



# SLOVENSKI STANDARD

## SIST EN 81-40:2009

01-april-2009

J U f b c g l b U d f U j ] U n U \_ c b g l f i ] f U b ^ Y ] b ' j [ f U X b ^ c ' X j ] [ U ' f l ] z c j k ! ' D c g Y V b U X j ] [ U U n U d f Y j c n ' c g Y V ' ] b ' V U [ U ! ' ( \$ " X Y . ' D f ] d f U j Y n U j n d Y b ^ U b ^ Y ' d c ' g l c d b ] W U A ' ] b ' X j ] y b Y d ' c y U X ] n ' X ] U [ c b U b ] a ' d c a ] \_ U b ^ Y a ' n U c g Y V Y ' n ' c a Y ^ b ] a ] [ ] V U b ] a ] ' g d c g c V b c g l a ]

Safety rules for the construction and installation of lifts - Special lifts for the transport of persons and goods - Part 40: Stairlifts and inclined lifting platforms intended for persons with impaired mobility

**STANDARD PREVIEW**  
Sicherheitsregeln für die Konstruktion und den Einbau von Aufzügen - Spezielle Aufzüge für den Personen- und Gütertransport - Teil 40: Treppenschrägaufzüge und Plattformaufzüge mit geneigter Fahrbahn für Behinderte

<https://standards.iteh.ai/catalog/standards/sist/b04f197f-e0e5-4a53-920f-000144007100/sist-en-81-40-2009>  
Regles de sécurité pour la construction et l'installation des élévateurs - Élévateurs spéciaux pour le transport des personnes et des charges - Partie 40 : Ascenseurs et plates-formes élévatrices inclinées à l'usage des personnes à mobilité réduite

**Ta slovenski standard je istoveten z: EN 81-40:2008**

### ICS:

91.140.90      Öçä a p a z ^ \ [ ^ A q ] } a ^      Lifts. Escalators

**SIST EN 81-40:2009**

**en,fr,de**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 81-40:2009

<https://standards.iteh.ai/catalog/standards/sist/b04f197f-e0e5-4a53-920f-61f43924d8b7/sist-en-81-40-2009>

EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 81-40**

October 2008

ICS 11.180.10

English Version

**Safety rules for the construction and installation of lifts - Special lifts for the transport of persons and goods - Part 40: Stairlifts and inclined lifting platforms intended for persons with impaired mobility**

Règles de sécurité pour la construction et l'installation des élévateurs - Élévateurs spéciaux pour le transport des personnes et des charges - Partie 40 : Ascenseurs et plates-formes élévatrices inclinées à l'usage des personnes à mobilité réduite

Sicherheitsregeln für die Konstruktion und den Einbau von Aufzügen - Spezielle Aufzüge für den Personen- und Gütertransport - Teil 40: Treppenschrägaufzüge und Plattformaufzüge mit geneigter Fahrbahn für Behinderte

This European Standard was approved by CEN on 25 July 2008.

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 CEN 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 CEN Management Centre has the same status as the official versions.

<https://standards.iteh.ai/catalog/standards/sist/b04f197f-e0e5-4a53-920f-4181365448b7/EN-81-40:2008>

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, 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.....	4
1 Scope .....	6
2 Normative references .....	7
3 Terms and definitions .....	8
4 List of significant hazards .....	10
5 Safety requirements and/or protective measures .....	14
5.1 General.....	14
5.1.1 Introduction .....	14
5.1.2 Pattern of use .....	14
5.1.3 Access for maintenance, repair and inspection.....	14
5.1.4 Fire resistance.....	15
5.1.5 Rated speed.....	15
5.1.6 Rated load.....	16
5.1.7 Resistance to operating forces .....	17
5.1.8 Protection of equipment against harmful external influences.....	17
5.1.9 Guarding of equipment from mechanical damage.....	17
5.2 Guide rails and mechanical stops.....	18
5.2.1 Guide rails .....	18
5.2.2 Folding guide rails .....	18
5.2.3 Stairlift guide rail.....	18
5.2.4 Rail design.....	18
5.3 Safety gear and overspeed detection device.....	18
5.3.1 General.....	18
5.3.2 Control .....	19
5.3.3 Release .....	19
5.3.4 Access for inspection .....	19
5.3.5 Electrical checking .....	19
5.3.6 Overspeed detection device.....	19
5.3.7 Rotation monitor unit .....	19
5.3.8 Safety nut.....	20
5.4 Driving units and drive system .....	20
5.4.1 General requirements.....	20
5.4.2 Braking system .....	21
5.4.3 Emergency/manual operation .....	21
5.4.4 Additional requirements for rope suspension drive .....	22
5.4.5 Additional requirements for rack and pinion drive .....	23
5.4.6 Additional requirements for chain suspension drive .....	24
5.4.7 Additional requirements for screw and nut drive.....	24
5.4.8 Additional requirements for friction/traction drive .....	25
5.4.9 Additional requirements for guided rope and ball drive.....	25
5.5 Electrical installation and equipment .....	26
5.5.1 General.....	26
5.5.2 Drive contactors.....	28
5.5.3 Motor and brake circuits for stopping the machine and checking its stopped condition .....	28
5.5.4 Creepage and clearance distances and enclosure requirements .....	29
5.5.5 Protection against electrical faults .....	29
5.5.6 Electric safety devices .....	30
5.5.7 Time delay .....	31
5.5.8 Protection of the driving motor .....	31
5.5.9 Electrical wiring .....	31
5.5.10 Safety circuits .....	32
5.5.11 Residual current devices .....	33
5.5.12 Additional requirements for battery powered operation .....	33

5.5.13	Cableless controls.....	34
5.5.14	Control devices.....	34
5.5.15	Terminal limit switches and final limit electric safety devices .....	35
5.5.16	Emergency alarm devices and warning signals .....	36
5.5.17	Socket outlet .....	36
5.6	Carriage .....	36
5.6.1	Combined type of carriage .....	36
5.6.2	Chair.....	37
5.6.3	Carriage with standing platform .....	39
5.6.4	Carriage with wheelchair platform.....	40
6	Verification of safety requirements and/or protective measures .....	43
6.1	General .....	43
6.2	Verification of design .....	43
6.3	Examinations and tests before putting into service.....	45
6.4	Verification tests on each machine before first use .....	45
7	Information for use .....	45
7.1	General .....	45
7.2	Signals and warning devices .....	46
7.3	Accompanying documents (in particular: Instruction handbook) .....	46
7.3.1	General .....	46
7.4	Marking.....	47
7.4.1	Carriage .....	47
7.4.2	Emergency alarm device .....	48
7.4.3	Disabled persons symbol.....	48
7.4.4	Emergency manual operation.....	48
7.5	The additional information given to the installer.....	48
7.5.1	Dedicated electrical supply .....	48
Annex A	(normative) Verification type tests for overspeed detection device and safety gear .....	49
A.1	Instruments .....	49
A.2	Safety gear and overspeed detection device .....	49
A.2.1	General provisions .....	49
A.2.2	Method of test.....	49
A.2.3	Test report.....	50
Annex B	(normative) Electronic components: failure exclusion .....	51
Annex C	(informative) Guidance in selection of stairlifts .....	60
C.1	Introduction.....	60
C.2	Selection of stairlift .....	60
C.2.1	Suitability.....	60
C.2.2	Control devices.....	60
C.2.3	Location of the stairlift.....	60
C.2.4	Duty cycle.....	60
C.3	Electrical supply and lighting .....	61
C.4	Maintenance .....	61
C.5	Alarm system .....	61
Annex D	(informative) Recommendations for the provisions and use of specially adapted control devices, switches and sensors .....	62
D.1	Control devices.....	62
D.2	Specially adapted switches .....	62
Annex E	(informative) In-use periodic examination, tests and servicing .....	63
E.1	Periodic examinations and tests .....	63
E.2	Servicing.....	63
Annex ZA	(informative) Relationship between this European Standard and the Essential Requirements of the EU Directive 98/37EC .....	64
Annex ZB	(informative) Relationship between this European Standard and the Essential Requirements of the EU Directive 2006/42/EC .....	65
Bibliography	.....	66

**EN 81-40:2008 (E)****Foreword**

This document (EN 81-40:2008) has been prepared by Technical Committee CEN/TC 10 “Lifts, escalators and moving walks”, the secretariat of which is held by AFNOR.

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 April 2009, and conflicting national standards shall be withdrawn at the latest by April 2009.

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

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 and B, which is an integral part of this document.

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

SIST EN 81-40:2009

<https://standards.iteh.ai/catalog/standards/sist/b04f197f-e0e5-4a53-920f-61f43924d8b7/sist-en-81-40-2009>

## Introduction

This European Standard is a Type C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

The stairlifts defined in this European Standard are suitable for type A and type B wheelchairs as defined in EN 12183 and/or EN 12184.

When provisions of this type C standard are different from those which are stated in type A and type B standards the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

## Assumptions

With the aim of clarifying the intentions of the standard and avoiding doubts when reading it, the following assumptions were made when producing it:

- a) components without specific requirements are:
    - 1) designed in accordance with the usual engineering practice and calculation codes, including all failure modes;
    - 2) of sound mechanical and electrical construction;
  - b) general electrical hazards are dealt with according to B level electrical safety standards;
  - c) components are kept in good repair and working order, in accordance with the maintenance manual, so that the required characteristics remain despite wear;
  - d) by design of the load bearing elements, a safe operation of the machine is assured throughout the entire maximum working load range;
  - e) a mechanical device built according to good practice and the requirements of the standard, will not deteriorate to a point of creating a hazard without the possibility of detection;
  - f) to ensure the safe functioning, the operating temperature range of the equipment has to take into account the conditions of the place of use of the machinery, inside the range of ambient temperature between 0 °C and +40 °C.
- Negotiation occurs between the manufacturer (the person applying the CE mark) and the user concerning the specificity of the use and places of use of the stairlift:
- g) suitability for user (see Annex C);
  - h) the place of installation allows a safe use for the machine;
  - i) any additional fire protection requirements.

## EN 81-40:2008 (E)

## 1 Scope

**1.1** This European Standard deals with safety requirements for construction, manufacturing, installation, maintenance and dismantling of electrically operated stairlifts (chair, standing platform and wheelchair platform) affixed to a building structure, moving in an inclined plane and intended for use by persons with impaired mobility:

- travelling over a stair or an accessible inclined surface;
- intended for use by one person;
- whose carriage is directly retained and guided by a guide rail or rails;
- supported or sustained by rope (5.4.4), rack and pinion (5.4.5), chain (5.4.6), screw and nut (5.4.7), friction traction drive (5.4.8), and guided rope and ball (5.4.9).

**1.2** The standard identifies hazards as listed in Clause 4 which arise during the various phases in the life of such equipment and describes methods for the elimination or reduction of these hazards when used as intended by the manufacturer.

**1.3** This European standard does not specify the additional requirements for:

- operation in severe conditions (e.g. extreme climates, strong magnetic fields);
- lightning protection;
- operation subject to special rules (e.g. potentially explosive atmospheres);
- handling of materials the nature of which could lead to dangerous situations;
- use of energy systems other than electricity;
- hazards occurring during manufacture;
- earthquakes, flooding, fire;
- type C wheelchairs as defined in EN 12183 and/or EN 12184;
- evacuation during a fire;
- stairlifts for goods only;
- concrete, hardcore, timber or other foundation or building arrangement;
- design of anchorage bolts to the supporting structure.

**NOTE** For the actual type of machinery, noise is not considered a significant nor relevant hazard.

**1.4** This document is not applicable to power operated stairlifts which are manufactured before the date of publication of this document by CEN.



## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 81-1:1998, *Safety rules for the construction and installation of lifts — Part 1: Electric lifts*

EN 349, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 953, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

EN 12385-4, *Steel wire ropes — Safety — Part 4: Stranded ropes for general lifting applications*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements* (IEC 60204-1:2005, modified)

EN 60529, *Degrees of protection provided by enclosures (IP Code)* (IEC 60529:1989)

EN 60664-1:2007, *Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests* (IEC 60664-1:2007)

EN 60695-11-10, *Fire hazard testing — Part 11-10: Test flames — 50 W horizontal and vertical flame test methods* (IEC 60695-11-10:1999)

EN 60747-5 (all parts), *Discrete semiconductor devices and integrated circuits — Part 5: Optoelectronic devices*

EN 60947-1:2004, *Low-voltage switchgear and controlgear — Part 1: General rules* (IEC 60947-1:2004)

EN 60947-4-1, *Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters* (IEC 60947-4-1:2000)

EN 60947-5-1, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices* (IEC 60947-5-1:2003)

EN 60950-1, *Information technology equipment — Safety — Part 1: General requirements* (IEC 60950-1:2005, modified)

EN 61249-2-1, *Materials for printed boards and other interconnecting structures — Part 2.1: Reinforced base materials, clad and unclad — Phenolic cellulose paper reinforced laminated sheets, economic grade, copper-clad* (IEC 61249-2-1:2005)

EN 61508-2, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems* (IEC 61508-2:2000)

EN 61508-3, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 3: Software requirements* (IEC 61508-3:1998)

EN 61558-1:2005, *Safety of power transformers, power supplies, reactors and similar products — Part 1: General requirements and tests* (IEC 61558-1:2005)

EN 62326-1, *Printed boards — Part 1: Generic specification* (IEC 62326-1:2002)

EN ISO 9773, *Plastics — Determination of burning behaviour of thin flexible vertical specimens in contact with a small-flame ignition source* (ISO 9773:1998)

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology* (ISO 12100-1:2003)

**EN 81-40:2008 (E)**

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)*

EN ISO 13850, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

EN ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO 14121-1, *Safety of machinery — Risk assessment — Part 1: Principles (ISO 14121-1:2007)*

ISO 606, *Short-pitch transmission precision roller and bush chains, attachments and associated chain sprockets*

ISO 9772, *Cellular plastics — Determination of horizontal burning characteristics of small specimens subjected to a small flame*

ISO 7000:2004, *Graphical symbols for use on equipment — Index and synopsis*

IEC 60417-DB-12M (2002-10), *Graphical symbols for use on equipment*

IEC 60617 (all parts), *Graphical symbols for diagrams*

### 3 Terms and definitions

For the purposes of this document, the definitions given in EN ISO 12100-1 and EN 81-1 and the following apply.

#### 3.1

##### **barrier arm**

bar or similar device so arranged as to provide protection against persons falling from a stairlift

#### 3.2

##### **brake**

mechanism employed to bring the stairlift to a stop and hold it in position

#### 3.3

##### **carriage**

mobile trolley which is retained, supported and guided by one or more rails, upon which a chair, platform or other purpose-made adaptation to carry the user is supported and securely attached

#### 3.4

##### **competent person**

person, suitably trained and qualified by knowledge and practical experience, and provided with the necessary instructions to enable the required work to be carried out safely

#### 3.5

##### **drive system**

arrangements that cause the carriage to move under power

#### 3.6

##### **drive unit**

unit including the motor that drives and stops the stairlift

#### 3.7

##### **driving nut**

internally threaded component that acts in conjunction with a screw to produce linear motion of the carriage

#### 3.8

##### **driving screw**

externally threaded driving component that acts in conjunction with a nut

**3.9****electrical safety chain**

total of the electric safety devices, which can either be switches or safety circuits, connected in series with each other

**3.10****electrical safety circuit**

electrical or electronic circuit with an equivalent degree of safety to a switch containing electrical safety contacts

**3.11****electrical safety contact**

contact in which the separation of the circuit breaking elements is made by positive means

**3.12****electrical safety device**

either an electrical switch incorporating one or more electrical safety contacts, or a safety circuit

**3.13****final limit device**

last electric safety device situated beyond terminal floors

**3.14****guide rail**

rigid components which provide guiding for the carriage

**3.15****guided rope**

rope that is either fixed or moving, and is completely guided over its entire length such that it may transmit a load either in thrust or tension

**3.16****impaired mobility**

difficulty in using stairs because of impairment

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

[SIST EN 81-40:2009](https://standards.iteh.ai/catalog/standards/sist/b04f197f-e0e5-4a53-920f-61f43924d8b7/sist-en-81-40-2009)

<https://standards.iteh.ai/catalog/standards/sist/b04f197f-e0e5-4a53-920f-61f43924d8b7/sist-en-81-40-2009>

NOTE 1 Some examples, but not restricted to, are: wheelchair user, person with walking difficulties, persons with impaired mobility and/or children with impaired mobility and elderly persons.

NOTE 2 This definition is specific to the sense of this standard and not a full definition of the term.

**3.17****maximum working load**

rated load + overload

**3.18****overload**

25 % of rated load

**3.19****overspeed detection device**

device which interrupts the electric safety chain and if necessary causes the safety gear to be applied when the stairlift attains a pre-determined speed

**3.20****public access**

any location where the user is unknown

**3.21****rated load**

load for which the equipment has been designed

**EN 81-40:2008 (E)****3.22****rated speed**

speed ( $v$ ) in metres per second of the stairlift for which the equipment has been built

**3.23****safety gear**

mechanical device for stopping and maintaining the carriage stationary on the guide rail/s in case of overspeeding in the downward direction or the breaking of the suspension

**3.24****safety nut**

internally threaded component, used in conjunction with a screw/nut drive, so arranged that it does not normally carry the load but is capable of doing so in the event of failure of the threads in the main driving nut

**3.25****self-sustaining drive system**

system that, under free running conditions, ensures that the speed of the stairlift decreases

**3.26****sensitive edge**

device attached to any edge to provide protection against a trapping, shearing or crushing hazard

**3.27****sensitive surface**

device similar in effect to a sensitive edge but so arranged to protect a whole surface

**3.28****slack rope/chain device**

device or combination of devices, arranged to stop the stairlift if any suspension rope or chain slackens by a pre-determined amount

**3.29****stairlift**

appliance for transporting a person (either seated or standing) or person in a wheelchair between two or more boarding points by means of a guided carriage moving in an inclined plane

**3.30****terminal device**

device or combination of devices arranged to stop the stairlift at or near a boarding point

**3.31****unlocking zone**

zone extending above and below a boarding point in which the carriage must be positioned to enable the corresponding ramp(s) and barrier arm(s) to be unlocked

**4 List of significant hazards**

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

The significant hazards are based upon EN ISO 14121-1. Also shown are the subclause references to the safety requirements and/or protective measures in this standard.

Table 1 shows the hazards which have been identified and where the corresponding requirements have been formulated in this standard, in order to limit the risk or reduce these hazards in each situation.

NOTE Hazards resulting from allergic reactions to persons are not addressed in this standard.

Table 1 — Significant hazards relating to the general design and construction of stair lifts

	Hazards	Relevant clauses in EN 81-40
1	<b>Mechanical hazards</b> Shape; relative location; mass and stability (potential energy of elements which may move under the effect of gravity); mass and velocity (kinetic energy of elements in controlled motion); inadequacy of energy inside the machinery, e.g accumulation of energy inside the machinery elastic elements (springs); liquids and gasses under pressure the effect of vacuum	5 5.3.1.7 5.4
1.1	Crushing hazard	5.6.2.5, 5.6.3.5, 5.6.4.10
1.2	Shearing hazard	5.6.2.5, 5.6.3.5, 5.6.4.10
1.3	Cutting or severing hazard	5.6.2.5.5
1.4	Entanglement hazard	5.4.7.4
1.5	Drawing-in or trapping hazard	5.1.9, 5.4.1.2, 5.4.1.7, 5.4.6.4, 5.4.7.4
1.6	Impact hazard	5.6.4.4, 5.6.4.6.4, 5.6.2.5
1.7	Stabbing or puncture hazard	5.1.9
1.8	Friction or abrasion hazard	5.6.2.5.5, 5.6.2.5
1.10	Falling hazard	5.2.1.1, 5.3.1.7, 5.3.1
2	<b>Electrical hazards</b>	
2.1	Electrical contact of persons with live parts	5.5.11, 5.5.12, 5.1.8, 5.5.9.6
		(to be continued)

[SIST EN 81-40:2009](https://standards.iteh.ai/catalog/standards/sist/b04f197f-e0e5-4a53-920f-61f43924d8b7/sist-en-81-40-2009)  
<https://standards.iteh.ai/catalog/standards/sist/b04f197f-e0e5-4a53-920f-61f43924d8b7/sist-en-81-40-2009>

Table 1 (continued)

	Hazards	Relevant clauses in EN 81-40
2.2	Electrical contact of persons with parts which have become live under faulty conditions	5.5.1.2, 5.5.11
2.3	Approach to live part under high voltage	5.5.4.1, 5.5.1.3
2.4	Electrostatic phenomena	5.5.1.2, 5.5.12.10
3	<b>Thermal hazards</b>	
3.1	Burns and scalds	5.5.8, 5.5.1.3, 5.1.4
3.2	Health-damaging effects	5.1.7, 5.1, 5.5.12.3
7.1	Contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	5.1.4, 5.5.12.2
7.2	Fire or explosion	5.1.4, 5.4.2.2
8	<b>Hazards generated by neglecting ergonomic principles in machine design</b>	
8.1	Unhealthy postures or excessive effort	5.2.2.2, 5.6.4.4, 5.3.4
8.2	Inadequate consideration of human hand/arm or foot/leg anatomy	5.6.1.3, Annex C 2.1,
8.4	Inadequate area lighting	5.5.17, Annex C.3
8.6	Human error	5.5.14, 5.5.9.7, 5.5.7, 7.5
8.7	Inadequate design, location or identification of manual controls	7.4.4, 5.5.14, 5.1.3, Annex C.2.1.4
8.8	Inadequate design or location of visual display units	5.2.2.6, 5.5.12.9, 5.5.14.4, 5.5.16.2, 7.2, 7.4.3
10	<b>Hazards caused by failure of energy supply, breaking down of machinery parts and other functional disorders</b>	
10.1	Failure/disorder of the control system	5.5.5.1, 5.5.14.1, 5.4.2.1, 5.5.15, 5.5.6.5, 5.4.2, 5.5.3.3, 5.5.5.1, 6.4
10.2	Restoration of the energy after an interruption	5.5.5.1, 5.5.14.1, 5.5.2.4, 5.5.3.2, 5.5.5.1, 6.4
10.5	Errors in software	6.4, 5.5.6.5
10.6	Errors made by the operator (due to mismatch of machinery with human characteristics and abilities)	5.5.14, 5.4.3, 5.5.9.7, 7
11	<b>Impossibility of stopping the machine in the best possible conditions</b>	
11.1	Unsafe position	5.5.15, 5.2.3, 5.4.2.1
11.2	Overspeeding	5.4.2, 5.5.3.3, 5.5.5.1, 5.3
13	<b>Failure of the power supply</b>	
13.1	Overspeeding	5.4.2, 5.5.3.3, 5.5.5.1, 5.3
13.2	Unexpected start	5.5.5.1, 5.5.14.1
13.3	Change of direction	5.5.2.4, 5.5.3.2, 5.5.5
13.4	Loss of memory	5.5.5.1, 6.4
13.5	Unsafe position	5.2.4, 5.4.2.1, 5.5.15.1
13.6	Entrapment	5.4.3, 5.5.16, 5.6.4.7.2, 5.6.4.9, 5.6.4.11, 5.2.2.4
14	<b>Failure of the control circuit</b>	
14.1	Errors on software	5.5.6.5, 6.4
14.2	Failure to stop	5.5.2, 5.5.3, 5.5.4, 5.5.5, 5.5.6, 6.4
14.3	Unexpected stop	5.5.2, 5.5.3, 5.5.4, 5.5.5, 5.5.6, 6.4

(to be continued)

Table 1 (continued)

	Hazards	Relevant clauses in EN 81-40
14.4	Unexpected start	5.5.2, 5.5.3, 5.5.4, 5.5.5, 5.5.6, 6.4, 5.5.5.1, 5.5.13.1, 5.5.14.1.4
14.5	External influences	5.1.8
14.6	Unexpected start	(See 14.4 above)
14.7	Failure to start	5.6.3.4, 5.3.5, 5.5.3.2, 5.5.6.1, 5.5.6.2
14.8	Maintenance operation	5.4.3
14.9	Unexpected activation	5.4.3, 5.5.14.1, 5.5.14.2
14.10	Brake remains lifted	5.3, 5.4.2.2, 5.5.3.1
14.11	Prevent stopping	5.4.2, 5.5.3.2
14.12	Ineffective protection	5.6.4.6, 5.6.4.10, 5.6.2.5.1
14.13	Isolation	5.5.9
15	<b>Errors of fitting</b>	5.5.9.2, 5.5.9.3
16	<b>Break-up during operation</b>	
16.1	Stress failure	5.1.7
16.2	Falling	5.6.2.6, 5.6.3.3, 5.6.4.6, 5.6.4.7, 5.6.4.8, 5.6.2.1, 5.6.2.3, 5.6.3.1.1, 5.6.3.2
17	<b>Falling or ejected objects or fluid</b>	
17.1	Falling objects	5.6.4.5, 5.6.4.6.3, 5.6.3.2
18	<b>Loss of stability / overturning of machinery</b>	
18.1	Overturning	5.2, 5.3.1.7
18.2	Falling	5.2, 5.3.1.7, 5.6.2
19	<b>Slip, trip and fall of persons (related to machinery)</b>	
19.1	Slipping	5.6.2, 5.6.4.1
19.2	Tripping	5.6.4.1, 5.6.4.5.1
19.3	Falling	5.6.4.6.1, 5.6.4.6.3, 5.6.4.7, 5.6.4.5.2, 5.6.3.2
27	<b>Mechanical hazards and hazardous events</b>	
27.1	from load falls, collisions, machine tipping caused by:	
27.1.1	lack of stability	5.2.1
27.1.2	uncontrolled loading- overloading- overturning moments exceeded	5.5.8, 5.6.4.3, 6.4.
27.1.3	uncontrolled amplitude of movements	5.1.5, 5.4.2, 5.4.2.2, 6.3
27.1.4	unexpected/unintended movement of loads	5.1.5, 5.1.6, 5.4.2, 5.4.2.2, 6.3
27.1.5	inadequate holding devices/ accessories	5.6.4.6.2
27.3	from derailment	5.1.7.2, 5.2.1, 5.2.3, 5.2.2.
27.4	from insufficient mechanical strength of parts	5.1.2, 5.1.7
27.5	from inadequate design of pulleys, drums	5.4.1.3
27.6	from inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine	5.4.1.3, 5.4.4, 5.4.1.5, 5.4.1.6, 5.4.7.2, 7.4.1
27.7	from lowering of the load under the control of the friction brake	5.4.2.1

(to be continued)