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# International Standard



# 6385

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## 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 institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6385 was developed by Technical Committee ISO/TC 159 *Ergonomics*, and was circulated to the member bodies in October 1978.

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It has been approved by the member bodies of the following countries :

[ISO 6385:1981](#)

Australia  
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The member bodies of the following countries expressed disapproval of the document on technical grounds :

Bulgaria  
USA

# Ergonomic principles in the design of work systems

## 0 Introduction

Technological, economic, organizational and human factors affect the work behaviour and well-being of people as part of the work system. The design of the work systems shall satisfy human requirements by applying ergonomic knowledge in the light of practical experience.

## 1 Scope

This International Standard establishes ergonomic principles as basic guidelines for the design of work systems.

## 2 Field of application

The 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, taking into account technological and economic efficiency.

### NOTES

- 1 This International Standard shall be used in conjunction with other pertinent standards, regulations or agreements.
- 2 Adaptation of this International Standard may be necessary in order to meet additional requirements of some categories of individuals, for example, in view of age or handicap, or in the case of exceptional working situations, or emergencies.
- 3 While the principles in this International Standard are oriented to industry, they are applicable to any field of human activity.

## 3 Definitions

**3.1 work system** : The work system comprises a combination of people and work equipment, acting together in the work process, to perform the work task, at the work space, in the work environment, under the conditions imposed by the work task.

**3.2 work task** : An intended outcome of the work system.

**3.3 work equipment** : Tools, machines, vehicles, devices, furniture, installations and other components used in the work system.

**3.4 work process** : The sequence in time and space of the interaction of people, work equipment, materials, energy and information within a work system.

**3.5 work space** : A volume allocated to one or more persons in the work system to complete the work task.

**3.6 work environment** : Physical, chemical, biological, social, and cultural factors surrounding a person in his/her work space. However, social and cultural factors are not covered by this International Standard.

**3.7 work stress (or external load)** : The sum of those external conditions and demands in the work system which act to disturb a person's physiological and/or psychological state.

**3.8 work strain (or internal reaction)** : The effect of the work stress upon a person in relation to his/her individual characteristics and abilities.

**3.9 work fatigue** : The local or general non-pathological manifestation of work strain, completely reversible with rest.

## 4 General guiding principles

### 4.1 Design of work space and of work equipment

#### 4.1.1 Design in relation to body dimensions

The design of the work space and work equipment shall take into account constraints imposed by body dimensions, with due regard to the work process.

The work space shall be adapted to the operator. In particular :

- a) The working height shall be adapted to the body dimensions of the operator and to the kind of work performed. Seat, work surface, and/or desk should be designed as a unit to achieve the preferred body posture, namely trunk erect, body weight appropriately supported, elbows at the side of the body, and forearms approximately horizontal.
- b) The seating arrangements shall be adjusted to the anatomic and physiological features of the individual.
- c) Sufficient space shall be provided for body movements, in particular of the head, arms, hands, legs, and feet.
- d) Controls shall be within functional reach.
- e) Grips and handles shall suit the functional anatomy of the hand.

#### 4.1.2 Design in relation to body posture, muscular strength, and body movements

The design of the work shall be such as to avoid unnecessary or excessive strain in muscles, joints, ligaments, and in the respiratory and circulatory systems. Strength requirements shall be within physiologically desirable limits. Body movements should follow natural rhythms. Body posture, strength exertion and body movement should be in harmony with each other.

##### 4.1.2.1 Body posture

Attention shall be paid primarily to the following :

- a) The operator should be able to alternate between sitting and standing. If one of these postures must be chosen, sitting is normally preferable to standing; standing may be necessitated by the work process.
- b) If high muscle strength must be exerted, the chain of force or torque vectors through the body should be kept short and simple by allowing suitable body posture and providing appropriate body support.
- c) Body postures should not cause work fatigue from prolonged static muscular tension. Alternations in body postures shall be possible.

##### 4.1.2.2 Muscular strength

Attention shall be paid primarily to the following :

- a) Strength demands shall be compatible with the physical capacities of the operator.
- b) Muscle groups involved must be strong enough to meet the strength demands. If strength demands are excessive, auxiliary sources of energy shall be introduced into the work system.
- c) Maintenance of prolonged static tension in the same muscle shall be avoided.

##### 4.1.2.3 Body movement

Attention shall be paid primarily to the following :

- a) A good balance shall be established among body movements; motion shall be preferred to prolonged immobility.
- b) Amplitude, strength, speed and pace of movements shall be mutually adjustable.
- c) Movements with great accuracy requirements shall not entail exertion of considerable muscular strength.
- d) Execution and sequencing of movements shall be facilitated by guiding devices, as appropriate.

#### 4.1.3 Design concerning signals, displays, and controls

##### 4.1.3.1 Signals and displays

Signals and displays shall be selected, designed and laid out in a manner compatible with the characteristics of human perception.

In particular :

- a) The nature and number of signals and displays shall be compatible with the characteristics of the information.
- b) In order to achieve clear identification of information where displays are numerous, they shall be laid out in space in such a way as to furnish reliable orientation clearly and rapidly. Their arrangement may be a function either of the technical process or of the importance and frequency of use of particular items of information. This may be done by grouping in accordance with the functions of the process, the type of measurements, etc.
- c) The nature and design of signals and displays shall ensure unambiguous perception. This applies especially to danger signals. Account shall be taken, for instance, of the intensity, shape, size, contrast, prominence, and the signal-to-noise ratio.
- d) Rate and direction of change of display of information shall be compatible with rate and direction of change of the primary source of that information.
- e) In protracted activities in which observation and monitoring predominate, overload and underload effects shall be avoided by design and layout of signals and displays.

##### 4.1.3.2 Controls

Controls shall be selected, designed and laid out in such a way as to be compatible with the characteristics (particularly of movement) of that part of the body by which they are operated. Skill, accuracy, speed and strength requirements shall be taken into account.

In particular :

- a) Type, design and layout of controls shall correspond to the control task, taking into account human characteristics, including learned and innate responses.
- b) Travel of controls and control resistance shall be selected on the basis of the control task and of biomechanical and anthropometric data.
- c) Control movement, equipment response, and display information shall be mutually compatible.
- d) Function of the controls shall be easily identifiable to avoid confusion.
- e) Where controls are numerous they shall be laid out so as to ensure safe, unambiguous and quick operation. This

may be done similarly as for signals by grouping them according to their functions in the process, to the order in which they are used, etc.

f) Critical controls shall be safeguarded against inadvertent operation.

## 4.2 Design of the work environment

The work environment shall be designed and maintained so that physical, chemical and biological conditions have no noxious effect on people but serve to ensure their health, as well as their capacity and readiness to work. Account shall be taken of objectively measurable phenomena and of subjective assessments.

Depending on the work system it is necessary to pay attention in particular to the following points:

a) The dimensions of the work premises (general layout, space for work, and space for work related traffic) shall be adequate.

b) Air renewal shall be adjusted with regard to the following factors, for example :

- number of persons in the room;
- intensity of the physical work involved;
- dimensions of the premises (taking account of work equipment);
- emission of pollutants in the room;
- appliances consuming oxygen;
- thermal conditions.

c) Thermal conditions at the work place shall be adjusted in accordance with local climatic conditions, taking into account mainly :

- air temperature;
- air humidity;
- air velocity;
- thermal radiation;
- intensity of the physical work involved;
- properties of clothing, work equipment, and special protective equipment.

d) Lighting shall be such as to provide optimal visual perception for the required activities. Special attention shall be paid to the following factors :

- luminance;
- colour;

- distribution of light;
- absence of glare and undesirable reflections;
- contrast in luminance and colour;
- age of operators.

e) In the selection of the colours for the room and for the work equipment, their effects on the distribution of luminances, on the structure and quality of the field of vision, and on the perception of safety colours, shall be taken into account.

f) The acoustic work environment shall be such that noxious or annoying effects of noise are avoided, including those effects due to outside sources. Account shall be taken in particular of the following factors :

- sound pressure level;
- frequency spectrum;
- distribution over time;
- perception of acoustic signals;
- speech intelligibility.

g) Vibrations and impacts transmitted to man shall not attain levels causing physical damage, physio-pathological reactions or sensorimotor disturbances.

h) Exposure of workers to dangerous materials and harmful radiations shall be avoided.

j) During outdoor work, adequate protection shall be provided against adverse climatic effects (for example against heat, cold, wind, rain, snow, ice).

## 4.3 Design of the work process

The design of the work process shall safeguard the workers' health and safety, promote their well-being, and facilitate task performance, in particular by avoiding overloading and underloading. Overloading and underloading will result from transgressing, respectively, the upper or lower limits of the operational range of physiological and/or psychological functions, for example :

- physical or sensory overloading produces fatigue;
- conversely, underloading or work sensed as monotonous diminishes vigilance.

The physical and psychological stresses exerted depend not only on factors considered in 4.1 and 4.2 but also on the content and repetitiveness of operations and on the workers' control over the work process.

Attention shall be directed to implementation of one or more of the following methods of improving the quality of the work process :

- a) Having one operator perform several successive operations belonging to the same work function, instead of several operators (job enlargement).
- b) Having one operator perform successive operations belonging to different work functions, instead of several operators. For example, assembly operations followed by quality checks performed by the operator who also removes defects (job enrichment).
- c) Change of activity as, for example, voluntary job rota-

tion among workers on an assembly line or in a team working within an autonomous group.

- d) Breaks, organized or non-organized.

In implementing the above measures, particular attention should be paid to the following :

- e) Variations in vigilance and work capacity over day and night.
- f) Differences in work capacity among operators, and changes with age.
- g) Individual development.

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