INTERNATIONAL STANDARD

ISO 11064-5

First edition
2008-07-01

Ergonomic design of control centres —

Part 5: Displays and controls

Conception ergonomique des centres de commande —

Partie 5: Dispositifs d'affichage et commandes

Reference number
ISO 11064-5:2008(E)

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 11064-5 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: Displays and controls*

— *Part 6: Environmental requirements for control centres*

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

Introduction

This part of ISO 11064 presents principles and processes to be adopted when designing the human-system interface of a control centre. These interface considerations are relevant for operators, supervisors and maintainers of systems. It is intended for use by individuals such as project managers, purchasers, systems designers, specifiers and those developing operator interfaces.

The purpose of this part of ISO 11064 is to maximize the safe, reliable, efficient and comfortable use of displays and controls in control centre applications. To this end, rules and recommendations based upon ergonomic findings are established for

— selecting the appropriate display and control types,

— structuring and presenting information on screens and shared off-workstation displays, and

— establishing control and dialogue procedures.

This part of ISO 11064 focuses on the main principles for the selection, design and implementation of controls, displays and human-system interactions for control room operation and supervision. The wide range of control and displays used in control rooms and the fast changes in technology make it impracticable to provide requirements meeting all situations. The approach adopted here is to identify general principles of good practice that will need to be supported by information accessed from human factors publications and other ergonomics standards.

The use of displays and controls in control centres differs from that typically found in offices and other non-control situations. Control centre activities are characterized by:

— being driven by externally controlled events occurring within the process;

— requiring an appropriate human response in real time — human reactions that are inadequate or too late can cause environmental damage, serious personal injury (e.g. safety-critical situations), equipment damage, lost production, decreased output quality or pollution of the environment;

— controlling the dynamic behaviours of high-energy or hazardous physical and chemical processes;

— involving information derived from a variety of sources;

— including the monitoring of many complex process variables typically presented via multiple parallel visual and auditory devices;

— involving team work with resources both within and outside the control room.

For these reasons, the standards required in a control environment can need to be more stringent than those of the typical office environment (i.e. as covered by ISO 9241).

This part ISO 11064 defines principles and specifies requirements to be applied when determining the most appropriate displays and controls for control room functions. Thus, the application of this part of ISO 11064 ought to be of benefit to operators, operating companies, equipment purchasers, interface designers, manufacturers and engineering firms as outlined below.

— Operators and operating companies

  Communication between operators and equipment will be more uniform across plants to which the standard is applied. This can reduce training burdens and facilitate job rotations. Operator stress, and situation-induced operator errors, can be reduced, thus improving operator efficiency and job satisfaction.

— Purchasers of equipment

  The buyer has standard criteria to use in judging and selecting any man-machine interface under consideration and the material can be included in procurement requirements. Tighter control of procurement offers project managers a reduction of risk.

— Manufacturers of displays and controls

  This part of ISO 11064 provides an agreed baseline from which manufacturers can develop and/or offer products.

— Engineering firms

  Engineering firms or departments can reference a common set of guidelines and principles in the selection and application of displays and controls to fit their particular needs. This part of ISO 11064 also offers engineers and product developers advice in the design of displays and controls.

Ergonomic design of control centres —

Part 5:
Displays and controls

SAFETY PRECAUTIONS — Many of the topics covered by this part of ISO 11064 relate to safety-critical matters. It may be advisable to seek professional advice in the interpretation of requirements and the selection of appropriate solutions.

1 Scope

This part of ISO 11064 presents principles and gives requirements and recommendations for displays, controls, and their interaction, in the design of control-centre hardware and software.

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 9241-12, *Ergonomic requirements for office work with visual display terminals (VDTs) — Part 12: Presentation of information*

ISO 11064-1, *Ergonomic design of control centres — Part 1: Principles for the design of control centres*

ISO 11064-7, *Ergonomic design of control centres — Part 7: Principles for the evaluation of control centres*

ISO 13407, *Human-centred design processes for interactive systems*

3 Terms and definitions

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

3.1
alarm
high priority alert used to attract the operator's attention to important deviations or abnormal events in system operation

3.2
alert
method by which operators are notified of system events requiring a reaction or response

3.3
analogue display
display in which the status information is shown as a function of length, angle or other dimension

NOTE 1 In the case of visual displays, the information may be shown as a function of pointer deflection, length of a bar graph, or similar visual quantity.

NOTE 2 Adapted from ISO 9355-2:1999, definition 3.8.

EXAMPLE A physical variable (e.g. temperature) is represented by a bar. Its length corresponds to the current value of the variable.

3.4
brightness
attribute of visual sensation associated with the amount of light emitted from a given area

NOTE It is the subjective correlate of luminance. See ISO/CIE 8995-1.

3.5
code
technique for representing information by a system of alphanumeric characters, graphical symbols or visual techniques (e.g. font, colour or highlighting)

[ISO 9241-12]

3.6
coding
procedure within the design process by which categories of information are allocated to elements of a code alphabet

NOTE These categories of information include the operation modes of machines (i.e. ON, OFF, standby, in alarm) and the kinds of media within the pipes or vessels of a plant.

EXAMPLE Alphabet, shape, colour or size.

3.7
control, verb
purposeful action to affect an intended change in the system or equipment

EXAMPLE Adjusting set-point, changing the operation mode from ON to OFF.

3.8
control, noun
device that directly responds to an action of the operator, e.g. by the operator applying pressure

NOTE See also **process control** (3.25).

EXAMPLE Push button, mouse, track ball.

3.9
control room
core functional entity, and its associated physical structure, where control room operators are stationed to carry out centralized control, monitoring and administrative responsibilities

[ISO 11064-3]

3.10
control room operator
individual whose primary duties relate to the conduct of monitoring and control functions, usually at a control workstation, either on their own or in conjunction with other personnel both within the control room or outside

[ISO 11064-3]

3.11
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]

3.12
data
raw material from which a user extracts information

NOTE “Data” can include numbers, words and/or pictures, such as a view out of a window.

3.13
digital display
display in which the information is shown in numerical code

[EN 894-2]

3.14
display
device for presenting information that can change with the aim of making things visible, audible or discriminable by tactile or proprioceptive perception

[ISO 11064-3]

NOTE See also Figure 1.

3.15
element
basic component used to make up formats such as abbreviations, labels, items, symbols, coding and highlighting

NOTE 1 Based on NUREG-0700 [14].

NOTE 2 See also Figure 1.

3.16
event
any spontaneous transition from one discrete status to another

NOTE If the initial status is not displayed (i.e. it is normal), an event will be perceived as the occurrence of a defined change of status. (“Occurrence” is here synonymous with *a transition from one discrete status to another* and “status” can relate to either normal or abnormal conditions.)

3.17
format
pictorial display of information on visual display units (VDU) such as message text, digital presentation, symbols, mimics, bar chart, trend graphics, pointers, multi-angular presentation

[IEC 60964]

NOTE For the purposes of ISO 11064, this term also covers auditory displays.

3.18
human-system interface
HIS
human-machine interface
HMI
all matters and procedures of a machine (or system) available for interaction with its (human) users

3.19
information
anything which is not known by a person in advance

NOTE 1 Information is extracted from **data** (3.12).

NOTE 2 *Knowledge* is required to interpret information.

NOTE 3 One example of another definition of information is “commodity that reduces the uncertainty”. The definition used for the purposes of this part of ISO 11064 is essential for allocating the appropriate importance or quality value to display elements.

3.20
interaction
dialogue
exchange of information between a user and a system via the human-system interface to achieve the intended goal

3.21
mimic
mimic display
mimic diagram
simplified graphical depiction of a system by presenting its components and their interrelationships

EXAMPLE Piping diagram, rail network or road network.

3.22
monitoring
activity for the purpose of detecting deviations from normal operation (by checking variables, or their course against limits, trends or the values of other variables) to enable timely and appropriate action for response

NOTE Monitoring of the process is performed either by a human being and/or by a control system.

3.23
overview display
high-level abstraction, or low level of detail, of the system status, covering the areas of responsibility

NOTE An overview display supports control room personnel in obtaining an overall view of systems status by bringing to their attention significant changes in system conditions and presenting those that are important.

3.24
page
defined set of information that is intended to be displayed on a single display screen

NOTE 1 Based on NUREG-0700 [14].

NOTE 2 A window may form an entire page where it fills a single display screen. See Figure 1.

3.25
process control
monitoring and manipulation of variables influencing the behaviour of a process to conform to specified objectives

NOTE 1 Operators use displays and controls in executing their activities of monitoring, control, and system management.

NOTE 2 Process control is accomplished by regulation or manipulation of variables influencing the conduct of a process in such a way as to obtain a product of desired quality and quantity in an efficient manner [15].

3.26
status
state
distinct condition of an object

NOTE The object can be a system, a process unit, a machine, etc. Conditions can be operation modes — either normal (e.g. “on”, “closed”, “standby”) or abnormal (e.g. “disturbed”). They may be determined by checking values of variables against limits (e.g. “too high” or “high alarm”).

3.27
symbol
letters, digits, pictorial representations or combinations of these, used for labelling a display's graduations, or as a means of identifying the display itself

3.28
task
human activities required to achieve a goal

NOTE 1 Adapted from ISO 9241-11:1998, definition 3.9.

NOTE 2 The task is accomplished by means of (several) jobs. The goal is specified by the organization responsible for the human-machine system.

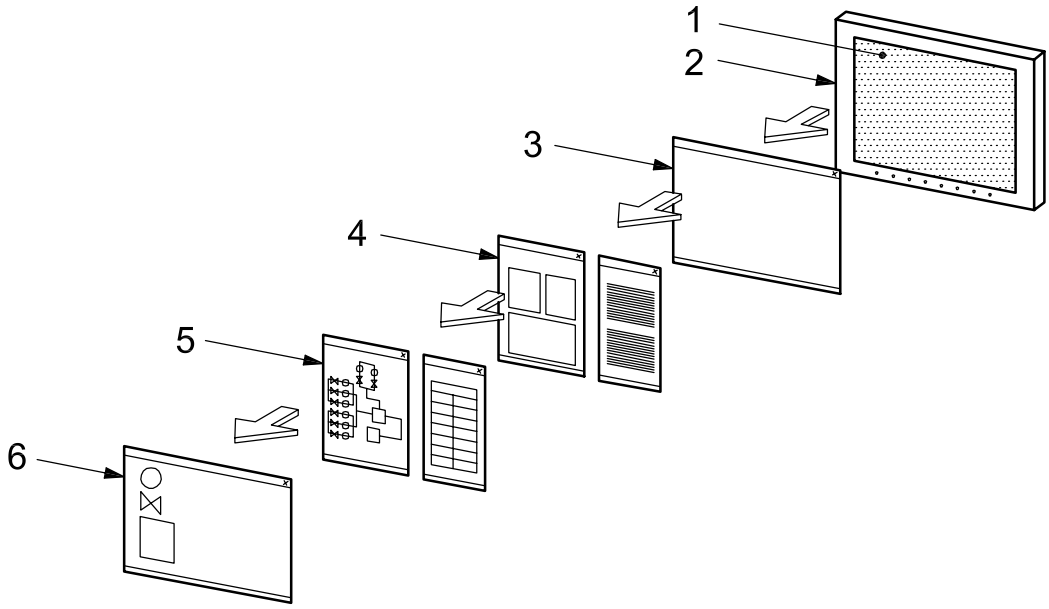
EXAMPLE Process control that pursues the goal of safe and economic operation of a production plant or passenger safety for a transportation system.

3.29
visual display
display (in the sense of format) providing visual presentation of data, mappings or videos

NOTE Visual displays are classified in accordance with the presentation mode of single data (analogue, binary, digital, hybrid) of a single datum. Complex data can be presented in graphic or alphanumeric dimension (2D, 3D) providing a relation between time of view and time presented (“predictive” or “quickened” display).

3.30
window
independently controllable area on the display screen used to present objects and/or conduct a dialogue with a user

[ISO 9241-16]



Key

1 display screen
2 display
3 page (everything presented on a single display screen)
4 window (a single window can occupy an entire display screen)
5 format (e.g. mimic, bar chart, trend curve)
6 element (e.g. icon, label)

Figure 1 — Relationship between display, display screen, page, windows, format and elements

4 Principles

Principles for the ergonomic design of human-system interfaces, presented in Tables 1 to 3, are intended for use in systems design, display design and interaction (or dialogue) design. These principles are grouped into three categories:

— general principles (Table 1, principles 1 to 8);

— display-related principles (Table 2, principles 9 to 14);

— control- and interaction-related principles (Table 3, principles 15 to 24).

While many of these principles are of general applicability in the domain of ergonomics, they have been selected because of their particular relevance to control room design. For example, many are equally applicable to office design, though the consequences of not applying them are unlikely to have the same safety implications to be found in control rooms. The principles have been grouped such that the earlier ones concern wider considerations, whereas those which follow are more specific. Inevitably, there are some overlaps between different principles and their associated key questions — this does not detract from any underlying need to meet the recommendations and requirements presented.

The “examples of key questions” in the tables are offered as examples of the type of features to be sought when checking to see whether the principles have been met. They are not to be interpreted as requirements.

Specific guidance on application of the principles is presented in Annex A.

Table 1 — General principles

Principle	Examples of key questions to be used for verification
1: System authority The human operator shall at all times be the highest authority in the human-machine system.[a]	Has the requirement to ensure that the operators are always within the control “loop” been fully addressed, except when functions are completely allocated to the machine?
	Are all control functions required to cope with each situation available to the operator within a reasonable time?
	Have all situations where systems might fail been analysed?
	Does the system “patronize” the operator?
	Does the system act without the operator’s initiative, thus hampering him/her in finishing or continuing a task (e.g. pre-empting him/her by changing the displayed format automatically)?
	Is the operator restricted from using the system in accordance with his/her wishes?
	Are reasonable and feasible operator inputs rejected?
	Are inputs changed by the system without further inquiry?
	Is the system interruptible within 2 s by operator inputs, even when busy?
	Can automated functions that have no effect on the controlled process be stopped (e.g. in a chemical plant, complex calculations for simulation or forecast)?
	Can those functions that have no influence to the production plant be undone?
	Can the operator interact with the system (e.g. close or open windows) at any time?
2: Information requirements The operator [b] at the human-system interface shall be provided with all the information needed to accomplish his/her tasks.	Have underload and overload been analysed for both normal and abnormal operations?
	Does the operator get the information required to accomplish his/her task in a timely and satisfactory way?
	Has appropriate information been provided for the operator to maintain situational awareness?
	Does the operator have a permanent overview of the current status of the system he/she is responsible for?
	Are any elements of the overview display obscured by windows?
	Does the operator get sufficient and timely information to focus on any problem which may arise?
	Is all the information presented relevant to the task?