
**Ergonomic design of control centres —
Part 2:
Principles for the arrangement of control
suites**

*Conception ergonomique des centres de commande —
Partie 2: Principes pour l'aménagement de la salle de commande et de ses
annexes*

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Contents

Page

Foreword.....	iv
Introduction.....	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Design procedure for arrangement of control suites	2
5 Ergonomic aspects to be considered.....	6
6 Verification and validation of layout of the control suite	10
Annex A (informative) Some detailed considerations for specific rooms and areas.....	11
Bibliography	14

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 part of ISO 11064 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11064-2 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 rooms*
- *Part 7: Principles for the evaluation of control centres*
- *Part 8: Ergonomic requirements for specific applications*

Annex A of this part of ISO 11064 is for information only.

Introduction

This part of ISO 11064 considers ergonomic principles, recommendations and guidelines for the layout of control suites.

ISO 11064 covers all types of control centres, including those for the processing industry, for transport and for the control and communication systems of emergency services. Though ISO 11064 is primarily intended for non-mobile control centres, many of the principles are relevant to mobile centres such as those found on ships, locomotives and aircraft.

User requirements are a central theme of this part of ISO 11064 and the processes described are designed to take the needs of users into account at all stages. The overall strategy for dealing with user requirements is specified in ISO 11064-1.

This part of ISO 11064 provides guidance on the design and planning of the control suite in relation to its supporting areas. Requirements for the layout of the control room are specified in ISO 11064-3. Requirements for the design of workstations, displays and controls, human-computer interaction and physical working environment are specified in ISO 11064-4 to ISO 11064-6. Evaluation principles are dealt with in ISO 11064-7.

ISO 11064-1 to ISO 11064-7 cover general principles of ergonomic design appropriate to a range of control sectors. The specific requirements appropriate to particular sectors or applications are specified in ISO 11064-8. The requirements specified in ISO 11064-8 are to be read in conjunction with ISO 11064-1 to ISO 11064-7.

The main beneficiaries of this part of ISO 11064 are the operators and other users in the control suite. It is the needs of these users that provide the ergonomic requirements used by the International Standard developers. Although it is unlikely that the end-user will read ISO 11064, or even know of its existence, its application should provide the user with interfaces that are more usable, a working environment that is more consistent with operational demands and result in a solution which will minimize error and enhance productivity.

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Ergonomic design of control centres —

Part 2: Principles for the arrangement of control suites

1 Scope

This part of ISO 11064 covers ergonomic design principles for control centres and, more specifically, the various arrangements of rooms and spaces in a control suite. The principles are based on an analysis of functions and tasks that have to be supported by the control room and functionally-related rooms. They include identifying functional areas, estimating the space provisions for each functional area, determining operational links between functional areas and developing preliminary layouts for the control suite to facilitate the transition between all the activities conducted in the control suite.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of ISO 11064-2. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11064 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

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

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

EN 614-1, *Safety of Machinery — Ergonomic design principles — Part 1: Terminology and general principles*.

3 Terms and definitions

For the purposes of this part of ISO 11064, the terms and definitions given in ISO 11064-1 and the following apply.

3.1

task allocation

distribution of work tasks or work task elements between operators and systems

3.2

task zone

combination of a work task with associated space and location requirements

3.3

work environment

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

[EN 614-1]

**3.4
work space**

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

[ISO 6385]

**3.5
workstation**

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

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

**3.6
work system**

one or more persons and work equipment acting together to perform the system task, in the work space, in the work environment, under conditions imposed by the work tasks

[EN 614-1]

**3.7
work task
task**

activity required to achieve an intended outcome of the work system

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4 Design procedure for arrangement of control suites

4.1 General approach

ISO 11064-2:2000

A general approach to the design of work systems shall be in accordance with ISO 6385 and EN 614-1. The multipart standard ISO 11064 discusses the application of the general approach to the design, redesign or refurbishment of control centres. The objectives of the aforementioned standards are to design the work system in consistency with human capabilities, limitations and needs. Consequently, an analysis of the existing or a comparable situation is required. Clause 4 explains how to apply the general approach to the analysis when designing control centres. In particular, it concerns the activities needed to enable the architectural planning (for example space planning) of the general layout of a control suite. Detailed engineering design of the control room suite, operator workstations and the human-computer interfaces are covered in subsequent parts of ISO 11064.

The development of a site plan (also called plot plan) has particular implications for the control suite. A site plan is a mapping of all process units, major equipment, buildings and routing on a production site or within a production building. The site plan includes the location of production units, buildings, traffic systems and so on. The layout of the control centre includes the location of the control suite relative to the processes to be monitored and controlled, workstations and other equipment.

Emphasis of this part of ISO 11064 is on ergonomic considerations for the overall design of a control suite, based on such factors as the layout of the control centre, job content and work organization. It includes the location of the control room suite relative to the production site.

It is recognized that many other factors (for example economic factors, size, shape and surroundings of the area, existing parts of the site) will also be considered and will be of major importance for decision making. However, the user of this part of ISO 11064 should be aware that the physical location of a control suite relative to the sub-systems to be controlled and/or monitored establishes constraints for the design of the control room, workstations and jobs. Amongst other things, this part of ISO 11064 specifies routing, distances, communication patterns and the level of flexibility in job and work organization design. In some cases, the physical location is critical as the control room is operationally dependent on location (for example site security, reception), whereas, in other cases, location may be irrelevant.

Where physically challenged control suite users or visitors are expected, adequate facilities should be taken into account during design.

4.2 Steps in the design of control suites

The general layout of a plant or production unit, a process description, main process operating principles and the general layout of buildings are important considerations at the beginning of a project. The process of designing a control centre usually consists of several project phases, as follows:

Phase A: Clarification

Phase B: Analysis and problem definition

Phase C: Conceptual design

Phase D: Detailed design

Phase E: Implementation and operational feedback

For further information, see ISO 11064-1.

The principles of an ergonomic design (see ISO 11064-1:2000, clause 4) for control suite arrangement should be developed and used during phase C. In order to ensure effective input to a project concerning the layout of control suites, the following project steps are recommended (see Figures 1 and 2 of ISO 11064-1:2000, step 9A):

- during phase A, functional requirements are generated;
- the starting point for the conceptual design consists of a description of the intended performance of the work system (system functions) and an overview of tasks to be performed within the work system, including an allocation of tasks to human operators or technical equipment (see 4.3);
- the general layout of the site or production facility, including the location of a control suite (see 4.4), can be determined;
- an overview of space requirements for the control suite should be made. A useful approach to this is to list the tasks to be performed in the control suite, and to attach to each task an overview of the requirements imposed on the workstation and other facilities. The resulting task zones should then be arranged into workstations in such a way that the requirements are met (see 4.5).

Typically, the layout of the control suite is baselined at the start of phase D. During this phase any design changes shall be controlled.

User input shall be an integral part of the development of a control suite. User participation is a structured approach of employing future users and all others involved in the design project (see [2] in the Bibliography). User participation shall be organized by an expert in this field (for example an ergonomist). In general, the first communication between users and the project team arises at the time of a situation analysis. Assuming that such a communication has been established, the project team should consult the users on the layout of the control suite. Amongst the various tools that can be used to facilitate an effective consultation on building layout are, for example, a scale-model or layout board (for example a magnetic space planning board), or a three dimensional computer graphics model.

4.3 Starting point for layout of control suite

As a precondition to the design of a control suite arrangement, the following activities have been performed:

- specification of the system functions (the function of the plant built);
- allocation of functions to human operators or equipment and instruments (see EN 614-1);
- global definition of the jobs of the operational staff (that is job rotation, training level).

These three steps then provide the following information as a starting point for the design of the control suite:

- a list of system functions;
- the work tasks, their relationships, length, frequency and workload;
- the job of every member of the operating staff, grouping all tasks allocated to one person;
- a preliminary description of the equipment to be installed in the control suite.

All this should then be used to specify the work places and other working areas (see 4.5).

For a completely new control suite design, it is possible that no or little information from comparable installations is available. In the absence of practical experience, the starting point can only be a rough overview of staffing level and work tasks. It has to be completed as the design progresses. Where accurate information is not available, working assumptions may be used.

In the case of the redesign or modification of an existing facility, the starting point is the result of the situation analysis. A complete function analysis might then be replaced by an overview of the current work tasks, in combination with an analysis of the constraints to be observed when proposing changes to the work organization. This situation analysis also enables direct participation of users in the design process.

4.4 Location of control suite

In order to determine an appropriate location of the control suite on a site, the user of this part of ISO 11064 should consider, amongst other rules, the following interacting ergonomic aspects:

- visibility requirements; in other words, if it is important that a process or site/area is visible to particular operators, that work area should be located such that visual inspection is unobstructed;
- distances between control suite, process units, local control rooms and local workstations;
- control suite accessibility and emergency exits;
- job and work organization design proposals, including requirements concerning communication and interpersonal interactions;
- user task interaction with equipment;
- consideration of the movement of operators, other personnel and visitors within the control suite;
- consideration of adequate space for service and maintenance activities.

Environmental aspects to be considered:

- adequate light and windows;
- adequate control of room temperature;
- adequate protection against or avoidance of high noise levels;
- adequate protection against or avoidance of draught, wind, dust and toxic hazards;
- adequate protection against or avoidance of vibrating environments;
- in the case of alternating electromagnetic fields of external equipment (for example radar, electromagnetic separators), workplaces should be located such as to minimize their influence, because the effects on human health are not yet sufficiently understood. For further information, see ISO 11064-6.

Technical aspects to be considered:

- civil construction of a building;
- relationships between process units (interacting processes), areas to be guarded and so on;
- pipe, cable and duct routing;
- accommodation for future expansion.

Other aspects to be considered:

- some safety aspects of the control suite, for example blast-proof building or not, toxic hazards, whether the control suite is to be used as a shelter, and so on;
- security; access to the public, special security checks and gates;
- public relations (this also concerns access to the public);
- control suite visibility for reasons of security or public relations;
- architecture; the building shall fit into the general environment.

NOTE As a tool for evaluation, clause 6 gives ergonomic considerations.

4.5 Overview of task zones in the control suite

An overview of task zone requirements for the control suite shall be made.

The overview of task zones concerns the control suite and all the rooms that have a functional relationship to the tasks performed in it (see clause 6).

The specification should include the following factors:

- number of users per room (including the variability in the numbers);
- estimated sizes of fully equipped workstations per room and their estimated space requirements;
- requirements for handover during shift changes and team briefing;
- location of noise sources, such as printers, phones, alarm signals and associated requirements;
- space allowances made for future modifications and extensions.

A useful approach is to specify a task zone for each work task. These task zones should then be allocated to workstations according to one or several of the following principles:

- certain task zones can be organized in one room. For example, all control and supervision task zones (that is the operator desks) and a rest area can be in one room;
- task zones can be merged. For example: the task zones for control and supervision tasks can be merged with the task zone for an administration task (that is both tasks are performed by the same person at one workstation);
- a task zone can be in a separate room (excluding other tasks).