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Ergonomics — Manual handling —

Part 1: Lifting, lowering and carrying

Ergonomie — Manutention manuelle —

Partie 1: Manutention verticale vers le haut, manutention verticale vers le bas et manutention horizontale

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 3, *Anthropometry and biomechanics*.

This second edition cancels and replaces the first edition (ISO 11228-1:2003), which has been technically revised.

The main changes to the previous edition are as follows:

— revision of the scope to include lowering;

— expansion of the risk estimation;

— expansion of Annexes A, B and C;

— addition of Annexes D to I to include updated information; expansions of the RNLE (revised NIOSH lifting equation); more examples for lifting and carrying; detailed information on the scientific background and recommended interpretation of the RNLE.

A list of all parts in the ISO 11228 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

0.1 General

The ISO 11228 series establishes ergonomic recommendations for different dynamic manual handling tasks. It provides information for designers, employers, employees and others involved in work, job and product design. The ISO 11228 series provides information on the evaluation of static postures.

Disorders of the musculoskeletal system are common worldwide and one of the most frequent disorders in occupational health. The risk-assessment model in this document allows the estimation of the risk associated with a manual material handling task. It takes into consideration the hazards (unfavourable conditions) related to manual handling tasks and the time spent performing them. Unfavourable conditions can include factors such as the size and mass of the object being handled, working posture (e.g. twisting, bending, overreaching), quality of grip on items, and the frequency and duration of manual handling. Any of these can, alone or in combination, lead to a hazardous handling activity and increase the risk of musculoskeletal disorders. Accordingly, these factors are considered when determining a recommended safe limit of the mass of objects being handled.

The method of determination of safe recommended limits in this document is based on the integration of data derived from four major research approaches, namely the epidemiological, the biomechanical, the physiological and the psychophysical approach.

0.2 The ergonomic approach

0.2.1 General

Ergonomics pursues the specific goals of optimizing human well-being and overall system performance. This is achieved through contributions to the design and evaluation of tasks, jobs, production, environment and systems in order to make them compatible with the needs, abilities and limitations of people. It strives to design or to modify a work system to accommodate, as far as possible, a broad range of people in order to meet the needs of workers with various characteristics, including people with special requirements. Thus, the development of special solutions for individuals can be minimized. Achieving these goals also contributes to organizational sustainability and social responsibility.

Manual handling tasks in the workplace occur within the context of work systems. Interactions of humans with items, information, environment and other people must be taken into consideration when designing or modifying tasks and work areas. The ergonomics approach can be used to prevent manual-handling-related injuries from occurring by being used proactively in the design of processes, systems or work organization, in addition to when modifications to existing systems are being considered.

The ergonomic approach considers tasks in their entirety, taking into account a range of relevant factors including the nature of the task, the characteristics of objects handled, the working environment and the individuals performing the task. It considers environmental conditions (e.g. lighting, noise, temperature), as well as an individual's characteristics and experiences. An individual's characteristics include physical and mental capabilities, skills, work techniques, behaviour and their perception of the work environment and its social characteristics.

0.2.2 Organizational considerations

Work organization (e.g. task duration, job duration, recovery time, shift patterns) is a contributing factor in the prevention or development of musculoskeletal disorders. For example, recovery periods help to mitigate possible muscular fatigue and help to avoid the overuse of similar muscle groups over the duration of the work shift. Job rotation, job diversification and job enlargement are all methods of structuring the work to facilitate variation and recovery within the work period.

Work organization includes appropriate training of workers, including how to safely perform tasks, how to recognize and respond to hazardous conditions in workplaces, and which procedures and communication channels to use to report and correct hazards. Regularly and properly maintained equipment and facilities contribute to safer work, including manual handling tasks. The selection of

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equipment and supplies which are appropriate for the workplace and task conditions helps to make work demands safer.

0.2.3 Psychological health and safety and the ergonomics approach

The ergonomics approach considers the cognitive or psychological demands on humans, as well as the psychosocial environment in which work takes place. Psychological response to work and workplace conditions (psychosocial factors) has an important influence on mental, physiological and musculoskeletal health. Psychosocial factors in the workplace include the design, organization and management of work, work content, job complexity, job demands (cognitive and physical), job content and the overall social environment (i.e. the context of work).

Undesirable psychosocial aspects of a job can include:

— little or no control over work methods or organization;

— high levels of attention and concentration required;

— poor use of skills;

— little or no involvement in decision-making;

— repetitive, monotonous tasks only;

— machine- or system-paced work;

— work demands perceived as excessive;

— payment systems which encourage working too quickly or without breaks;

— work systems that limit opportunities for social interaction;

— high levels of effort not balanced by sufficient reward (e.g. resources, remuneration, self-esteem, status);

— no training and skill enhancement encouraged or supported;

— poor co-worker or supervisory support.

Many of the effects of these factors on workers occur via stress-related processes, which can in turn have a direct effect on biochemical and physiological responses, which can increase the likelihood of experiencing musculoskeletal injury. Thus, for the prevention of musculoskeletal disorders (MSDs), these psychosocial stressors should be controlled in addition to the biomechanical risk factors. For more information on the effects of the psychosocial stressors on MSDs, see References [63] to [66]. For further information on psychological health and safety in the workplace, see References [1] to [42]

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Ergonomics — Manual handling —

Part 1: Lifting, lowering and carrying

1 Scope

This document specifies recommended limits for manual lifting, lowering and carrying while taking into account the intensity, the frequency and the duration of the task. It is designed to provide requirements and recommendations on the assessment of several task variables, allowing the health risks for the working population to be evaluated.

This document applies to manual handling of objects with a mass of 3 kg or more and to moderate walking speed, i.e. 0,5 m/s to 1,0 m/s on a horizontal level surface.

This document is based on an 8 h working day, but also covers more prolonged working times, up to 12 h. It also addresses the analysis of combined lifting, lowering and carrying tasks in a shift during a day.

This document does not cover the holding of objects (without walking), the pushing or pulling of objects or manual handling while seated. The pushing and pulling of objects are covered in the other parts of the ISO 11228 series.

This document does not cover handling people or animals. (For further information on handling people, refer to ISO/TR 12296.)

This document does not address the manual lifting of objects while using lift-assistive devices such as exoskeletons and does not address the needs of pregnant women or persons with disabilities.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
manual handling
activity requiring the use of human force to lift, lower, carry or otherwise move or restrain an object

3.2
lifting
manually (i.e. without using mechanical assistance) moving an object from its initial position

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3.3
lowering
manually (i.e. without using mechanical assistance) moving an object from its initial position downwards

Note 1 to entry: Included in lifting.

3.4
carrying
manually (i.e. without using mechanical assistance) moving an object which is held with either one or two hands, or positioned on one or two shoulders or on the neck, by walking one metre or more

Note 1 to entry: Does not include the use of backpacks.

3.5
risk assessment
overall process comprising a risk analysis and risk evaluation

3.6
reference conditions
set of conditions (environmental, physical, biomechanical and task-design-related) which are considered to be the ideal conditions for safe manual handling to take place

Note 1 to entry: See 4.2.1, 4.2.3.2, A.4 and H.1 for detailed definitions of lifting and carrying conditions.

3.7
repetitive lifting
lifting an object more than once every 10 min

Note 1 to entry: Infrequent lifting at one lift every 10 min is defined in Reference [57], where a multiplier of 1,0 is applied for all duration scenarios at a frequency of 1 lift per 10 min.

3.8
mid-sagittal plane
vertical plane in the anterior-posterior direction that divides a person assuming a neutral body posture into equal left and right halves

Note 1 to entry: See Figure C.1

Note 2 to entry: A neutral body posture is an upright standing posture with the arms hanging freely by the side of the body.

3.9
plane of asymmetry
vertical plane passing through the midpoint of the line between the inner ankle bones and the centre of gravity of the load when the load is at its most extreme displacement from the neutral, mid-sagittal plane

3.10
angle of asymmetry
angle formed between the lines that result from the intersections of the mid-sagittal plane and the plane of asymmetry

Note 1 to entry: If the feet are repositioned during the lift or lower sequence, the referent planes shall be determined at the point in the action sequence where the largest degree of asymmetrical twist is encountered (see Figure C.1).

3.11
reference mass
mass considered appropriate for use with an identified user population during the application of the risk-assessment method described herein

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3.12
cumulative carried mass
product of the carried mass and the carrying frequency

Note 1 to entry: The cumulative mass for carrying is defined in kilograms per minute to represent the risk for short-term carrying, in kilograms per hour to represent the risk for medium-term carrying and in kilograms per 8 h to represent the risk for long-term carrying.

3.13
recovery time
time used for determining the work/recovery pattern, which is the period of light work activity Note 1 to entry: Light work activity can include monitoring activities, light assembly work using the upper limbs, work not involving lifting or lowering or carrying > 3 kg, and work not involving pushing or pulling.

4 Risk reduction for manual lifting or carrying tasks

4.1 General

Risk assessment is the overall process of risk identification, risk analysis and risk evaluation, the results of which are ultimately used in the effort to reduce risk. The goal in manual materials handling risk reduction is to take measures to improve the design of the task, the object and the working environment relative to the characteristics of the individuals performing the work.

In those cases where manual handling cannot be avoided, a risk assessment shall be completed to determine if, and to what extent, modifications are recommended. The risk assessment takes into account the mass of the object, the grip on the object, the position of the object relative to the position of the body, and the frequency and duration of a specific task.

The risk assessment is accomplished using the step-by-step approach illustrated in Figure 1 (step model). With each successive step, the evaluator analyses the interrelated aspects of the tasks.

If recommended limits are exceeded, the task shall be adapted in such a way that all questions in the step-by-step approach are satisfied.

Employees engaged in manual handling should be provided with adequate information and training on how to perform these tasks safely. The provision of this information and training does not, in isolation, ensure safe manual handling in all cases. However, it is an integral part of the ergonomics approach, and the risk of injury can be reduced by adopting safe ways of manual handling (see A.6).

4.2 Risk assessment (step model)

4.2.1 Using the step model

The step model illustrated in Figure 1 describes the steps involved in beginning, and working through, a risk assessment of manual handling tasks, including lifting and carrying. Initially, the mass of the object being handled is determined; if it is more than 3 kg, the risk assessment is continued. The task is further analysed to determine if the mass exceeds recommended limits for handling (step 1).

The user shall make modifications where limits are exceeded. In those tasks where lifting and carrying is repetitive, the assessment is continued using the quick assessment procedure (step 2). Based on the outcome of step 2, the task will possibly:

— require immediate modifications for safety (see Annex A for further information);

— be determined to be acceptable; or

— need further, more detailed, risk evaluation (step 3).

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