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

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

Reference number
ISO 11064-5:2008(E)

© ISO 2008

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.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

COPYRIGHT PROTECTED DOCUMENT

© ISO 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

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

 © ISO 2008 – All rights reserved

Contents

Page

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

 © ISO 2008 – All rights reserved

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*

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

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).

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

 © ISO 2008 – All rights reserved

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.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

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.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

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.

© ISO 2008 – All rights reserved

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]

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

 © ISO 2008 – All rights reserved

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

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

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].

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

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

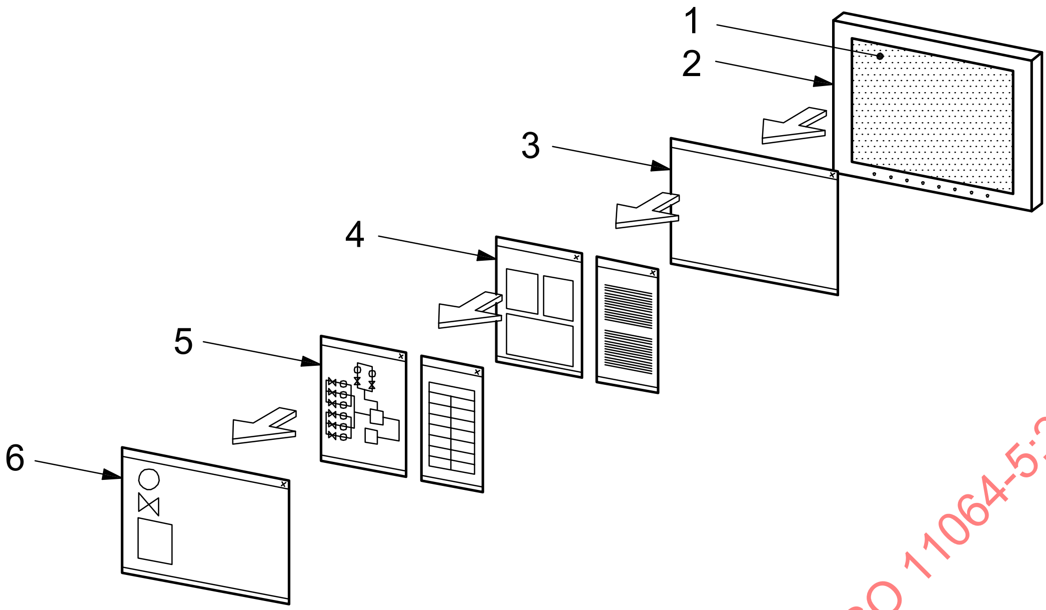
NOTE Visual displays are classified in accordance with the presentation mode of single data (analogue, binary, digital, hybrid) of a single datum. Complex data can be presented in graphic or alphanumeric dimension (2D, 3D) providing a relation between time of view and time presented (“predictive” or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

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved



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

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

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.

© ISO 2008 – All rights reserved

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?

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

Table 1 (*continued*)

Principle	Examples of key questions to be used for verification
	Is the required exchange of information during shift changes minimized by the system?
	Do the attention-getting measures match the urgency of the required response?
	Are events requiring the operator's urgent response also announced by an audible signal?
	Are the different levels of attention-getting easily distinguishable?
	Does the interface design avoid the obstruction of important information, e.g. safety-related information?
	Has all the information required to complete a particular task been presented on a minimum number of displays?
	Have necessary precautions been taken so that shared information can only be changed with mutual consent?
	Have the requirements of all the potential users (e.g. maintenance engineers) been systematically evaluated?
3: Efficient human-system interface The human-system interface shall support the user to complete his/her activities efficiently and effectively. [c]	Is the user presented only with information necessary to complete the tasks?
	Have tasks that can easily be automated been allocated to the technical system?
	Are recurrent tasks executed by easily repeatable sequences?
	Are CCTV (closed circuit TV) images presented taking full account of user requirements, e.g. use of split screens?
	Are infrequently used tasks self-explanatory or supported by help information?
	For skilled users, are shortcuts allowed?
	Is easily available "help" support available to the operator? (this may be hard or soft)
	Does the system allow the operator freedom to select between alternative input devices?
4: Human-centred design The human's abilities, characteristics, limitations, skills and task needs shall be primary considerations when designing the human-system interface.	Is the amount of information to be acquired by the operator appropriate?
	Over a short period (15 minutes), is the rate of message presentation to the operator restricted to a maximum of 15 per minute?
	Over periods longer than 15 minutes, has the rate of message presentation to the operator taken account of all the other activities undertaken by the operator?
	Are those displayed events that prompt the operator for a reaction (i.e. alarms) prioritized according to the urgency of his/her required response?
	Have the needs of older persons and persons with disabilities been adequately analysed?

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

Table 1 (*continued*)

Principle	Examples of key questions to be used for verification
5: Application of ergonomic principles The information presented to the operator should be based on known ergonomic principles to ensure that the information is conveyed quickly and accurately.	Are events that require the operator's quick response presented in an appropriate manner?
	Are all events to which the operator has to respond easily perceptible and prioritized?
	Is the information organized in a way that is easily recognizable and understandable by the operator?
	Has the balance between static and dynamic information been addressed (e.g. dynamic information given greater area)?
6: Mental models The users shall at all times be provided with the necessary information such that they are able to maintain a comprehensive and robust mental model of the system and its associated sub-systems.	Is the operator provided with an overview of the system at all times?
	Has the operator been trained about the operating concepts?
	Has the operator got enough knowledge about the system he/she is controlling?
	Is the system predictable (e.g. responds in accordance with the expectations of the operator)?
7: Working "quality" The task created should promote job satisfaction and provide both a satisfying and challenging working environment.	Do operators express job satisfaction and are they presented with a stimulating work environment?
	Do operators express the wish to come to work?
	Do health and sickness records support the view that operators are satisfied with their jobs?
	Have both operator underloading and overloading been analysed?
8: Memory Demands on the operator's short-term memory shall not exceed known limitations.	Is the "magic seven plus or minus two" rule followed?

[a] Exception: No opportunity should be offered to override safety-critical systems; for instance, if the pressure in a pipe drops beyond a certain threshold, which indicates a leak in the pipe, the valve is closed by the safety system. The operator should not be allowed to override the safety system.

[b] The main focus is on control room operators.

[c] Do not allocate, for example, the hourly compilation of measured values to the operator. If a strict relation exists between a condition and required reaction, it should be automated.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

Table 2 — Display-related principles

Principle	Examples of key questions to be used for verification
9: Self-explanatory The information presentation shall be easily and unambiguously understood by appropriately trained users.	Has the application of “metaphors” been examined?
	Has the information been presented as economically as possible (e.g. using a minimum of characters)?
	Have superfluous elements been minimized (e.g. suppliers' logos)?
10: Coding Where items need to be identified individually, they shall be presented in such a manner that they are clearly distinguishable.	Have known principles of coding been applied (size, shape, etc.)?
	Has redundant coding been examined?
	Have the principles of information grouping been applied?
	Is every object uniquely and unambiguously identifiable (e.g. display formats by name)?
11: Present true information Only valid information in terms of time, origin and appropriate resolution shall be displayed; where not practicable, this shall be indicated (e.g. time of last measurement).	Can the operator trust the information provided?
	Does the system indicate invalid information?
	Is vital information verifiable by other means?
	Is redundancy provided for safety-critical information?
12: Attention-getting The level of attention applied to a particular item of information should be matched to the importance of that information for the operator and the safety of the system.	Are dynamic elements presented more obviously (i.e. more attention-getting than background information)?
	Have appropriate decisions been made in the allocation of auditory or visual displays?
	Has account been taken of ambient noise, etc.?
	Has care been taken to avoid confusion between attention-getting sources?
	Has the presentation of critical and infrequent alarms been properly taken into account?
	Have priority levels been applied to avoid overloading the operator?

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

Table 2 (*continued*)

Principle	Examples of key questions to be used for verification
13: Consistency The same information presented on different displays should be consistent with respect to such features as location, coding (e.g. colour coding), behaviour principles and access and navigation principles.	Is the screen design consistent with predictable locations for system responses?
	Has account been taken of the need to achieve consistency between different media (e.g. liquid crystal displays (LCD), plasma, cathode ray tubes (CRT) and printed material)?
	Are response times predictable?
	Are the same objects to be recognized at various levels of display hierarchy designed so that they are clearly legible and recognizable at all levels of magnification or zoom?
	Are the same terms, colours and arrangements consistently applied for equipment, events and states?
	Is the system predictable and does it respond in accordance with the expectations of the operator?
	Are controls consistently applied for all states and conditions of system operation?
	Are the soft control systems consistent and compatible with the rest of the human-system interface?
14. Information coding Information coding shall be discriminable, legible, clear, concise, consistent, conspicuous and comprehensible.	Are the different states and priorities clearly differentiated?
	Does the display present information clearly and unambiguously?
	Are codes applied which are already in use by the operator?
	Are labels located close to the objects they relate to?
	Has the information been structured in accordance with the activity to be accomplished?
	Does the presentation of information on the human-system interface allow for an intuitive understanding of its relationships to other information presented elsewhere?

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

Table 3 — Control- and interaction-related principles

Principles	Examples of key questions to be used for verification
15. Avoid "flying blind" The objects under control shall always be displayed. [a]	Can only objects present on the screen be manipulated?
	Are all responses to all control actions appropriately displayed?
	Has adequate consideration been given to the recording and handover of information that is not on the system?
	Are inputted commands that might have serious consequences displayed for confirmation before execution?
	Are dependent system responses shown to the operator?
16: Simplicity Human-system interaction should be kept simple by the application of a minimum number of rules.	Are the interactions with the system based on simple, easily understood concepts, and do they involve as few rules as practical?
	Is the navigation through the system simple and obvious?
	Can the system be used by an operator without the use of a written manual?
	Does the interface design (interaction logic, style principle) take proper account of operator training levels?
	Does the human-system interface offer straightforward interactions for emergency situations?
	Have exceptions from the underlying rules of interaction been avoided?
17: Operator support The system should aid the operator in inputting information efficiently and correctly as well as in minimizing the risk of errors.	Are inputs checked automatically?
	Does syntax checking leave an element of flexibility as far as correct inputs are concerned; for instance, if character strings are checked on delimiters, are alternative, applicable characters (such as ",", ".", "-" and "/") allowed?
	Is the overall plausibility of inputs checked by the system?
	Is the plausibility of specific inputs checked against the current status of the system?
	Where severe consequences might result from an operator's action (e.g. where safety or irreversible actions are involved), does the system request confirmation prior to execution?
	If an input is obviously wrong, does the system generate an appropriate message?
18: Single-data sources The system shall automatically support the operator by inputting data that are already available.	Have data inputting tasks been avoided where the information already exists in the system?
	Has manual data transfer between different systems been avoided?

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

Table 3 (*continued*)

Principles	Examples of key questions to be used for verification
19: Maximizing efficiency The system should minimize the demands placed on the operator from frequently occurring actions.	Are dialogues designed so that the operator is able to concentrate on the primary task and minimize the time spent on secondary tasks?
	Are short-cuts offered to the user for frequently occurring control actions?
	Is there an opportunity to configure short-cuts for frequently used commands?
	Has the potential impact of safety-related errors been analysed when providing short-cuts, etc.?
20: Feedback Appropriate feedback shall be provided to the operator at all times.	Does the system provide feedback for every discrete control action?
	Is feedback information offered consistently?
	Is feedback from similar types of control actions predictable and conform to users' expectations?
	Can feedback easily be understood by the users?
	Is there an indication whenever the controlled equipment is busy or out of order? [b]
	Does the system notify the operator of any failure to execute a control command?
	Is the system feedback, as a result of operator control action, compatible with the control action undertaken and does it conform to good ergonomic practice?
	Where feedback is not immediate (e.g. deployment of resources by radio), have the implications been fully analysed (e.g. message not received or misunderstood)?
	Does the system inform the operator when a control action is invalid?
	Is feedback information provided in such a way that it can be fully understood by the operator?
	Is the type of feedback provided to the operator compatible with the control action?
	Are the feedback responses to similar control actions predictable and constant?
	Where severe consequences may result from the operator's action, does the system request confirmation?
	Does the system provide self-explanatory and unambiguous error messages?
21: Response times System response times shall be appropriate to the nature of the control tasks being undertaken.	Does every operator input result in a noticeable feedback signal within a reasonable time span (less then 2 s)?
	Where more than 2 s are required by the system to complete a command (e.g. opening of a large valve, filling a tank, etc.), is there an indication that the system is responding?
	Is the variability in response times less than ± 50 % around average values? For example, if the average reaction time is 1 s, the system response should be within the range of 0,5 s to 1,5 s.
	For extended operations (more than 2 s), is there an indication of the time left to complete a selected operation?

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

Table 3 (*continued*)

Principles	Examples of key questions to be used for verification
22: Alarms High-priority alarms shall always be brought to the attention of the operator. [c]	Can priority alarms be obscured by lower-priority information or data?
	Are alarms always presented in the same manner?
	Are alarms presented in the same locations on screen formats or in relation to relevant icons?
	Are overview alarm displays protected against being obscured by windows?
23: Error tolerance The system shall take account of the fact that the operator will make errors and minimize the effects of these.	Is the operator clearly informed of the consequences of an action before taking that action?
	Are safeguards associated with safety-critical control actions, e.g. repeated control action?
	Where it is not possible to “undo” a control action, are suitable safeguards included?
	Are safety-related conventional controls protected to avoid inadvertent operation?
	Have good ergonomic principles been applied to the layout of controls and displays to avoid incorrect activation of control functions or misreading of information?
	Has the systems design and training taken account of potential errors of commission or omission?
	Does the system allow the user to correct an input by amending only the faulty part?
	Does the system offer simple, comprehensible mechanisms for handling errors?
	Does the system allow for the easy reversal of actions?
24 Dialogue structure Dialogues shall be organized into groups which have a beginning, middle and an end.	Does the interaction allow the operator to form a clear view on the overall status of a series of actions?
	Is there a clear indication that a sequence of actions has been completed?
	Does the structuring of the transactions provide a positive feeling that a task has been completed?
	Is the route to “exiting” a series of commands clear to the operator at all times?

[a] An exception is controls for emergency shutdowns, which may occur regardless of the current display of information.

[b] Wherever practical, an indication should be given of the time required before control actions can be commenced.

[c] Requirements for alarms are presented separately in Clause 6.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

5 Process for display and control specification

5.1 Design process

The design process shall take account of earlier decisions concerning task synthesis, staff numbers, workstation numbers and previously developed team working, in accordance with ISO 11064-1 and ISO 13407. These shall form the basis for the development of the control interfaces, although the original assumptions could need to be revisited as the detailed control and display design develops.

5.2 Design team and competencies

Displays and controls shall be designed by a multi-disciplinary team that includes representatives of the following groups:

a) human factors;

b) users;

c) human interface designers;

d) application specialists;

e) documentation authors;

f) quality assurance personnel.

Future users are to be involved in the design process and testing of the developing interface proposals through

— being kept informed from the outset of the control-display design process, and

— being encouraged to contribute with their experience and their expectations,

as early in the process as is practicable.

5.3 Evaluation

Design results shall be evaluated during each of the design steps described in 5.5. For this purpose, it is recommended that early sketches, prototypes, and mock-ups be applied for each step.

The framework for assessing usability presented in ISO 9241-11 may be used to form the basis of user assessments, although it does not address the safety-critical elements associated with control rooms (e.g. situational awareness and team working).

The overall approach to the control-display design concept should be revised in the light of the findings from the user tests/trials. The following criteria may be used for prioritizing such changes:

— must be changed, e.g. unsafe;

— sub-optimal but acceptable — there are better solutions, e.g. quicker handling.

When alternative operating systems are being reviewed, these shall be judged against ergonomic control, display and interaction requirements (see Clause 4). They should also be checked to see whether the operator system can be configured to cope with all the display formats and interactions, qualitatively as well as quantitatively.

For more information on evaluation issues, refer to ISO 11064-7.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

5.4 Iteration

The results emerging from each design step (see 5.5.) should be checked. Steps should be repeated to remove the reasons for inconsistency and/or incompatibility with the general principles presented in Table 1.

5.5 Design process steps

The seven-step design process for display and control specification shown in Figure 2 is followed by a brief description of each step.

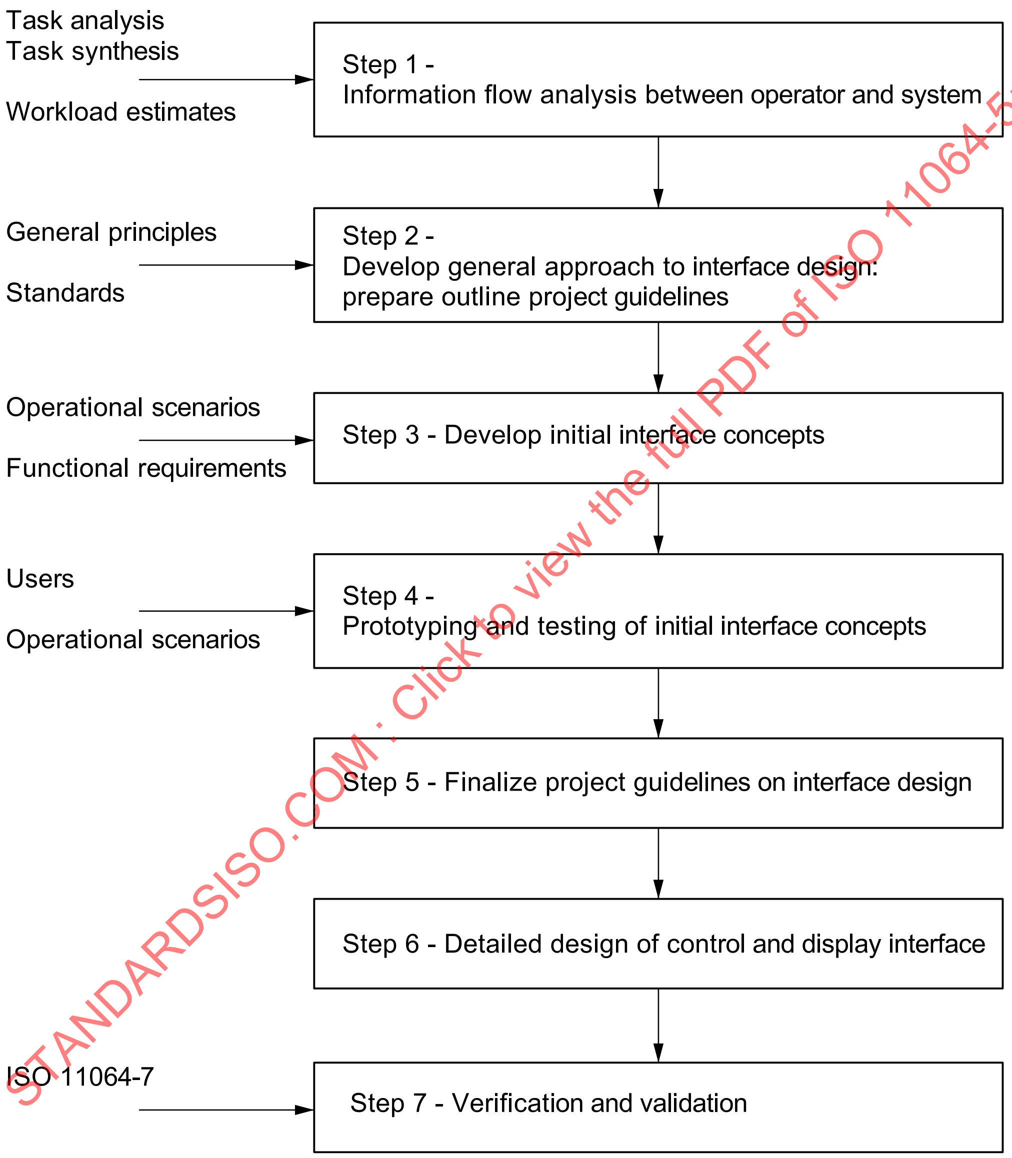


Figure 2 — Process for display and control specification

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

Step 1 — Information flow analysis between operator and system

This step concentrates on the information flow necessary to undertake the control tasks. For this step, detailed methods of presentation and possible options for technology are disregarded.

© ISO 2008 – All rights reserved

Step 2 — Develop a general approach to the interface design

In this step, the overall framework is developed for the control display design. The process is used as the basis for scoping the project guidelines for the interfaces to be developed in Step 5. This step will list the main topics to be covered.

Step 3 — Develop initial interface concepts

This step involves the development of key elements of the interface to the point where they can be tested by user trials. The proposed design would be expected to take account of the framework developed in Step 2, but not to the extent of discarding more practical and effective solutions, should they emerge.

Step 4 — Prototyping and testing of initial interface concepts

At this stage of the human-computer interface development, the proposals developed during Step 3 are tested prior to finalizing the project guidelines for interface design (Step 5).

Step 5 — Finalize project guidelines on interface design

During this step, the lessons learnt during the prototyping and testing (Step 4) are used. The final version of the project guidelines will form the basis for the detailed design of the control display interface and will include, but not be limited to, the following:

— presentation of information;

— control devices;

— user guidance;

— menu dialogues;

— direct manipulation dialogues;

— navigation;

— alert management;

— standards.

Step 6 — Detailed design of control and display interface

During this stage, the ergonomist will undertake the development of the emerging interface and advise on changes and compromises which could be necessary to achieve a successful implementation.

All design decisions shall be documented together with the reasoning behind them.

Step 7 — Verification and validation

Verification and validation is an iterative process conducted throughout the stages of control and display design and not just at the end of the process. See ISO 11064-7.

6 Alarms — High-level requirements and recommendations

The effective presentation of alarms is a vitally important issue in control centre design — particularly for those control rooms with safety-critical responsibilities. The alarm-related requirements and recommendations presented in this clause are grouped under "general", "structuring", "presentation", "interaction and handling", and "documentation".

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

6.1 General

6.1.1 There shall be an alarm management process in place.

Alarm management should be an active process with specific responsibilities for such matters as monitoring against key performance indicators, numbers of alarms, and implementing improvements in alarm management.

6.1.2 Procedures that specify individual responsibilities for monitoring and controlling large process disturbances and emergency situations shall be available and known by the operators.

Such procedures should ensure that work in the control room in critical situations will be effective and well organized.

6.1.3 The alarm system shall be explicitly designed to take account of human factors and limitations.

The design should ensure that the alarm system remains usable in all process conditions, by checking that unacceptable demands are not placed on the operator by exceeding his/her perceptual and/or cognitive capabilities.

6.1.4 Operators shall receive instruction and systematic training in all realistic operational usage of the alarm system.

NOTE The objective of such training is to ensure that the usage and functionality of the alarm systems are familiar and well understood by operators.

6.1.5 All alarm limit settings should be systematically determined and documented during systems design, commissioning and operation.

NOTE Proper alarm limit settings are important to ensure that alarms are triggered early enough for effective response by operators while minimizing the number of false alarms caused by overly tight alarm limits.

6.1.6 There shall be key performance indicators (KPI), in respect of alarm management, against which performance can be measured

NOTE The measurement of alarm system performance is one of the most important factors contributing to effective alarm management. KPI provide management with targets against which performance can be checked.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

6.2 Structuring

6.2.1 The number of alarm messages for the same disturbance that are presented to an operator during that disturbance should be minimized to reduce operator overload.

The use of dynamic mock-ups and prototypes of the alarm system may be adopted during the development of the alarm system. Particular attention needs to be paid to the tendency of the number of alarms to increase over the plant lifecycle.

6.2.2 Alarms shall be prioritized.

Alarms should be prioritized in accordance with the severity of the consequences of not responding appropriately and with the time available for successful corrective action to be performed.

Alarm priorities should help the operator focus on the conditions that, if not corrected, will have the biggest impact and aid him or her to give primary attention to those conditions that ought to be handled most urgently.

NOTE The purpose of prioritization is to help the operator to decide which alarms to deal with when several occur at the same time in a disturbance, and to show especially urgent alarms to the operator during normal operation.

6.2.3 The priority of alarms shall be coded.

© ISO 2008 – All rights reserved

This is to ensure that different priorities are, for example, visually separated in a way that makes it very quick and easy to spot the most important alarms among the less important ones. Redundant codes (e.g. colour and location) may be used for alarms that require rapid action.

6.2.4 Alarm suppression functions shall be included in the system.

NOTE The objective of alarm suppression is to ensure that the presented alarms are relevant to the operator's work under the current process condition/state, and to avoid alarm flooding during process disturbances.

Alarm points should be determined to ensure that the operator can monitor and take appropriate action for each category of alarm.

To achieve this, setpoints may be specified at conservative levels that are well within the actual limits to allow sufficient response time for operators and plant systems.

6.3 Presentation

6.3.1 Alarms for any shared systems in multiple-unit plants should be duplicated in all control rooms.

When an item of shared equipment is being operated from one control room, status displays or alarms should also be provided in all other control rooms where the condition of the equipment is operationally relevant.

6.3.2 The alarm system should be context-sensitive.

Alarms should be designed so that they are worthy of operator attention in all plant states and operating conditions in which they are displayed.

6.3.3 Where operators are required to use a complex alarm system, an appropriate, separate overview should be provided.

The main alarm display should support the task of monitoring and controlling the future behaviour of the plant by attracting the operator's attention towards process conditions that require assessment or action. It should show only alarms that are relevant in the current process conditions.

6.3.4 Key alarms shall be shown in overview displays that are permanently on view, with designated alarm areas.

The purpose of a key alarm display is to improve the management of alarm overloads. Alarm presentation should not rely on alarm lists only to provide the operators with an alarm overview. Key alarm displays ensure both an information rate and a presentation form that will remain manageable under all process conditions.

6.3.5 Alarms should be integrated in process displays.

NOTE Combining relevant process and alarm information in the displays helps reduce the mental workload imposed on operators.

6.3.6 Audible alarm annunciation should be used when new alarms appear.

Audible annunciation should be used to notify the operator of the occurrence and importance of new alarms that require his/her attention.

6.3.7 Special visual annunciation should be used for new alarms.

Visual coding should be used to attract the operator's attention towards new alarms and distinguish them from alarms that have been accepted. For example, unacknowledged alarms might be coded by blinking indicators.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

6.3.8 Alarm information shall be informative and easy to understand.

NOTE This is to avoid misunderstandings and to minimize the time and effort required to understand the meaning of each alarm message.

6.3.9 Alarm information should be easily readable.

NOTE Alarm messages that are clear, easy to read, and well structured will help the operator read each message correctly with a minimum of time and effort.

6.3.10 Necessary alarm information shall be available from all relevant workplaces.

This is to ensure that all relevant personnel have a correct picture of the process conditions within their area of responsibility at all times, and to ensure that alarms are shown near the controls and displays required for corrective or diagnostic action.

6.3.11 Incoming alarm indications shall not be obscured under any circumstances.

NOTE This is to ensure that the operator cannot obscure incoming alarms — say, with windowing systems.

An incoming alarm indication may not be required to present full information about the alarm it relates to.

6.4 Interaction and handling requirements

6.4.1 Only useful alarms requiring action or attention shall be brought to the operator's notice.

This is to ensure that no unnecessary alarms are presented to the operator.

6.4.2 Appropriate system response times shall be specified.

Suitably specified system response times are essential for the system to remain useful in critical situations — particularly where there are high demands on operators. KPI may be used to actively monitor performance.

NOTE Recommended system response times are presented in Annex A.

6.4.3 Where there is no negative impact on safety, operators should have the flexibility to select, group and sort alarms.

NOTE The provision of selection, sorting and grouping facilities makes the system more flexible and usable by letting operators configure online the information they would like to have presented, adapting it to their special needs.

6.4.4 It should be possible to defer individual alarms.

NOTE The objective of alarm deferring is to allow operators to remove standing or nuisance alarms that the alarm generation and structuring mechanisms have failed to prevent.

6.4.5 Navigation within and outside alarm displays should be quick and easy.

NOTE This is to support effective operator response to alarms by allowing quick navigation to additional information.

6.5 Documentation

6.5.1 There shall be an administrative system for handling access control and the documentation of changes made to the alarm system.

The administrative system should prevent unauthorized modifications to the system and ensure that all changes are traceable and properly documented.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

 © ISO 2008 – All rights reserved

6.5.2 The alarm system shall be properly documented for maintaining and improving the system.

Documentation should ensure that good practice is established and sustained throughout any modification of the system, and that the designers and users of the system have a common understanding of the functionality of the system. It should also ensure that each alarm defined in the system is documented with a description of the purpose of the alarm and a criticality assessment.

Ownership of an alarm system and the responsibilities for problems or tasks related to the alarm system may be defined in a contract.

6.5.3 Every system shall have written rules on how priorities should be assigned.

NOTE 1 This is to ensure that the operators are familiar and comfortable with the prioritization rules employed by the system designers, so that priority information can be effectively utilized by operators when handling alarms.

A historical log of alarms and events should be available to the operator.

NOTE 2 The log can be used for analysing incidents.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

Annex A
(informative)

Guidelines

A.1 Overview

Technology changes over time, while human performance remains relatively stable. For this reason, standardization of technological performance that is excessively prescriptive is not particularly helpful, and it is preferable to focus on the ergonomic issues. Human factors specialists should be involved early in the design process, when discussions of displays and controls are first raised, as well as throughout the development of the systems.

This annex highlights aspects of particular relevance for screen-based control room design. Other published ergonomic standards and guidance, drawn from other domains, also provide information that the control room designer may find helpful. For control rooms that include, or are based around, conventional instrumentation, ISO 9355 provides requirements for control and display design. It is recommended that the user of this part of ISO 11064 consult these documents, and others referenced in this annex, as appropriate.

NOTE These guidelines are not intended to be exhaustive.

A.2 Guidance on presentation of information

A.2.1 General

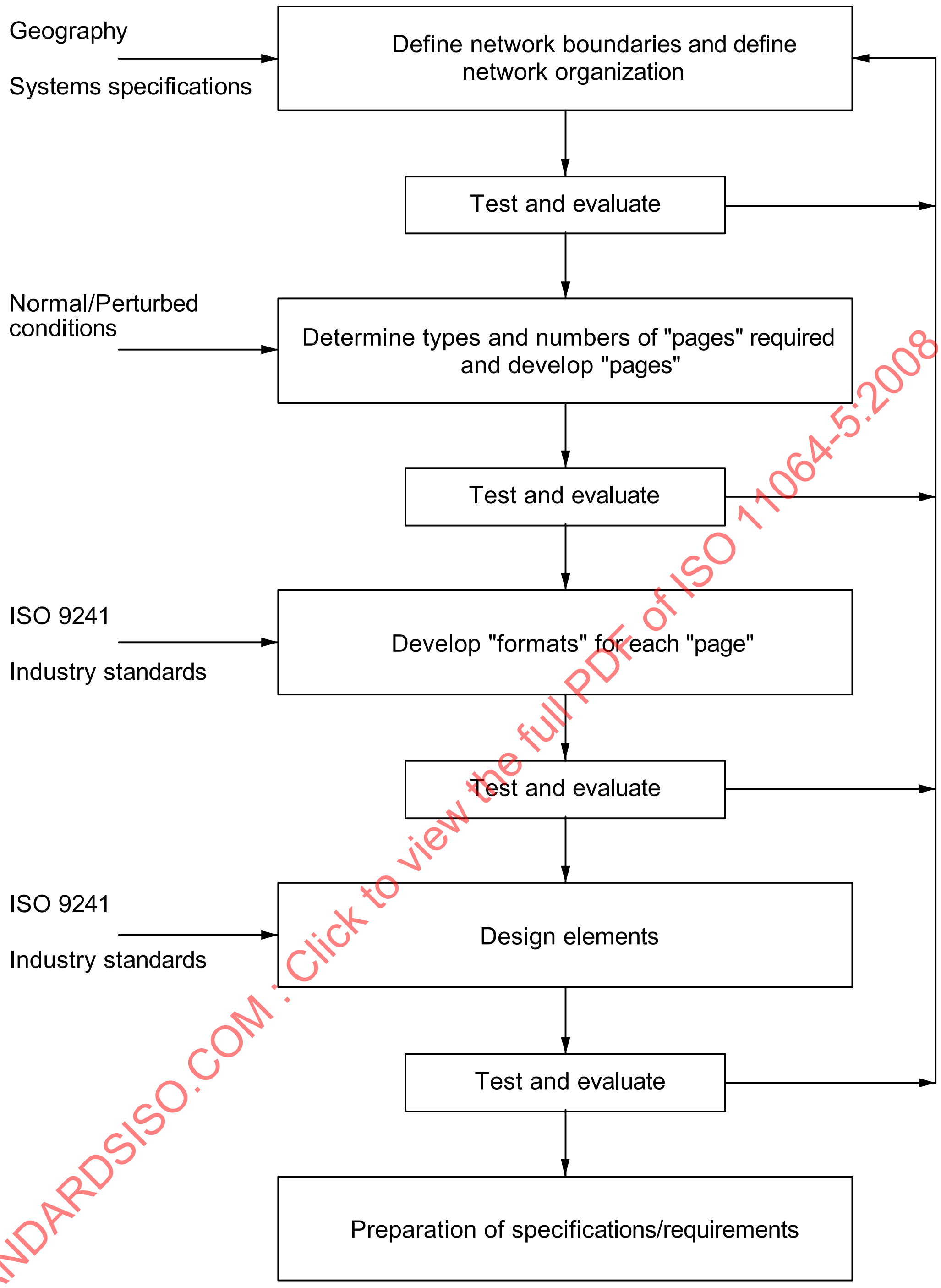
This section presents guidance on the structuring of data and on the appropriate selection of display devices.

The flowchart presented in Figure A.1 develops in more detail the processes summarized in steps 3 to 7 of 5.5.

The process described in Figure A.1 presents a “top down” approach in which the boundaries of the systems to be controlled are identified before decisions are made about the number of “pages” required and the nature and structure of the data to be presented.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved



STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

Figure A.1 — Process for information structuring

A.2.2 Defining network boundaries

During this stage, the ergonomist establishes the entire scope of what it is that is to be controlled through the system and by operators in the control room.

A.2.3 Determining types and numbers of pages

A.2.3.1 General

In most cases, it is not possible to present all the necessary data on a single display. For complex systems, it will be necessary to subdivide this information.

The display structure can be

— hierarchical,

— relational, or

— sequential,

or any combination of these. A key feature is that the data should be easy to find whenever needed.

The use of more than four levels of information in a *hierarchical structure* is not recommended. A hierarchical structure could, for example, be based upon

a) goals/overview,

b) functions/subprocesses,

c) objects/components.

In a *relational structure*, there are links between individual information pages. For example, information elements may have links to their corresponding trend information on other information pages.

In a *sequential structure*, each information page might display only one part of a process flow, which itself occupies several information pages.

At system start-up, an initial information page should appear from which any other information pages can be easily found. It should always be possible to directly access this initial information page by pressing one single key (or similar).

The following guidelines should be applied where appropriate.

— Information pages should be capable of presenting simultaneously the set of data — information, static graphics, controls, etc. — necessary for handling the worst case scenario. The operator's short-term memory, typically 5 s to 7 s half-life for seven to nine variables, suggests that toggling between different windows should be avoided in performing a particular task.

— Where operating practices demand, dedicated overview information should be provided for the display of such parameters as safety-related alarms, weather, etc. Potential system users should be consulted on alternative information structuring proposals; this may be conducted through "paper-based" interface representations or "soft" mock-ups.

A.2.3.2 Identification

Predetermined pages should have a unique and unambiguous identifying name which should

— preferably be located at the top of the screen or presented consistently in the same position, and

— express the display content (e.g. a specific reactor or reservoir).

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

A.2.3.3 Windowing

The real-time environment found in control rooms imposes special requirements as far as the use of windowing in the presentation of information is concerned.

— Only a limited number of windows should be displayed on the screen at once: as a "rule of thumb" fewer than three can be used simultaneously.

— No window should overlay safety-critical information or alarms.

— The system design should ensure that windows are positioned or tiled upon opening, so as to facilitate the user's task. Default window sizes and locations should be designed to minimize the number of operations users have to perform to complete a task.

— The relationship between a parent window and its child windows should always be visually apparent.

A.2.3.4 "Layered" approach

In developing a *layered* approach for page information structuring, the following recommendations can be usefully applied.

a) Background

Backgrounds should be selected to optimize foreground information. Dark backgrounds should be avoided where high levels of ambient illumination can be expected (and vice versa).

b) Static data layer

The purpose of the static data is to enable the user to interpret the meaning of the displayed information (e.g. showing the geography and/or structure of a process).

c) Information layer

Changing data are presented in the information layer and should be easily distinguishable from the background and static data layers.

d) Priority layer

Alarm information should be presented in a priority layer where any changes are brought immediately to the operator's attention. This layer may also be used for other more urgent or higher-priority information, for example that maintenance is about to start on a section of the railway system.

A.2.3.5 Redistribution of pages to display devices

It should be possible for the operator to change page allocations to specific displays to

— compensate for a failed monitor,

— combine displays relating to a common situation.

Each screen should be capable of displaying all categories of information — overviews, trend displays, mimics, alarm lists, tables, database parameters, etc. This can be an advantage when substituting for a failed monitor or providing multiple views of important information, e.g. trend displays for tuning along with complementary monitoring and control displays.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

A.2.3.6 Spatial orientation

As a general rule, it is good ergonomic practice to adopt a consistent disposition of pages to displays throughout a control complex — thus, all workstations are organized in an identical way. Search and recognition times can be reduced if certain types of data can be found in predetermined locations.

A.2.4 Developing formats

A.2.4.1 General

A format is a particular way of presenting data to convey information to the user. The selection of the most appropriate format is highly significant as far as a user's ability to correctly interpret outputs from the system.

Formats include text, forms, histograms, bar charts, tables, mimics and diagrams, and can occupy an entire page or part of one.

The following offers some high-level guidelines for different types of formats. For further ergonomics recommendations, see ISO 9241-12.

A.2.4.2 Text

Text is more often associated with office applications, but is also extensively used for control-room operator interfaces. When using text, the following are some ergonomic factors that should be taken into account:

— for reading tasks of continuous text, lower case gives shorter reading times;

— for search and identification tasks, upper-case text can be identified at greater distance and more quickly, particularly if the text is displayed briefly;

— a standard information presentation format should be used from one page to another;

— VDU displays of textual data, messages or instructions should generally follow design conventions for printed text;

— affirmative statements rather than negative statements should be used;

— when the user has to read continuous text on line, at least four lines of text should be displayed at one time.

A.2.4.3 Bar charts/histograms

Bar charts are the VDU equivalent of the conventional analogue instruments traditionally used in process control rooms. The following are some ergonomics recommendations for creating bar charts or histograms.

— Each bar should have a unique identification label.

— When data have to be compared, bars should be adjacent to one another and spaced such that direct visual comparison can be made without eye movement.

— With a related series of bar charts, a consistent orientation of the bars (vertical or horizontal) should be adopted.

— If one bar represents data of particular significance, then that bar should be highlighted.

— The zero reference should be the centre of a deviation bar chart. The magnitude of each variable should be displayed when a deviation bar chart is used as a main information format for safety function parameters.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

 © ISO 2008 – All rights reserved

— Segmented bars, in which differently coded segments are shown cumulatively within a bar, should be used when both the total measures and the portions represented by the segments are of interest.

— For segmented bars, the data categories should be ordered within each bar in the same sequence, with the least variable categories displayed at the bottom and the most varied variable at the top.

A.2.4.4 Trend curves

Trend curves are the electronic version of the traditional strip recorder, and provide two-dimensional analogue historical and/or predictive information.

EXAMPLE One dimension is a process variable, while the second variable is the time factor.

The following are some ergonomics recommendations when drawing trend curves.

— Trend lines should be about twice as thick as the thickest line used in the background grids and scale base lines.

— If colours are used, a wide spectral separation between the colours should be provided.

— Trend displays should be capable of showing data collected during time intervals of different lengths.

— Trend rates should not fluctuate as a result of minor changes in data or oscillatory behaviour that can be superimposed on a well-defined trend.

— Curves representing planned, projected or extrapolated data should be distinctive from curves representing actual data.

A.2.4.5 Graphs

Graphs are representations showing relations between various variables.

EXAMPLE Pressure represented as a function of temperature.

The following are some ergonomics recommendations and considerations that should be taken into account when creating graphs.

— Graphs should be self-descriptive, i.e. it should be possible to interpret the data without consulting additional information.

— It should be possible to identify multiple curves without the need for a separate legend.

— It can be helpful for the target area, preferred combination of X and Y axis values, to be graphically defined.

— Graphs which form recognizable patterns, relating to normal or abnormal conditions, can prove helpful to the user.

A.2.4.6 Data fields and forms

A data field is a delineated area where data are entered or presented, generally consisting of a fixed number of characters or blanks. Data forms are formats containing one or more data fields. The following are some ergonomics recommendations for their design.

— Data fields to be compared on a character-by-character basis should be positioned one above the other.

— The ordering and layout of corresponding data fields across different pages should be consistent from one page to another.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

— The format of the screen-based data forms should be similar to that of commonly used hard-copy source documents.

— When paper-based forms are used during fallback procedures, these should follow the same format as the software-based designs.

— Clear visual definition of data fields should be provided so that the data are distinct from labels and other display features.

— The current field to be entered should be highlighted.

— Data entered which does not match the predefined format of the data form should be highlighted and signalled to the user.

— A field group heading should be centred above the labels to which it applies.

— The number of pages in a data form required to complete the transaction should be minimized to reduce the amount of navigation.

— The user should be able to move from one entry field to the next using a simple action that requires minimal focused attention.

A.2.4.7 Pie charts

A pie chart is a circular chart divided into sections (as pieces of a pie) to graphically represent the relative proportions of different parts of the whole. The segments can represent magnitudes or frequencies. The following are some ergonomics recommendations for creating pie charts.

— Partitioning should be limited to five segments or less.

— Wherever practical, segments should be labelled directly rather than using a separate legend.

A.2.4.8 Flowcharts

A flowchart is a diagram that illustrates sequential relations among elements or events. The following are some ergonomics recommendations for designing flowchart presentations.

— The available decision options should be presented in a logical order.

— Only a single decision should be required at each step.

— The information should be presented in a clear, logical manner: top-to-bottom or left-to-right sequences.

A.2.4.9 Mimics and diagrams

A mimic is a format combining graphics and alphanumerics, used to integrate system components into functionally orientated diagrams that reflect component relationships.

EXAMPLE 1 A mimic used as a schematic representation of sewage or airport baggage conveyor systems.

A diagram is a special form of a picture page in which details are only shown if they are necessary for a task.

EXAMPLE 2 An electric wiring diagram for a rail system showing the distribution of electricity in the network but not geographic landmarks.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

 © ISO 2008 – All rights reserved

The following are some ergonomics recommendations for creating mimics or diagrams.

— The mimic or diagram should contain the minimum amount of detail necessary to yield a meaningful pictorial representation.

— It should be possible to easily identify all the system components presented on a mimic diagram.

— All flowpath line origin/destination points should be labelled or begin/end at labelled components.

— Wherever flow direction is important, it should be clearly indicated by distinctive arrowheads.

— Overlapping of flowpath lines should be avoided. Where crossovers cannot be avoided, they should be clearly indicated so that they do not appear as connections.

A.2.4.10 Maps

A map is a graphical representation of a geographical area or space such as the layout of a building or facility. The following are some ergonomics recommendations for designing and displaying maps.

— When several different maps are to be displayed, consistent orientation should be used so that the top of each map will always represent the same direction.

— When a map exceeds the capacity of a single information page, users should be able to navigate easily and be provided with appropriate feedback on their current location.

— If the map orientation can be changed, the map labels and symbols should remain oriented to the user's position.

A.2.5 Design elements

Elements consist of features including alphanumeric characters, icons and symbols, arrows and labels. Important data should be displayed in a prominent position, such as centrally on a page or at its top.

The static portion of any page, e.g. process equipment symbols, frames, piping, etc., should consist of the minimum number of elements necessary for the following.

a) Identification

What does the picture show (e.g. which process unit, which component, which aspect)?

b) Orientation

How does this page relate to other pages?

c) Navigation

What is the easiest path to any other required data?

The area allotted to dynamic symbols and data should be large with respect to the overall page in order to facilitate unambiguous recognition and interpretation of the dynamic values and states. Exceptions may include tables and large arrays of symbols where pattern recognition is important.

The dynamic elements (symbols and figures) in the page should have attributes making them conspicuous against background and static data elements by the use of colour, shape, style, etc.

In selecting the appropriate coding technique, relevant task demands include the operator needing to count, to compare and to read text. The most effective arrangement for inter-related information should be selected, i.e. logical, physical, left-to-right or top-to-bottom fluid flow, etc.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

A.2.6 Display devices

The actual numbers of displays on which data are to be presented, needs to take account of workstation equipment layout constraints (see ISO 11064-4) as well as any control room layout requirements (see ISO 11064-3).

When selecting the size of display screens, or the necessary display-area on conventional instruments, a constant visual angle should be achieved regardless of the viewing distance (i.e. double viewing distance requires double character height).

When determining the amount of the visual angle required, account should be taken of such aspects as the visual task, the colour used and the viewing conditions. See ISO 11064-4 and ISO 11064-6.

A.3 Guidance on “user-interface interaction”

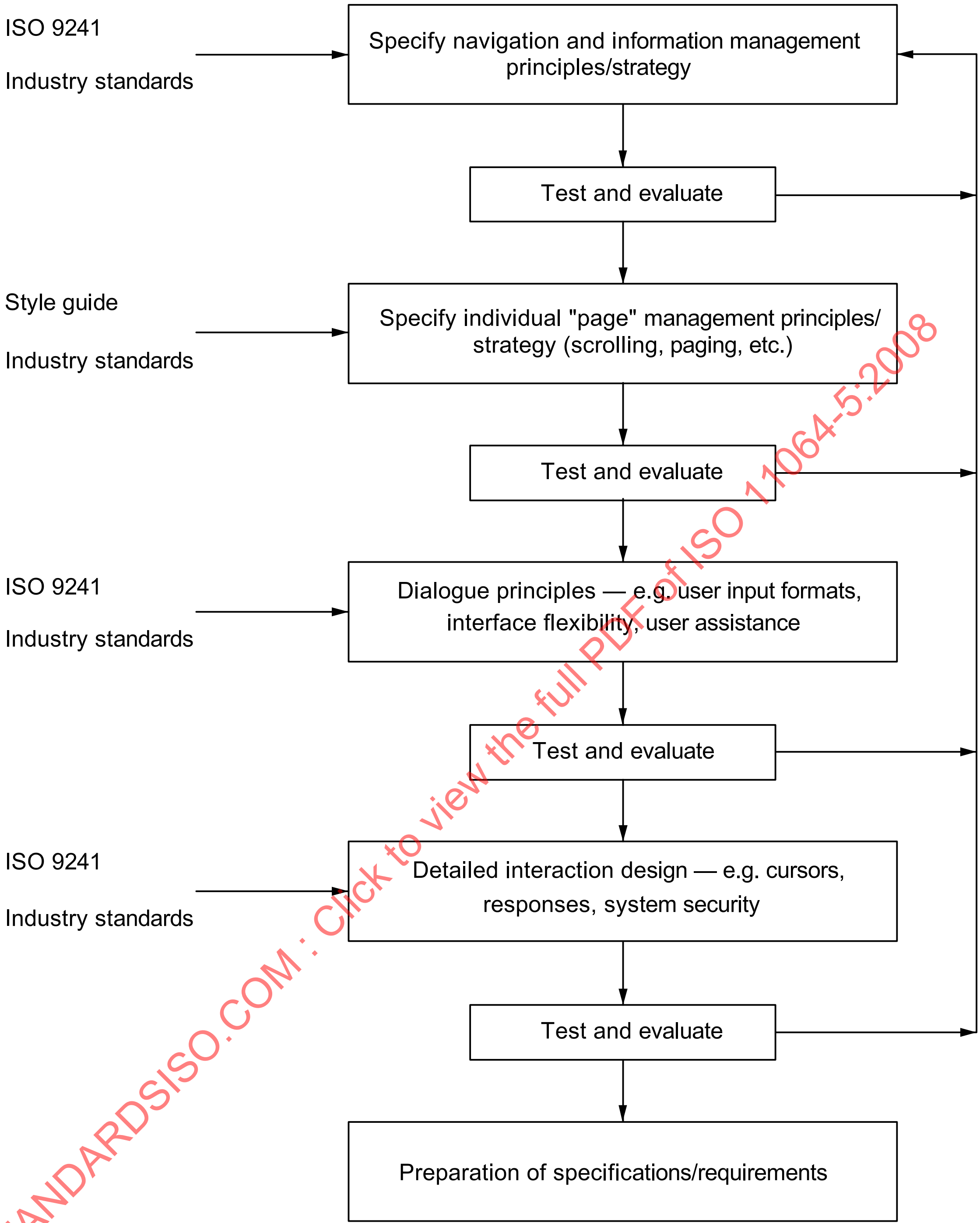
A.3.1 General

The guidance presented in this clause concerns the operator’s interaction with the system and addresses issues related to network management, page management, selection of dialogue types and system response times.

Figure A.2 presents an overall sequence of activities which may be adopted in specifying the user interface interaction.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

 © ISO 2008 – All rights reserved



STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

Figure A.2 — Process for user interface design

A.3.2 Network management

Network management includes display navigation and display selection. Display navigation is concerned with all operations associated with searching for pages in a network of pages or finding a specific item of data in a display page.

Display selection involves the retrieval of a desired page or item of information. Important aspects to consider include

— orientation of data,

— data retrieval, and

© ISO 2008 – All rights reserved

— navigation for large display pages.

A.3.3 Page management

The conception of page management for control room applications should consider the following:

— use of designated positions for windows and the items within them;

— use of a tiled window format in cases where continuous visual access to the information currently displayed is required;

— where legacy systems exist, commonality between new and old window management systems.

For alarms presented on windows, see Clause 6. Further recommendations on the management of windows can be found in ISO 9241-12.

A.3.4 Selecting dialogue types

The selection of dialogue types should be based on anticipated task requirements, user skills and anticipated system response times (see Table A.1 [14]). For principles of dialogue design, see ISO 9241-10.

Table A.1 — Dialogue types vs task requirements

Task	Command language	Menus	Function keys	Macros and program keys	Forms	Direct manipulation	Natural/ Query language	Question/ Answer	Speech
Arbitrary entry sequences	X					X			
Wide range of control entries	X								
Routine data entry								X	
Entry order constrained								X	
Data entry flexibility needed					X				
Frequent control/transactions			X	X					
Infrequent control/transactions		X			X		X	X	
Small command set		X	X						
Large command set		X		X					
Slow computer response time					X				
Fast computer response time		X				X		X	
Highly trained users	X								

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved

Table A.1 (*continued*)

Task	Command language	Menus	Function keys	Macros and program keys	Forms	Direct manipulation	Natural/ Query language	Question/ Answer	Speech
Moderately trained users				X	X		X		
Little training		X				X		X	X
Reduced hands-on control									X
Unpredictable retrieval							X		X
Complex control				X	X	X			

A.3.5 System response times

Table A.2 presents some of the available guidance on maximum and preferred system response times for various control room operator transactions. Additional guidance can be found in Reference [14].

Table A.2 — System response times vs user activity

User activity		Response time s	
		Maximum	Preferred
Control activation (for example keyboard entry, cursor controller movement)		0,1	< 0,1
System activation (system initialization)		3	< 0,5
Request for given service:	Simple	2	< 0,25
	Complex	5	< 2
	Loading and restart	15 to 60	< 6
Error feedback (following completion of input)		2	< 0,25
Response to ID		2	< 0,25
Information on next procedure		< 5	< 2
Response to simple inquiry from list		2	< 0,25
Response to simple status inquiry		2	< 0,25
Response to complex inquiry in table form		2 to 4	< 0,25
Request for next page		0,5 to 1	< 0,25
Response to "execute problem"		< 15	< 6
Response to complex inquiry in graphic form		2 to 10	< 0,25
Response to graphic manipulation		2	< 0,25
Response to user intervention in automatic process		4	< 1,5
Command entry			< 0,2
Control system response			< 0,5
Plant process response		Open-ended but feedback required if greater than 0,5	
Input of commands to CCTV system		Task-dependent	

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

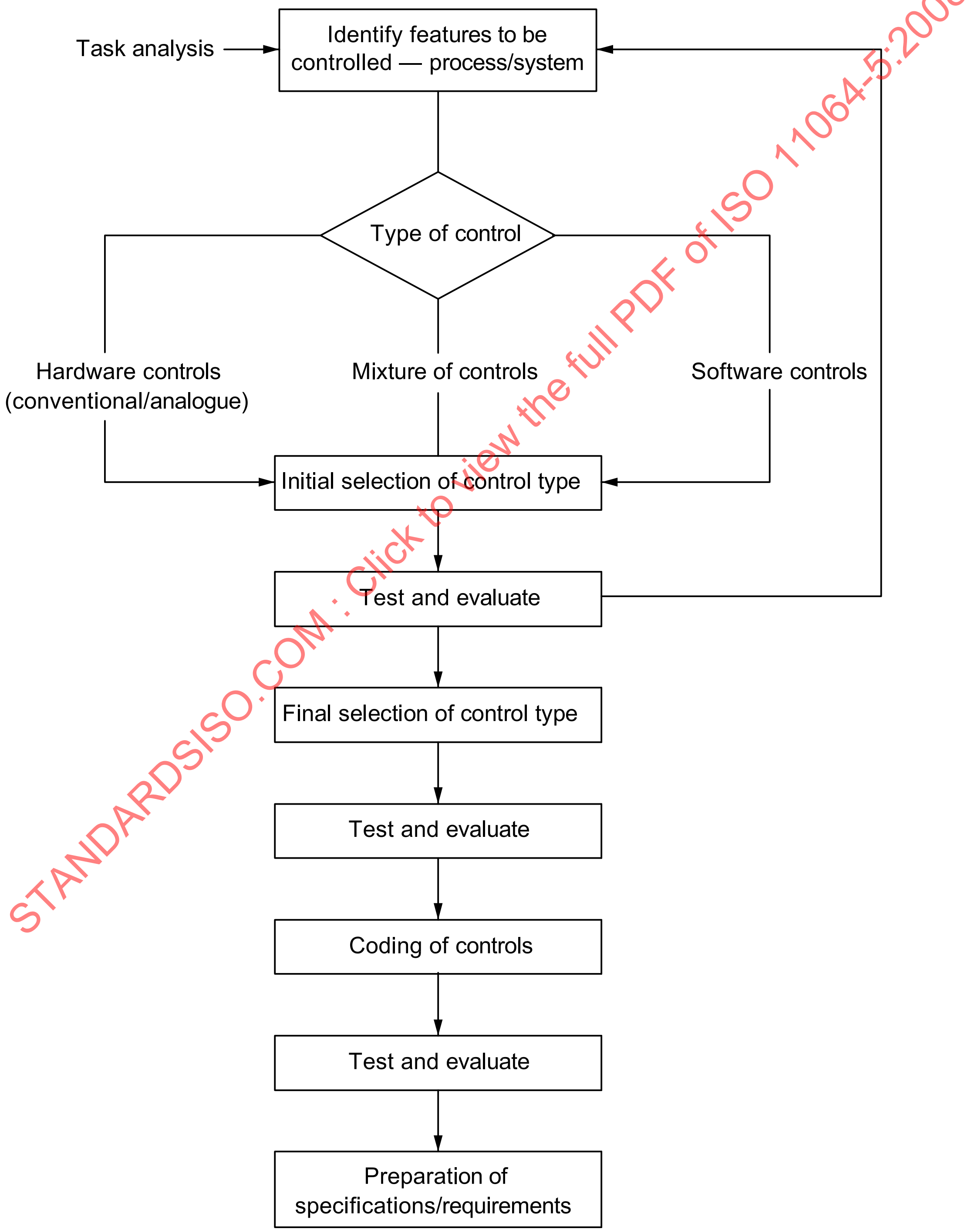
A.4 Selecting control devices

A.4.1 General

Control devices, in the context of control room environments, include keyboards, mice, touch screens, "soft" controls and conventional controls. There are two types of input activities, *data input* and *pointing*.

This clause provides guidance on which the selection of alternative controls may be based. Ergonomic recommendations concerning non-keyboard entry devices are also presented in ISO 9241-9.

Figure A.3 presents a process for the selection and coding of control devices.



STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

Figure A.3 — Process for selection of control devices

 © ISO 2008 – All rights reserved

A.4.2 List of features to be controlled

The features to be controlled should have been identified during earlier task analysis phases of the control room design programme (see ISO 11064-1).

A.4.3 Selection of control type

Table A.3 [11] summarizes some of the general considerations that may be applied to the selection of computer-based controls. "Conventional" control requirements, including the selection process, are presented in ISO 9355-3. Additional control device requirements are presented in ISO 9241-9.

Table A.3 — Selection of control devices

Control/Input	Considerations for appropriate use
Cursor control keys	Moving cursor in X and Y dimensions
Touch screen	Moving/holding arm to screen for long periods of time is not required Screen does not have small "poke points" relative to size of finger tip A low level of resolution is required for positioning Task will not be disrupted by hand temporarily blocking screen Periodic cleaning of screen is provided
Mouse	Adequate space is available for mouse movement over a pad or desktop A low to medium level of resolution is required for positioning Periodic cleaning is provided
Isotonic joystick (displacement)	Positioning accuracy is more important than positioning speed
Trackball	Rapid cursor positioning is desirable Limited space is available for installing an input device
Graphics tablet	A low to medium level of resolution is required
Isometric joystick (force)	Precise or continuous control of two or more related dimensions is required

A.4.4 Coding of controls

For conventional controls, various coding systems can be used, including location, shape, size, mode of operation, labelling and colour. The advantages and disadvantages of these options in the control room environment are presented in Reference [14], which also gives guidance on screen-based systems.

A.5 "Soft" controls, overview displays, communications systems and CCTV

A.5.1 Soft controls

"Soft" control systems provide operators with control functions that are operated through software rather than by direct physical connections. They can be used to control a facility, specific items of equipment or the human-system interface itself, e.g. display selection.

Soft controls have characteristics different from conventional controls. For example, they are not spatially dedicated in the control room; their presentation is more serial than parallel; they are addressable and therefore available, but may not be continuously present. Since both the human-system interface and the

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

facility equipment may be controlled with the same device, a soft control may perform a range of control functions. By comparison, a conventional control typically performs a single control function.

The following is recommended where soft controls are to be used.

— Where soft controls are accessible from multiple locations in a control room, it is advisable to ensure that no conflicts arise among the users, e.g. by restricting any control actions to one user at a time.

— Secondary tasks (interface managements actions) and primary tasks (process control actions) should not be mixed.

— The use of different control modes should be minimized and — if used — clearly marked.

— Soft control systems need to be consistent and compatible with the rest of the human-system interface, e.g. they should be coordinated with any conventional instrumentation.

— Where the failure of a soft control system would have unacceptable consequences, redundant systems should be provided.

A.5.2 Overview displays

At each control workstation, “overview” information should be available and provide the state of all facilities the operator is responsible for. This should be a starting point for navigating in the hierarchy of more detailed pages. These overview displays can be on the workstation, closely coupled to specific workstations, or remote and shared by a number of operators.

If the sequence or status of events, or the trends of some process variables, are frequently monitored, dedicated screens for the event lists and trend displays may be employed as overview displays. An alternative recommendation is single-key access for the frequently referenced data.

Off-workstation shared displays (OSD) allow a number of individuals to simultaneously view exactly the same information. The OSD system can support team performance by enhancing coordination and communication within a team. Overview displays do not convey more information than workstation-mounted displays since the greater viewing distances demand corresponding increases in character/icon heights.

The primary function of an OSD system can differ between installations, but important functions typically include provision of facility status overviews, directions to operators on additional (more detailed) information of other parts of the human-system interface (HSI), and supporting crew coordination, communication, and collaboration.

Important aspects to consider in OSD system design are

— allocation of information between on-workstation displays and the shared off-workstation display(s),

— information structuring on the OSD,

— user-system interaction with the OSD system,

— backup capabilities in cases of OSD system loss, particularly if it has an effect on safety, and

— consistency and compatibility between the OSD system and the rest of the HSI.

In practice, a combination of an off-workstation, shared overview display and desk-based monitors can be appropriate where requirements for team working, visitors, mobility of users and provision of secondary support information are to be accommodated.

STANDARDSISO.COM : Click to view the full PDF of ISO 11064-5:2008

© ISO 2008 – All rights reserved