
**Ergonomic principles in the design of
work systems**

Principes ergonomiques de la conception des systèmes de travail

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Foreword

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

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

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 6385 was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 1, *Ergonomic guiding principles*.

This second edition cancels and replaces the first edition (ISO 6385:1981), which has been technically revised.

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Introduction

Technological, economic, organizational and human factors affect the work behaviour and well-being of people as part of a work system. Applying ergonomic knowledge in the light of practical experience in the design of a work system is intended to satisfy human requirements.

This International Standard provides a basic ergonomic framework for professionals and other people who deal with the issues of ergonomics, work systems and working situations. The provisions of this International Standard will also apply to the design of products, e.g. consumer products.

In the design of work systems in accordance with this International Standard, the body of knowledge in the field of ergonomics is taken into account. Ergonomic evaluations of existing or new work systems will show the need for, and encourage attention to, the role of the worker within those systems.

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Ergonomic principles in the design of work systems

1 Scope

This International Standard establishes the fundamental principles of ergonomics as basic guidelines for the design of work systems and defines relevant basic terms. It describes an integrated approach to the design of work systems, where ergonomists will cooperate with others involved in the design, with attention to the human, the social and the technical requirements in a balanced manner during the design process.

Users of this International Standard will include managers; workers (or their representatives); and professionals such as ergonomists, project managers and designers who are involved in the design or redesign of work systems. Those who use this International Standard may find a general knowledge of ergonomics (human factors), engineering, design, quality and project management helpful.

The term “work system” in this International Standard is used to indicate a large variety of working situations. The intention is to improve, (re)design or change work systems. A work system involves a combination of people and equipment, within a given space and environment, and the interactions between these components within a work organization. Work systems vary in complexity and characteristics. Some examples of work systems are: a machine with a single person; a process plant including its operating and maintenance personnel; an airfield with users and personnel; an office with its workers; and computer-based interactive systems. The observance of ergonomic principles applies also to the installation, adjustment, maintenance, cleaning, repair, removal and transport of work systems.

The systems approach in this International Standard gives guidance to the users of this standard in existing and new situations.

The definitions and ergonomic guiding principles specified in this International Standard apply to the design of optimal working conditions with regard to human well-being, safety and health, including the development of existing skills and the acquisition of new ones, whilst taking into account technological and economic effectiveness and efficiency.

While the principles in this International Standard are oriented to the design of work systems, they are applicable to any field of human activity, e.g. in the design of products for domestic and leisure activities.

NOTE This International Standard is considered to be the core ergonomic standard from which many others on specific issues are derived.

2 Terms and definitions

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

2.1

allocation of functions

process of deciding how system functions shall be implemented, by humans, by equipment and/or hardware and/or software

2.2

design population

designated group of workers delimited as a percentile range of the general population, defined according to relevant characteristics, e.g. gender, age, skill level, etc.

**2.3
ergonomics**

study of human factors

scientific discipline concerned with the understanding of interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance

**2.4
job**

organization and sequence in time and space of an individual's work tasks or the combination of all human performance by one worker within a work system

**2.5
system function**

broad category of activity performed by a system

**2.6
work environment**

physical, chemical, biological, organizational, social and cultural factors surrounding a worker

**2.7
work equipment**

tools, including hardware and software, machines, vehicles, devices, furniture, installations and other components used in the work system

**2.8
worker
operator**

person performing one or more tasks within the work system

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**2.9
work fatigue**

mental or physical, local or general non-pathological manifestation of excessive strain, completely reversible with rest

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**2.10
work organization**

sequence and interaction of work systems fitted together to produce a specific result

**2.11
work process**

sequence in time and space of the interaction of workers, work equipment, materials, energy and information within a work system

**2.12
workstation**

combination and spatial arrangement of work equipment, surrounded by the work environment under the conditions imposed by the work tasks

**2.13
work strain**

internal response of the worker to being exposed to work stress depending on his/her individual characteristics (e.g. size, age, capacities, abilities, skills, etc.)

**2.14
work stress
external load**

sum of those external conditions and demands in the work system which act to disturb a person's physiological and/or psychological state

2.15**workspace**

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

2.16**work system**

system comprising one or more workers and work equipment acting together to perform the system function, in the workspace, in the work environment, under the conditions imposed by the work tasks

2.17**work task**

activity or set of activities required by the worker to achieve an intended outcome

3 Designing work systems**3.1 General principles**

In the design process, the major interactions between one or more people and the components of the work system, such as tasks, equipment, workspace and environment, shall be considered.

These interactions create demands on the worker that together constitute the work stress. This work stress will result in reactions within the worker, depending on her/his individual characteristics (e.g. size, age, capacities, abilities, skills, etc.) called work strain. Work strain will result in impairing (e.g. work fatigue), or facilitating effects (e.g. skill development), thus affecting the individual characteristics of the worker in a feedback loop.

NOTE Work stress and work strain have a neutral interpretation in ergonomics and no negative connotations.

Ergonomic work system design aims at optimizing work strain, avoiding impairing effects and promoting facilitating effects. Unimpaired human performance at the same time will often improve system effectiveness and efficiency, thus contributing to another important goal of ergonomic work system design.

Work system design should consider human beings as the main factor and an integral part of the system to be designed, including the work process as well as the work environment.

Ergonomics shall be used in a preventive function by being employed from the beginning rather than being used to solve problems after the design of the work system is complete. However, it can be successfully employed in the redesign of an existing, unsatisfactory work system.

The most important decisions that have consequences in the design are made at the beginning of the design process. Therefore, ergonomic efforts should be greatest at this stage. Ergonomic contribution to the work system design shall continue throughout the design process. However, the level of input can vary from being fundamental and extensive during the analysis of the system needs ("formulation of goals") to fine-tuning when the completed system is being implemented ("realization, implementation and validation"). Sufficient attention shall be given to the application of ergonomic principles until late in the design process in order to prevent negative effects such as: delays in projects; extra costs for adaptation; a lower design quality; and worse usability.

Workers shall be involved in and should participate in the design of work systems during the process in an effective and efficient manner. In work system design, a participatory approach is essential in order to avoid sub-optimal solutions, because the experience of workers provides an indispensable knowledge base. The design process shall therefore, wherever possible, involve workers in all stages.

It is recommended to design a work system for a broad range of the design population in order to meet the needs of workers with various characteristics, including people with special requirements, as far as possible. Thus the development of special solutions for individuals can be minimized.