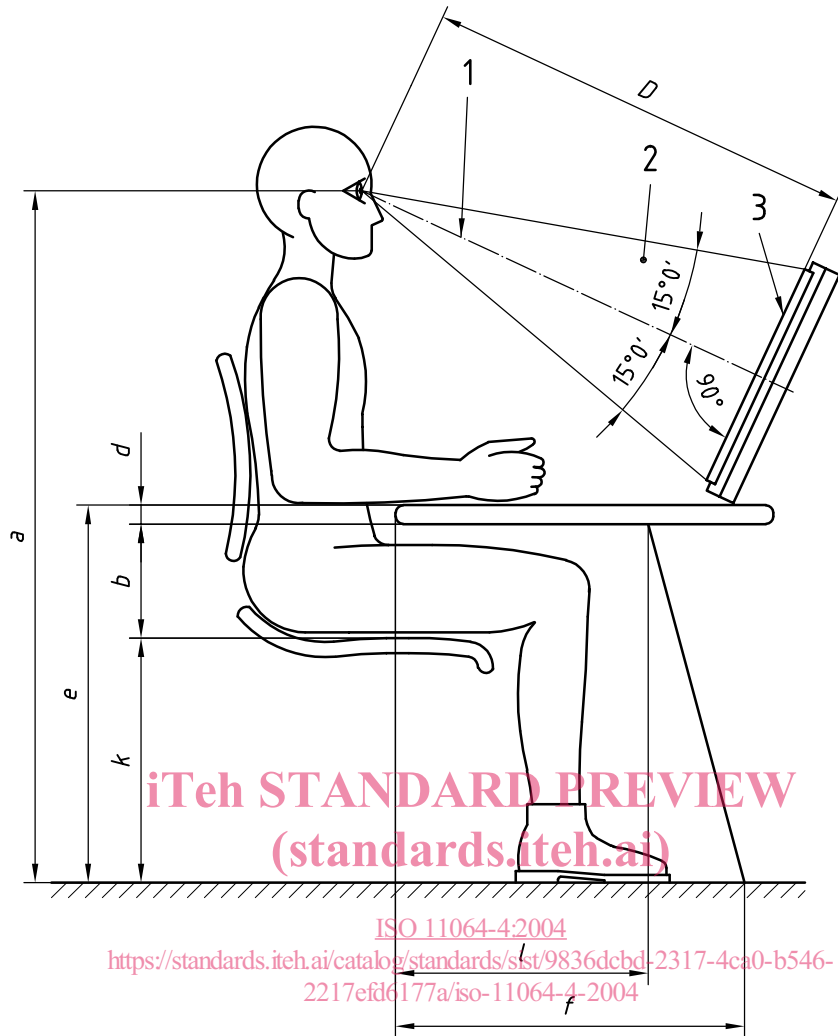
5.1.2 User requirements

The layout and dimensioning of control workstations shall be governed by the anthropometric dimensions of the user and any requirements for movement to accomplish their tasks. Anthropometric data are usually given in terms of percentiles.

General anthropometric requirements are the following

- a) The percentile values referred to in this part of ISO 11064 shall be computed from the set of anthropometric data of the expected user population.
- b) Control workstation dimensions shall accommodate at least a range from the 5th to the 95th percentile of the user population.
- c) The following anthropometric data shall be used to primarily determine the control workstation dimensions:
 - Reach envelope: 5th percentile of the user population, e.g. reach to critical dimensions.
 - Clearances: 95th percentile of the user population, e.g. clearances under worksurfaces.

The key anthropometric dimensions for consideration of a seated operator are shown in Figure 2. Any design solution selected should not unnecessarily disadvantage members presenting extreme anthropometric dimensions of the user population. Design parameters proposed should be checked against the relevant characteristics of the user population.



Key

- | | |
|--|-------------------------------|
| 1 normal line of sight | <i>d</i> desk thickness |
| 2 optimal cone of fixations (i.e. allows fixation of any position just by eye movement, no head movement required) | <i>e</i> elbow/surface height |
| 3 display | <i>f</i> feet clearance |
| <i>D</i> viewing Distance | <i>k</i> popliteal height |
| <i>a</i> eye height | <i>l</i> upper leg clearance |
| <i>b</i> thigh clearance | |

NOTE For details see 6.2.2, 7.1 and 7.2.

Figure 2 — Illustration of the key anthropometric dimensions of a seated control console

EXAMPLE

For standing vertical panels, controls should not be so low that the standing-tall user must stoop to reach down to them.

- In those cases where no clothing allowances are specified in the anthropometric database, the dimensional effects of footwear and clothing shall be considered.
- The effects of different postures shall be considered. (See Figure 3 for the effects on reach envelopes and clearances based on different postures.)