INTERNATIONAL STANDARD

ISO 11064-6

First edition
2005-07-01

Ergonomic design of control centres —

Part 6:
Environmental requirements for control centres

Conception ergonomique des centres de commande —

Partie 6: Exigences relatives à l'environnement pour les centres de commande

Reference number
ISO 11064-6:2005(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 11064-6 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 6: Environmental requirements for control centres*

— *Part 7: Principles for the evaluation of control centres*

Introduction

The environmental aspects associated with the design of man–machine systems need to be addressed, since poor environments can seriously affect operator performance. In control rooms, these environmental factors include lighting, humidity, temperature, vibration and noise. These factors also need to take account of shift work, real-time operations under time pressure and the specialised equipment used in control rooms.

In this part of ISO 11064, environmental requirements are presented which optimize work conditions in such a way that safety is ensured, health is not impaired and the efficiency of control room operators is promoted.

The degree of specificity of this standard does not extend to national and local requirements, which can vary between countries and/or regions. In such cases, experts in the relevant areas (human factors and ergonomics, lighting, acoustics, thermal environment, etc.) will need to be consulted. For specific values on environmental variables, see Annex A and/or consult local and/or national standards for the relevant country or region.

Ergonomic design of control centres —

Part 6: Environmental requirements for control centres

1 Scope

This part of ISO 11064 gives environmental requirements as well as recommendations for the ergonomic design, upgrading or refurbishment of control rooms and other functional areas within the control suite.

The following aspects are covered:

- thermal environment (temperate regions);
- air quality;
- lighting environment;
- acoustic environment;
- vibration;
- aesthetics and interior design.

It is applicable to all types of control centres, including those for the process industry, transport and dispatching systems and emergency services. Although primarily intended for non-mobile control centres, many of its principles are relevant to mobile centres such as those found on ships, locomotives and aircraft.

It does not cover the influence of electromagnetic fields. Guidance on the influence of electromagnetic fields on the image quality of visual displays is given in ISO 9241-6.

This part of ISO 11064 is closely connected with ISO 11064-2 and ISO 11064-3, which describe the control room layout. It also relates to the design of equipment interfaces, which are influenced by environmental factors. It would be prudent for designers to also take account of the more general environmental requirements associated with display screen equipment use presented in ISO 9241-6 and ISO 9241-7.

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 7731, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 7779, *Acoustics — Measurement of airborne noise emitted by information technology and telecommunications equipment*

ISO/CIE 8995, *Lighting of indoor work places*

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

ISO 13731, *Ergonomics of the thermal environment — Vocabulary and symbols*

IEC 60651, *Sound level meters — Electromagnetic and electrostatic compatibility and test procedures*

3 Terms and definitions

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

3.1
A-weighted sound pressure level
sound level
logarithm to the base 10 of the ratio of a given sound pressure to the reference sound pressure of 20 µPa, the sound pressure being obtained with a standard frequency weighting and with standard exponentially weighted time-averaging

NOTE The sound level in decibels is twenty times the logarithm to the base ten of that ratio.

[IEC 60651]

3.2
air velocity
v_a
average of the effective velocity of the air, i.e. the magnitude of the velocity vector of the flow at the measuring point considered, over an interval of time (measuring period), expressed in metres per second

3.3
brightness
attribute of a visual sensation associated with the amount of light emitted from a given area

NOTE 1 It is the subjective correlate of luminance.

NOTE 2 See ISO 8995.

3.4
contrast
⟨subjective sense⟩ subjective assessment of the difference in appearance of two parts of a field of view seen simultaneously or successively

NOTE Hence: brightness contrast, colour contrast, simultaneous contrast, successive contrast.

3.5
contrast
⟨objective sense⟩ quantities usually defined as a luminance ratio (usually for successive contrasts L_2/L_1) or, for surfaces viewed simultaneously, by the equation

$$\frac{L_2 - L_1}{L_1}$$

where

L_1 is the dominant or background luminance

L_2 is the object luminance

NOTE 1 When the areas of different luminance are comparable in size and it is desirable to take an average, the following formula can be used instead:

$$\frac{L_2 - L_1}{0,5\left(L_2 + L_1\right)}$$

NOTE 2 See ISO 8995.

3.6
equivalent continuous A-weighted sound pressure level
$L_{\text{Aeq},T}$
A-weighted sound pressure level, in decibels, given by the equation

$$L_{\text{Aeq},T} = 10\ \lg\left(\frac{1}{t_2 - t_1}\int_{t_2}^{t_1}\frac{p_\text{A}{}^2(t)}{p_0^2}\text{d}t\right)$$

where $t_2 - t_1$ is the period T over which the average is taken started at t_1 and ending at t_2

NOTE See ISO 7779.

3.7
glare
discomfort or impairment of vision experienced when parts of the visual field are excessively bright in relation to the brightness of the general surroundings to which the eyes are adapted

NOTE See ISO 8995.

3.8
illuminance
E
density of the luminous flux (ϕ) incident at a point, expressed in lux (1 lx = 1lm/m^2)

NOTE 1 In practice, the average illuminance of a given surface is calculated by dividing the flux falling on it by the area (A) of the illuminated surface:

$$E = \frac{\phi}{A}$$

NOTE 2 See ISO 8995.

3.9
luminance
L
physical measurement of the stimulus which produces the sensation of brightness, in terms of the luminous intensity in a given direction, ε, (usually towards the observer), per unit area, of an emitting, transmitting or reflecting surface, expressed in candelas per square metre

NOTE 1 It is the luminous intensity of the light emitted or reflected in a given direction from an element of the surface, divided by the area of the element projected in the same direction.

NOTE 2 The luminance L, in candelas per square metre, of a perfectly matt surface is given by:

$$L = \left(\frac{\rho \times E}{\pi}\right)$$

where

E is the illuminance, in lux (lx);

ρ is the reflectance of the surface considered.

NOTE 3 See ISO 8995.

3.10
luminance balance
ratio between the luminances of the displayed image and its adjacent surround, or sequentially viewed surfaces

[ISO 9241-6:1999, 3.13]

3.11
reflectance
ρ
ratio of the luminous flux reflected from a surface (ϕ_r) to the luminous flux incident (ϕ_0) on it

NOTE 1 The reflectance depends on the direction of the incident light, except for matt surfaces, and on its spectral distribution.

NOTE 2 Reflectance $\rho = \frac{\phi_r}{\phi_0}$

NOTE 3 See ISO 8995.

3.12
reflected glare
glare resulting from specular reflections from polished or glossy surfaces

NOTE See ISO 8995.

3.13
relative humidity
RH
ratio (× 100) between the partial pressure of water vapour in the air and the water vapour saturation pressure at the same temperature and the same total pressure

[ISO 13731:2001, 2.96]

3.14
reverberation
continuation of a sound in an enclosed space after the source has stopped, result of reflections from the boundary surfaces of the room

[ISO 9241-6:1999, 3.21]

3.15
air temperature
t_a
dry-bulb temperature of the air surrounding the occupant

NOTE It is expressed in degrees Celsius (°C).

[ISO 13731:2001, 2.2]

4 General principles for environmental design

The following nine general ergonomic principles shall be followed for good environmental design.

NOTE 1 It is important to recognise that design features related to one particular environmental principle can have an impact on other principles.

Principle 1: Operator task demands and comfort shall be the primary focus when designing control centre environments.

Principle 2: In order to optimize operator's performance and comfort, levels of illumination as well as temperature shall be adjustable in accordance with the operator's needs.

Principle 3: Where conflicting demands exist between different environmental features (i.e. thermal conditions, air quality, lighting, acoustics, vibration, and interior design and aesthetics), a balance shall be sought which favours operational needs.

NOTE 2 One way to achieve this would be to consult experts in human factors and ergonomics with the aim of identifying optimal compromises between conflicting demands, e.g. to design a lighting system in which old and new equipment work in parallel in upgraded control centres.

Principle 4: External factors providing operational information (e.g. security views, weather conditions) shall be taken into account when designing the control centre.

Principle 5: Environmental factors work in combination and shall be taken into account in a holistic way, i.e. the whole environmental entity needs to be taken into account, (e.g. interaction between air conditioning systems generating noise and the acoustic environment).

Principle 6: Environmental design shall be used to mitigate the detrimental effects of shift work, e.g. raising ambient air temperature in the early morning.

NOTE 3 A complementary approach would be to consider improved shift work schedules.

Principle 7: The design of environmental systems shall take account of future change (e.g. equipment, workstation layouts, and work organisation).

NOTE 4 This can be done by designing for flexibility (location of lighting, ventilation ducts, etc.). Another possible measure would be to reserve extra capacity in the environmental systems.

Principle 8: The quality of the working environment shall be an integral part of the overall design process for control centres, as shown in Figure 1.

NOTE 5 The steps presented in Figure 1 are part of a wider process discussed in ISO 11064-1.

Principle 9: An iterative and multi-disciplinary design approach shall be taken in order to achieve an appropriate balance between buildings, equipment and the control centre environment. This approach shall be checked and evaluated as the design develops.

NOTE 6 This approach is necessary because most building and equipment design features have a potential impact on the design of the control centre environment. For example, the heat dissipation of lighting equipment can affect an air conditioning system.

