

**Masinate ohutus. Inimeste füüsiline töö.
Osa 3: Masinate tööks soovitatava jõu
piirmäärad**

Safety of machinery - Human physical performance
- Part 3: Recommended force limits for machinery
operation

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-EN 1005-3:2002 sisaldab Euroopa standardi EN 1005-3:2002 ingliskeelset teksti.</p> <p>Käesolev dokument on jõustatud 12.07.2002 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-EN 1005-3:2002 consists of the English text of the European standard EN 1005-3:2002.</p> <p>This document is endorsed on 12.07.2002 with the notification being published in the official publication of the Estonian national standardisation organisation.</p> <p>The standard is available from Estonian standardisation organisation.</p>
--	---

<p>Käsitlusala: This European Standard presents guidance to the manufacturer of machinery or its component parts and the writer of C-standards in controlling health risks due to machine-related muscular force exertion.</p>	<p>Scope: This European Standard presents guidance to the manufacturer of machinery or its component parts and the writer of C-standards in controlling health risks due to machine-related muscular force exertion.</p>
---	---

ICS 13.110, 13.180

Võtmesõnad: human factors engineering, mathematics, men, occupational s, operating stations, operation, people, physical strength, physiological effects (human body), ratings, safety, safety design, specification (approval), specifications, working places

Hinnagrupp M

ICS 13.110; 13.180

English version

Safety of machinery - Human physical performance - Part 3: Recommended force limits for machinery operation

Sécurité des machines - Performance physique humaine -
Partie 3: Limites des forces recommandées pour
l'utilisation de machines

Sicherheit von Maschinen - Menschliche körperliche
Leistung - Teil 3: Empfohlene Kraftgrenzen bei
Maschinenbetätigung

This European Standard was approved by CEN on 8 November 2001.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

	page
Foreword.....	3
Introduction	4
1 Scope	4
2 Normative references	5
3 Terms and definitions.....	5
4 Recommendations.....	5
4.1 General recommendations and information	5
4.2 Risk assessment of action forces.....	5
4.2.1 Step A: Determination of basic force generating capacity.....	8
4.2.2 Step B: Determination of adjusted capacity	9
4.2.3 Step C: Evaluation of tolerability and risk.....	11
4.3 Factors affecting risk.....	12
4.3.1 Working posture.....	12
4.3.2 Acceleration and movement precision.....	12
4.3.3 Vibration.....	12
4.3.4 Man-machine interaction.....	12
4.3.5 Personal protective equipment	12
4.3.6 External environment	12
Annex A (informative) Calculation procedure for Alternative 2.....	13
A.1 General.....	13
A.2 Input parameters	13
A.3 Procedure	14
A.3.1 Force distribution	14
A.3.2 Logarithmic transformation	14
A.3.3 Calculation of force percentiles	15
A.4 Results	15
Annex B (informative) Calculation procedure for Alternative 3.....	17
B.1 General.....	17
B.2 Input parameters	17
B.2.1 Force	17
B.2.2 User demography.....	18
B.3 Procedure	19
B.3.1 Synthetical distribution parameters of subgroups	19
B.3.2 Logarithmic distributions.....	20
B.3.3 Generation of new distribution functions of male and female subgroups	21
B.3.4 Weighting and combining of all subgroup distributions.....	22
B.3.5 Calculation of percentiles	23
B.4 Result	23
Annex ZA (informative) Relationship of this document with EC Directives.....	24
Bibliography	25

Foreword

This European Standard 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 July 2002, and conflicting national standards shall be withdrawn at the latest by July 2002.

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 Directive(s), 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 2¹⁾: Manual handling of machinery and component parts of machinery;
- Part 3: Recommended force limits for machinery operation;
- Part 4¹⁾: Evaluation of working postures and movements in relation to machinery;
- Part 5¹⁾: Risk assessment for repetitive handling at high frequency.

Annexes A and B are for information only.

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

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

Introduction

Within the life cycle of a machine from construction to dismantling, various machine-related actions require muscular force exertion. Muscular force exertion causes strain to the musculo-skeletal system. Unfavourable musculo-skeletal strain corresponds to the risk of fatigue, discomfort and musculo-skeletal disorders. The manufacturer of a machine is in a position to control these health risks by optimising the required forces, while taking into account the frequency, duration and variation of force exertion.

The calculation procedure and the recommended limits in this standard aim to reduce the health risk for the operator as well as to increase the flexibility and possibility for a larger population to operate the machines which increases efficiency and profitability.

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

This standard is written in conformity with EN 1050 and gives the user hazard identification for harm through musculo-skeletal disorders and tools for qualitative and, to an extent, a quantitative risk assessment. The tools for the risk assessment also implicate how to do the risk reduction. This standard does not deal with risks connected to accidents.

The recommendations provided by this standard are based on available scientific evidence concerning the physiology and epidemiology of manual work. The knowledge is, however, scarce and the suggested limits are subject to changes according to future research. In accordance with the rules for CEN/CENELEC-standards Part 2, 4.9.3, European Standards are reviewed at intervals not exceeding five years.

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.

1 Scope

This European Standard presents guidance to the manufacturer of machinery or its component parts and the writer of C-standards in controlling health risks due to machine-related muscular force exertion.

This standard specifies recommended force limits for actions during machinery operation including construction, transport and commissioning (assembly, installation, adjustment), use (operation, cleaning, fault finding, maintenance, setting, teaching or process changeover) decommissioning, disposal and dismantling. The standard applies primarily to machines which are manufactured after the date of issue of the standard.

This standard applies on one hand to machinery for professional use operated by the adult working population, who are healthy workers with ordinary physical capacity, and on the other hand to machinery for domestic use operated by the whole population including youth and old people.

The recommendations are derived from research on European population.

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 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 1070, *Safety of machinery – Terminology*.

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 614-1, EN 1005-1:2001 and EN 1070 apply.

4 Recommendations

4.1 General recommendations and information

The manufacturer should first consider EN 292-2:1991, annex A and EN 614-1 and EN 614-2 and then use the procedure for determining force limits presented below.

It is crucially important that the operator is in control of the operation sequences and the pace of the machinery. Furthermore, machines shall be designed in a way so that actions demanding force exertion can be performed optimally with respect to the posture of body and limbs and the direction of force application. In addition machines shall be designed to allow for variations in movements and force exertions.

The risk assessment procedure conveyed by this standard should formally be carried out for each action occurring during handling of the machinery. It may be noted, however, that infrequently occurring actions with low force demands may be assessed on an overview base.

Actions related to the handling of control actuators are considered in EN 894-3, however the present standard provides additional important information related to physical capacity and safety of the operator.

4.2 Risk assessment of action forces

The risk assessment in the present standard is based on the force generating capacity of the intended users, and follows a three-step procedure as illustrated in Figure 1.

In step A, the maximal isometric force generating capacity is determined for relevant actions within specified intended user populations. Within the scope of this standard the determination of maximal forces can be carried out according to three alternative methods.

In step B, the force generating in step A capacity is reduced, according to the circumstances under which the force is to be generated (velocity, frequency and duration of action). The reduction is achieved by a set of multipliers. Basically, the output is a force that may be delivered without substantial fatigue.

In step C, the risk associated with the intended use of the machinery is assessed. The risk evaluation is accomplished using risk multipliers, reducing the maximal attainable force from step B to values associated with different levels of risk.

The risk assessment focuses on musculo-skeletal disorders, and is preferentially based on the assumption that decreasing fatigue during work is effective in reducing disorders.