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Maskinsäkerhet – Människans fysiska förmåga –
Del 2: Manuell hantering av maskiner och maskindelar

Safety of machinery – Human physical performance –
Part 2: Manual handling of machinery and component parts of machinery

ICS 13.110; 13.180
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EUROPEAN STANDARD

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EUROPÄISCHE NORM

EN 1005-2

April 2003

ICS 13.110; 13.180

English version

Safety of machinery - Human physical performance - Part 2: Manual handling of machinery and component parts of machinery

Sécurité des machines - Performance physique humaine - Partie 2: Manutention manuelle de machines et d'éléments de machines

Sicherheit von Maschinen - Menschliche körperliche Leistung - Teil 2: Manuelle Handhabung von Gegenständen in Verbindung mit Maschinen und Maschinenteilen

This European Standard was approved by CEN on 13 February 2003.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

Foreword

This document (EN 1005-2:2003) has been prepared by Technical Committee CEN /TC 122, "Ergonomics", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EC Directive(s).

For relationship with EC Directives, see informative annex ZA, which is an integral part of this document.

EN 1005 consists of the following parts, under the general title "Safety of machinery - Human physical performance":

— Part 1: Terms and definitions;

— Part 2: Manual handling of machinery and component parts of machinery;

— Part 3: Recommended force limits for machinery operation;

— Part 4[1)]: Evaluation of working postures and movements in relation to machinery;

— Part 5[1)]: Risk assessment for repetitive handling at high frequency.

Annexes A, B and C are for informative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1) This European Standard is under preparation by CEN/TC 122/WG 4 "Biomechanics".

Introduction

When designing and constructing machinery, the manufacturer should meet the essential requirements for safety and health set out in the Machinery Directive. The manufacturer should assess the hazards of the machine and consider these hazards related to the life cycle of the machine.

This European Standard is one of several ergonomic standards for the safety of machinery. EN 614-1 describes the principles to be applied by designers in order to accommodate ergonomic factors.

This standard has been prepared to be a harmonised standard in the sense of the Machinery Directive and associated EFTA regulations.

This European Standard is a type B standard as stated in EN 1070.

The provisions of this document can be supplemented or modified by a type C standard.

NOTE For machines which are covered by the scope of a type C standard and which have been designed and built according to the provisions of that standard, the provisions of that type C standard take precedence over the provisions of this type B standard.

Manual handling of loads can lead to a high risk of injury to the musculoskeletal system if the loads to be handled are too heavy, and/or handled at high frequencies for long durations and/or in awkward postures. Disorders of the musculoskeletal system are of a common occurrence throughout Europe. Manually applied effort is often required by operators working with machines for their intended purpose. Risks exist if the design of the machinery is not in accordance with ergonomic design principles. When designing and constructing machinery where manual handling is required, this standard provides relevant data for working posture, load, frequency and duration. The design criteria given in this standard can be used by the designer when making risk assessments.

This standard requires machinery designers to adopt a three stage approach to:

a) avoid manual handling activities wherever possible;

b) utilise technical aids;

c) further reduce the inherent level of risk by optimising handling activities.

For machines and their component parts which cannot be moved or transported by hand, see 4.2 in EN 292-2:1991.

1 Scope

This European Standard specifies ergonomic recommendations for the design of machinery involving manual handling of machinery and component parts of machinery, including tools linked to the machine, in professional and domestic applications.

This European Standard applies to the manual handling of machinery, component parts of machinery and objects processed by the machine (input/output) of 3 kg or more, for carrying less than 2 m. Objects of less than 3 kg are dealt with in prEN 1005-5[1)]. The standard provides data for ergonomic design and risk assessment concerning lifting, lowering and carrying in relation to the assembly/erection, transport and commissioning (assembly, installation, adjustment), operation, fault finding, maintenance, setting, teaching or process changeover and decommissioning, disposal and dismantling of machinery.

This standard provides current data on the general population and certain sub-populations (clarified in annex A).

This part of the standard does not cover the holding of objects (without walking), pushing or pulling of objects, hand-held machines, or handling while seated.

This document is not applicable to specify the machinery which are manufactured before the date of publication of this document by CEN.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 292-2:1991, *Safety of machinery – Basic concepts, general principles for design – Part 2: Technical principles and specifications.*

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

EN 1005-1:2001*, Safety of machinery – Human physical performance – Part 1: Terms and definitions.*

EN 1050*, Safety of machinery – Principles for risk assessment.*

EN 1070:1998, *Safety of machinery – Terminology.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 1005-1:2001 and EN 1070:1998 apply.

4 Recommendations for the design of machinery and component parts where objects are lifted, lowered and carried

4.1 General principles

In order to minimise the risks to the health and safety of the operator, when lifting, lowering and carrying the machine or component parts, the designer/manufacturer of the machine shall:

a) establish whether or not a hazard exists when manual handling activities are performed in relation to the intended use of the machine. If a hazard exists, the risk assessment model should be applied. (see 4.3.1, 4.3.2 and 4.3.3);

b) remove the hazard by excluding the need for manual handling activities (lifting, lowering and carrying) for the machinery or machinery-linked objects (see 4.2.1). If this is not possible, provide technical aids, additional to the system (see 4.2.2), and/or design/redesign the machinery and machinery-linked objects according to ergonomic principles (see 4.3);

c) provide technical specifications and instructions so that machinery is used appropriately and in the intended manner covered by the risk assessment, technical specifications and instructions for use.

In all cases, the designer shall provide instructions concerning construction, transport and commissioning, use and decommissioning of the machinery (see 4.4) to prevent risks for safety and health.

Technical aids for manual handling should preferably be incorporated into the machinery design and the machine.

Health, safety and productivity are most likely to be optimised if an ergonomic approach is used in designing the system of work as a whole.

4.2 Recommendations for the design of machinery

4.2.1 Systems without manual handling

The best way to eliminate manual handling risks is to remove the need to handle manually. In general, those designing new systems of work or installing new systems of machinery should consider introducing an integrated handling system that fully utilises powered handling, rather than a manual system.

4.2.2 Manual handling with technical aids

Designers should ascertain whether suitable aids and equipment can be installed, particularly if the existing practice involves frequent manual handling of objects and manual handling of objects weighing more than the reference mass (see Table 1), or the precise movement of objects. Appropriate technical aids diminish or eliminate the risk of musculoskeletal injury but may induce risks, for example, by the need for maintenance work. They may also have implications for particular handling methods at subsequent points in the handling chain. Handling aids should be compatible with the rest of the work system, including layout and access routes. They should be effective for the full range of operational conditions likely to be encountered. In employing technical aids, more space could be required for access to allow appropriate working postures.

When designing systems including manual handling follow the recommendations given in 4.3.2.

When considering the limits for manually pushing and pulling of technical aids, reference should be made to EN 1005-3. When considering working postures, reference should be made to prEN 1005-4[1)].

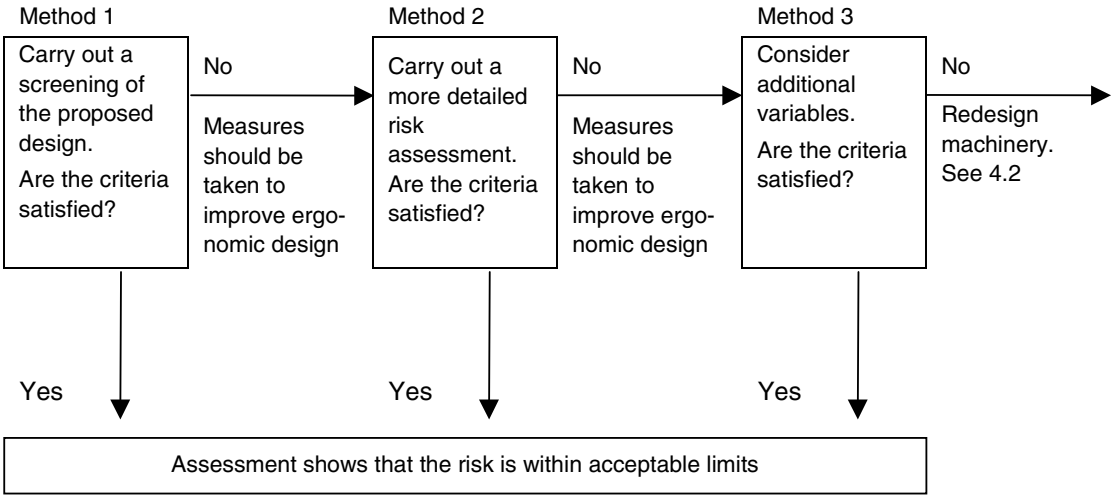
4.3 Risk assessment and recommendations for the design of machinery and component parts involving manual handling

4.3.1 Approach to risk assessment

To control the risks to an individual's health and safety, it is necessary for the designer to identify relevant hazards and to carry out an appropriate risk assessment. For general requirements of risk assessment, refer to EN 1050. Manual handling risks shall be reduced by applying ergonomic principles at the design stage of the machinery, see EN 614-1.

The risk assessment model presented here involves 3 methods. These methods have the same basis, but differ in their complexity of application.

The first method is a quick screening method. Method 2, an easy to handle method, shall be applied if the screening method indicates risks. Some additional risk factors can be taken into account in method 2. Method 3 is an extended assessment method, which assesses risks in a more thorough way and is supplemented by additional risk factors not presented in methods 1 and 2. All three methods have different levels of complexity. The most efficient approach is to begin the risk assessment by applying method 1 (the most simple one) and use methods 2 and/or 3 only if the assumptions and/or operational situations identified in method 1 are not met.



NOTE It is recommended to consider further steps to reduce risk factors to their lowest possible level.

Figure 1 — Flowchart identifying the step-wise approach to assessment

4.3.2 Hazard identification, risk estimation, risk evaluation and recommendations for risk reduction by design

In this paragraph recommendations for the design of a manual handling situation at a low risk level are given. The information is based on the state of the art of ergonomics. If these criteria are not met a risk assessment should be done.

The following aspects (see 4.3.2.1 to 4.3.2.3) shall be taken into account when assessing and reducing the risks.

4.3.2.1 Objects

4.3.2.1.1 Mass

The mass of the object (machines, machinery parts, input/output) includes everything connected with it such as packing, batteries, full magazines, etc. Technical aids needed for the manual handling activities are also included.

When designing machinery or components, the unit mass can be a hazard if an object is to be handled manually. To define the safe maximum limit for the mass refer to 4.3.3.

4.3.2.1.2 Mass distribution/stability

The object ‘s centre of gravity is determined by the distribution of mass. Wherever possible, the centre of gravity of the object should be within the object, distributed equally between both hands and positioned as close as possible to the body. While handling, movement of the object's centre of gravity should be constrained. When this is not possible (e.g. liquid), appropriate information should be marked on the object.

4.3.2.1.3 Size

Objects should be designed to be as compact as possible. When objects are gripped by both hands, the width of the object should not exceed shoulder width (approximately 60 cm) and the depth of the object should not exceed 50 cm (recommended to be 35 cm or less) in order to keep the load close to the body. The height of the object should be such that it does not obscure a person's visibility. If handling of the object needs one hand underneath and one hand above the object, the object should be redesigned.

4.3.2.1.4 Grip/handles

The surface properties of objects (including packaging materials of new component parts) should be suitable for handling. An object should be easy to grasp and hold and, therefore, should normally be equipped with handles or suitable cut-outs.

The placement of the handles should be consistent with the centre of gravity of the object and the type of action that is carried out, supporting to adopt the best working postures and movement during lifting and carrying. If the handle is supposed to be horizontal, this should be done by the machine. Handles should not have sharp edges or contain a risk of compressing the fingers. The shape of the handle should permit a hook-grip or power-grip with a neutral hand-arm posture.

The diameter of the handle should be between 2 cm and 4 cm.

The width of handle/cut-out should be a minimum of 12,5 cm to ensure clearance for a gloved hand, with 7 cm room above the fingers. The optimum shape of the handle should be cylindrical or elliptical. To assess the handgrip (coupling) go to 4.3.3.2. or 4.3.3.3.

4.3.2.2 Operation-machine interface

4.3.2.2.1 Horizontal location and distance

Obstruction between the object and the body, such that the object cannot be lifted, lowered or carried close to the body, is a hazard. The horizontal distance between the mid-point of the ankles and of the hands should be less than 25 cm. If the horizontal distance is greater than this value, a risk assessment should be carried out in accordance with 4.3.3.

4.3.2.2.2 Vertical location and displacement

The vertical grip position (measured from the knuckle of the middle finger to the ground) should be adjustable between 60 cm and 90 cm. Vertical displacement of the object should not exceed 25 cm. If the vertical distance is lower or higher, and/or the vertical displacement exceeds 25 cm, then a risk assessment should be carried out in accordance with 4.3.3.

4.3.2.2.3 Frequency of operation

Machinery should be designed so that manual handling at high frequency is avoided. It should be possible to regulate the frequency of the machine in relation to manual handling. A machinery design should, wherever possible, allow some degree of autonomy. To assess the risks arising from a combination of the frequency and mass, refer to 4.3.3.

4.3.2.2.4 Working postures

The designer should avoid awkward postures (e.g. twisting and bending, lifting from the ground) and prolonged activities which lead to body fatigue during manual handling, for every stage of machinery-operation (including assembly/erection, transport and commissioning, use and decommissioning). Occasional changes in posture should be provided (see prEN 1005-4).

4.3.2.2.5 Manual carrying of loads

In general, machines should be designed so that manual carrying is avoided. Where this is not possible, the maximum manual carrying distance should be as low as possible (less than 2 m).

4.3.2.2.6 One-handed handling

If an object is handled with one hand only it may be a hazard. If one-hand handling cannot be avoided a risk assessment should be carried out (see 4.3.3.3).

4.3.2.2.7 Handling by two persons

Handling by two (or more) persons can be used to reduce the load on one operator, but it also creates additional hazards because of difficulties in co-ordinating the movements and force exertions between the two (or more) people performing the lift together. Ergonomic design shall eliminate the need for using two (or more) people for lifts except in occasionally occurring special cases, for which a risk assessment should be carried out (see 4.3.3.3).

4.3.2.2.8 Handling including rotation of object

Manual handling of objects by turning around its axis should be avoided. Redesign is recommended by which machinery or technical aids take over the handling.

4.3.2.2.9 Additional physical demands

Additional physical demands to the manual handling task may imply new hazards. If they cannot be avoided, a risk assessment should be carried out (see 4.3.3.3).

4.3.2.2.10 Coupling

Unfavourable coupling conditions between hands and the objects handled or between the feet and floor may result in hazardous situations. If they cannot be avoided, a risk assessment should be carried out (see 4.3.3.3).

4.3.2.3 Environmental factors

Environmental factors can create hazards and can impose additional risk.

If they cannot be avoided, qualified personnel should make a risk assessment. Environmental factors include vibration, climate, thermal conditions (see EN ISO 7730), illumination, slippery ground, noise and chemical agents (see ENV 26385).

4.3.3 Risk assessment model

This risk assessment model consists of three methods. Method 1 is a quick screening method. Method 2 shall be applied if the screening method indicates risks. Some additional risk factors can be taken into account in method 2. Method 3 is an extended assessment method which assesses risks in a more thorough way and is supplemented by additional risk factors not presented in methods 1 or 2. All three methods have different levels of complexity. The most efficient approach is to begin the risk assessment by applying method 1 (the simplest procedure) and use methods 2 or 3 only if the assumptions or operational situations identified in method 1 are not met. Each method requires three steps to be carried out:

— Step 1: consider the reference mass in relation to the intended user population (see Table 1);

— Step 2: carry out the risk assessment according to the worksheet, see 4.3.3.1 to 4.3.3.3;

— Step 3: identify the action required:

  — no action, if risk level is tolerable;

  — redesign or;

  — use a more complex assessment method.

It is free to the designer to redesign already after Method 1, step 3 and not to go to Method 2. It is not a complete iteration but a more detailed risk assessment in Method 2 and Method 3, based on same methodology.

For practical application see annex C.