



BSI Standards Publication

Safety rules for the construction and installation of lifts — Special lifts for the transport of persons and goods

Part 41: Vertical lifting platforms intended for use by persons with impaired mobility

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National foreword

This British Standard is the UK implementation of EN 81-41:2010.

The UK participation in its preparation was entrusted to Technical Committee MHE/4, Lifts, hoists and escalators.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 81-41:2010) 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of an identical text or by endorsement, at the latest by June 2011, and conflicting national standards shall be withdrawn at the latest by June 2011.

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 2006/42/EC.

For relationship with EC Directive 2006/42/EC, see informative Annex ZA, 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.

Introduction

The population of Europe is ageing and the prevalence of disability, including disability associated with the ageing process, is increasing. Older people and people with disabilities at present are estimated to number some 80 million people – a large and growing proportion of the European Union population. The changing demography presents both opportunities and challenges for the Union. The economic, social and cultural potential of older people and people with disabilities is underexploited at present. However there is a growing recognition that society needs to exploit this potential for the economic and social benefit of society generally.

This is one of the reasons that led to this standard on vertical lifting platforms for people with impaired mobility being one means to provide accessibility to buildings.

This standard is a type C standard as stated in EN ISO 12100 (all parts).

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

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.

The lifting platforms defined in this standard are suitable for type A and type B wheelchairs as defined in EN 12183 and/or EN 12184.

Those items relevant to lifting platforms referenced within EN 81-70 have been included within this standard.

This standard does not only address the essential health and safety requirements of the Machinery Directive, but additionally states minimum rules for the installation of lifting platforms into buildings/constructions. There may be in some countries regulations for the construction of building etc. which cannot be ignored.

It is essential that minimum passageways conform to national building regulations and are not obstructed by any open door or trap and/or any protection means provided for working areas outside of the enclosed liftway where fitted according to the maintenance instructions.

Assumptions

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

- Vertical lifting platforms are installed in both new and existing buildings;
- For existing buildings where space is not available, other dimensions may be considered. Local building regulations should be observed;
- components without specific requirements are:
 - a) designed in accordance with the usual engineering practice and calculation codes, including all failure modes;
 - b) of sound mechanical and electrical construction;
 - c) general hazards due to hydraulic, pneumatic, etc. equipment are dealt with according to relevant B level standards for common use.
 - d) Materials known to be harmful materials, such as asbestos are not to be used as part of the machine;

- components are kept in good repair and working order, in accordance with the maintenance manual, so that the required characteristics remain despite wear;
- by design of the load bearing elements, a safe operation of the machine is assured for loading ranging from zero to, the dynamic operation maximum working load and static loading, to the maximum static load;
- 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 maximum range of ambient temperature between + 5 °C and + 40 °C. For very hot or cold environments extra requirements may be necessary.
- negotiations have been made between the customer and the manufacturer about:
 - environmental conditions;
 - civil engineering problems;
 - other aspects related to the place of installation;
 - the use and places of use of the machinery;
 - the place of installation allows a safe use for the machine;
 - any additional fire protection requirements;
 - suitability for the user (see Annex B).

1 Scope

1.1 This European Standard deals with safety requirements for construction, manufacturing, installation, maintenance and dismantling of electrically powered vertical lifting platforms affixed to a building structure intended for use by persons with impaired mobility:

- travelling vertically between predefined levels along a guided path whose inclination to the vertical does not exceed 15°;
- intended for use by persons with or without a wheelchair;
- supported or sustained by rack and pinion, wire ropes, chains, screw and nut, friction/traction between wheels and the rail, guided chain, scissors mechanism or hydraulic jack (direct or indirect);
- with enclosed liftways;
- with a speed not greater than 0,15 m/s;
- with platforms where the carrier is not completely enclosed.

1.2 This standard deals with all significant hazards relevant to lifting platforms, when they are used as intended and under the conditions foreseen by the manufacturer (see Clause 4).

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;
 - vertical lifting platforms whose primary function is the transportation of goods;
 - vertical lifting platforms whose carriers are completely enclosed;
 - vertical lifting platforms prone to vandalism;
 - hazards occurring during manufacture;
 - earthquakes, flooding;
 - fire fighting, evacuation and behaviour during a fire;
 - noise and vibrations;
 - the design of concrete, hardcore, timber or other foundation or building arrangement;
 - the design of anchorage bolts to the supporting structure;
 - type C wheelchairs as defined in EN 12183 and/or EN 12184.
- NOTE For the actual type of machinery, noise is not considered a significant nor relevant hazard.

1.4 This standard is not applicable to Vertical Lifting Platforms intended for use by persons with impaired mobility which are manufactured before the date of its publication as an EN.

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 81-2:1998, *Safety rules for the construction and installation of lifts — Part 2: Hydraulic lifts*

EN 81-58, *Safety rules for the construction and installation of lifts — Examination and tests — Part 58: Landing doors fire resistance test*

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 12015, *Electromagnetic compatibility — Product family standard for lifts, escalators and moving walks — Emission*

EN 12016, *Electromagnetic compatibility — Product family standard for lifts, escalators and moving walks — Immunity*

EN 12183, *Manual wheelchairs — Requirements and test methods*

EN 12184, *Electrically powered wheelchairs, scooters and their chargers — Requirements and test methods*

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

EN 13411 (all parts), *Terminations for steel wire ropes*

EN 50214, *Flat polyvinyl chloride sheathed flexible cables*

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

EN 60204-32, *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines (IEC 60204-32:2008)*

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

EN 60947-1:2007, *Low-voltage switchgear and controlgear — Part 1: General rules (IEC 60947-1:2007)*

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 (all parts), *Materials for printed boards and other interconnection structures — Part 2: Sectional specification set for reinforced base materials, clad and unclad*

EN 61558-1, *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 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

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)*

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

ISO 6336 (all parts), *Calculation of load capacity of spur and helical gears*

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

IEC 60417-DB, *Graphical symbols for use on equipment*

HD 384.6.61 S1, *Electrical installations of buildings — Part 6-61: Verification — Initial verification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100-1:2003 and the following apply.

3.1

balancing weight

mass which saves energy by balancing all/or part of the mass of the unloaded lifting platform

3.2

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

3.3

down direction valve

electrically controlled valve in a hydraulic circuit for controlling the descent of the lifting platform

3.4

drive system

system that causes the lifting platform to move under power input

3.5

drive unit

unit, including the motor, that drives and stops the lifting platform

- 3.6**
electric safety chain
total of the electric safety devices, which can either be switches or safety circuits, connected in series with each other
- 3.7**
electrical safety circuit
electrical or electronic circuit with an equivalent degree of safety to a switch containing electrical safety contacts
- 3.8**
electrical safety contact
contact in which the separation of the circuit breaking elements is made by positive means
- 3.9**
electrical safety device
either an electrical switch incorporating one or more electrical safety contacts, or a safety circuit
- 3.10**
enclosed liftway
space that is fully bounded by the bottom of the pit and a solid enclosure (but not necessarily a ceiling) and landing doors
- 3.11**
existing building
building which has been previously occupied and constructed prior to the requirement for a lifting platform
- 3.12**
final limit device
electrical safety device operated by the lifting platform in the event of over-travel of the normal operation stop
- 3.13**
full load pressure
static pressure exerted on the piping directly connected to the jack, the platform with the rated load being at rest at the highest landing level
- 3.14**
guide rail
rigid components that provide guiding for the platform
- 3.15**
guided chain
chain, which can be either fixed or moving, and which is completely guided over its entire length such that it can transmit a load either in thrust or tension
- 3.16**
guided chain system
platform supported, raised and lowered by means of one or more chain transmission units
- 3.17**
impaired mobility
difficulty in using stairs because of impairment

NOTE Examples of persons with impaired mobility include, but are not restricted to: wheelchair users, persons with pushchair, persons with walking difficulties, persons using walking aids, carers for persons with impaired mobility and/or children with impaired mobility, and elderly persons.

3.18

lifting platform

device permanently installed to serve predefined landings comprising a guided platform whose characteristics are primarily intended to permit the access of persons with impaired mobility

3.19

load carrying nut

internally threaded component which carries the load in conjunction with a screw

3.20

maximum static load

rated load + additional overload possible as a relationship of EN 81-1 and EN 81-2 floor area calculations

3.21

maximum working load

rated load + overload of one person

3.22

mechanical blocking device

device that, when set in position, guarantees a minimum safety space beneath the platform for the purposes of maintenance and inspection

3.23

over-speed governor

device which, when the lifting platform attains a pre-determined speed, causes the lifting platform to stop and if necessary causes the safety gear to be applied

3.24

overload

additional load which is permissible based upon one person

3.25

pressure relief valve

valve which limits the pressure to a pre-determined value by exhausting fluid

3.26

public access

location where the user is unknown

3.27

rack

bar with teeth with which a driving pinion engages to form a slip free driving means converting rotary motion into linear motion

3.28

rated load

load for which the equipment has been designed

3.29

rated speed

speed of the lifting platform for which the equipment has been designed

3.30

restrictor

valve in which the inlet and outlet are connected through a restricted passageway

3.31

rupture valve

valve designed to close automatically when the pressure drop across the valve, caused by the increased flow in a pre-determined flow direction exceeds a pre-set amount

3.32

safety circuit

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

3.33

safety factor

ratio, either of the yield load, or the ultimate tensile load to the load that can be imposed upon a member by the rated load for a particular material under static or dynamic conditions

3.34

safety gear

mechanical device for stopping and maintaining the platform stationary in case of over-speeding in the downward direction and/or breaking of the suspension

3.35

safety nut

internally threaded component which is linked to the load carrying nut but is unloaded during normal service which is capable of carrying the load if the load carrying nut should break

3.36

screw

external threaded component which carries the load in conjunction with the load carrying nut and in certain circumstances the load imposed by the safety nut

3.37

self-sustaining system

screw and nut system that, under free running conditions ensure that the speed of the platform decreases

3.38

sensitive edge

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

3.39

"shut-off" valve

manually operated two-way valve which can permit or prevent flow in either direction

3.40

slack rope/chain device

device, or combination of devices, arranged to stop the lifting platform should any suspension rope or chain slacken by a pre-determined amount

3.41

stopping safety device

mechanical device for stopping the relative rotation between screw and nut in case of over-speeding and stopping the lifting platform and maintaining it stationary

3.42

toe guard

vertical component extending downwards from the platform entrance

3.43

transmission unit

assembly comprising the chain, and its associated elements, sprocket wheel, return housing, guided elements for the chain

3.44

unlocking zone

zone, extending above and below a landing, in which the platform floor must be positioned to enable the corresponding landing door/s to be unlocked

3.45**user**

person making use of the services of the platform

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.

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.

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

Before supplying any lifting platform, it is important to review the risks in Table 1 to check that all site specific hazards have been identified in this clause.

NOTE Hazards resulting from allergic reactions to persons are not addressed in this standard, but advice on such materials is given in Annex D of EN 81-70:2003.

Table 1 — Significant hazards relating to the general design and construction of lifting platforms

	Hazards	Relevant clauses in EN 81-41
1	Mechanical hazards	
	a) shape;	5.9, 5.6.4.1, 5.6.4.2
	b) relative location;	
	c) mass and stability(potential energy of elements may move under the effect of gravity);	5.1.6, 5.3, 5.4.6, 5.4.1
	d) mass and velocity (kinetic energy of elements in controlled motion);	
	e) inadequacy of energy inside the machinery e.g.);	
	— accumulation of energy inside the machinery e.g.:	5.4.10
	f) elastic elements (springs);	
	g) liquids and gasses under pressure;	
	h) the effect of vacuum.	
1.1	Crushing hazard	5.1.3, 5.1.4.1.2, 5.1.4.2.1, 5.6.2, 5.6.4, 5.9
1.2	Shearing hazard	5.1.3, 5.6.4, 5.8.4, 5.9
1.3	Cutting or severing hazard	5.1.4.1.2, 5.1.4.4.1, 5.6.4, 5.6.6, 5.8.2, 5.9
1.4	Entanglement hazard	5.1.3, 5.1.4.1.2, 5.1.4.4.1, 5.5.5, 5.6.4, 5.9, 5.4.1.7
1.5	Drawing-in or trapping hazard	5.1.3, 5.1.4.1.2, 5.1.4.4.1, 5.1.11.3, 5.4.5.4.4, 5.4.5, 5.5.5, 5.6.6, 5.8.4, 5.9
<i>(to be continued)</i>		

Table 1 (continued)

	Hazards	Relevant clauses in EN 81-41
1.6	Impact hazard	5.1.4.1.2, 5.1.4.4.1, 5.8.7
1.7	Stabbing or puncture hazard	5.1.4, 5.9
1.8	Friction or abrasion hazard	5.1.3, 5.6.4, 5.9
1.9	High pressure fluid ejection hazard	5.1.4.4.1, 5.4.10
1.10	Falling hazard	5.1.3, 5.1.4.1.2, 5.1.4.2.3, 5.3, 5.6.4, 5.8.2, 5.8.3, 5.9.5.1, 7.3.1.6.5
2	Electrical hazards	
2.1	Electrical contact of persons with live parts	5.1.4.4.1, 5.5.1, 5.5.3, 5.5.8, 5.5.13
2.2	Electrical contact of persons with parts which have become live under faulty conditions	5.5.3
2.3	Approach to live part under high voltage	5.5.1.2, 5.5.8, 5.5.2
3	Thermal hazards	
3.1	Burns and scalds	5.1.4.4.1, 5.1.5, 5.5.12, 5.5.14
3.2	Health-damaging effects	5.1.5, 5.5.14.9
6	Hazards generated by radiation	5.5.9
7.1	Contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	5.5.14.9
7.2	Fire or explosion	5.5.14.9
8	Hazards generated by neglecting ergonomic principles in machine design	
8.1	Unhealthy postures or excessive effort	5.1.4.2.2, 5.1.8, 5.4.3, 5.5.15, 5.8.2, 5.8.7
8.2	Inadequate consideration of human hand/arm or foot/leg anatomy	5.4.3, 5.5.14, 5.8.7
8.4	Inadequate area lighting	5.5.3, 5.5.4
8.6	Human error	5.4.3, 5.5.15
8.7	Inadequate design, location or identification of manual controls	5.5.15
8.8	Inadequate design or location of visual display units	5.5.15
9	Hazard combinations	Considered satisfied when all individual hazards have been addressed
10	Hazards caused by failure of energy supply, breaking down of machinery parts and other functional disorders	
10.1	Failure/disorder of the control system	5.1.12, 5.4.2, 5.4.3, 5.5.11, 5.5.7
10.2	Restoration of the energy after an interruption	5.5.11
10.3	External influences on the electrical equipment	5.1.11
10.4	Other external influences (gravity, wind, etc.)	5.1.4, 5.1.11
10.5	Errors in software	5.5.15.5, 5.5.15.6
10.6	Errors made by the operator (due to mismatch of machinery with human characteristics and abilities)	5.4.3, 5.5.15
11	Impossibility of stopping the machine in the best possible conditions	5.5.15.5, 5.5.15.7
11.1	Unsafe position	5.4.2
11.2	Over-speeding	5.3, 5.4.2
13	Failure of the power supply	
13.1	Over-speeding	5.3, 5.4.2
13.2	Unexpected start	5.4.2, 5.5.11, 5.5.13
13.3	Change of direction	5.5.6.4, 5.5.11, 5.5.13
13.4	Loss of memory	5.5.11, 5.5.14
13.5	Unsafe position	5.4.2
13.6	Entrapment	5.4.3, 5.5.4, 5.5.11, 5.5.14, 5.5.16, 5.8.6
14	Failure of the control circuit	
14.1	Errors on software	5.5.15.5, 5.5.15.6
14.2	Failure to stop	5.5.6, 5.5.7, 5.5.11, 5.5.11.5, 5.5.17
14.3	Unexpected stop	5.5.6, 5.5.7, 5.5.11, 5.5.14, 5.5.17

(to be continued)

Table 1 (continued)

	Hazards	Relevant clauses in EN 81-41
14.4	Unexpected start	5.5.1.1, 5.5.6, 5.5.7, 5.5.8.2, 5.5.12, 5.5.13, 5.5.11.5, 5.5.17
14.5	External influences	5.4.3, 5.5, 5.5.8, 5.5.17
14.6	Unexpected start See 14.4 above	
14.7	Failure to start	5.4.3, 5.5.6, 5.5.11.3, 5.5.17
14.8	Maintenance Operation	5.5.1, 5.5.5, 5.5.6.3, 5.5.6.4, 5.5.11, 5.5.13
14.9	Unexpected Activation	5.5.1.1, 5.5.13, 5.5.17
14.10	Brake remains lifted	5.4.2
14.11	Prevent stopping	5.4.2, 5.5.11
14.12	Ineffective protection	5.5.1
14.13	Isolation	5.5.1
15	Errors of fitting	5.3, 5.5.13
16	Break-up during operation	
16.1	Stress failure (and fatigue)	5.1.2, 5.1.10, 5.1.6, 5.3, 5.4.1, 5.4.2, 5.4.4, 5.4.5, 5.4.6, 5.4.7, 5.4.8, 5.4.9, 5.4.10
16.2	Falling	5.1.4.1.2, 5.1.4.2.3, 5.1.6, 5.3, 5.4.1, 5.4.2, 5.4.4, 5.4.5, 5.4.6, 5.4.7, 5.4.8, 5.4.9, 5.4.10
17	Falling or ejected objects or fluid	
17.1	Falling objects	5.6.4, 5.6.5, 5.6.6, 5.8.2, 5.8.3
18	Loss of stability / overturning of machinery	
18.1	Overturning	5.1.7, 5.2.1
18.2	Falling	5.1.7, 5.2.1
19	Slip, trip and fall of persons (related to machinery)	
19.1	Slipping	5.5.4, 5.8.4.6, 5.9
19.2	Tripping	5.4.2, 5.5.4, 5.5.15.7, 5.8.4.6, 5.8.5, 5.9
19.3	Falling	5.1.4.3, 5.5.4, 5.5.15.7, 5.6.4, 5.6.5, 5.6.6, 5.8.2, 5.8.3, 5.8.5
19.4	Falling from the landing	5.1.4.3, 5.5.4, 5.6.4, 5.6.5, 5.8.2, 5.8.3, 5.8.4, 5.8.4.7, 5.8.5
27	Mechanical hazards and hazardous events	
27.1	From load falls, collisions, machine tipping caused by:	5.6.4
27.1.1	Lack of stability	5.2.1.1, 5.2.1.2
27.1.2	Uncontrolled loading- overloading- overturning moments exceeded	5.1.5, 5.1.7, 5.4.2, 5.4.3
27.1.3	Uncontrolled amplitude of movements	5.1.5, 5.4.2, 5.5.7
27.1.5	Inadequate holding devices/accessories	5.9.7
27.2	From access of persons to load support	5.4.4, 5.4.5, 5.4.6, 5.3, 5.4.7, 5.4.8, 5.8
27.3	From derailment	5.1.10, 5.2.1
27.4	From insufficient mechanical strength of parts	5.1.2, 5.1.10, 5.4.4, 5.4.5, 5.4.6, 5.4.7, 5.4.8, 5.4.9, 5.4.10, 5.9, 5.8.4.7, 5.6.4.3, 5.6.4.4
27.5	From inadequate design of pulleys, drums	5.4.5.4
27.6	From inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine	5.4.5, 5.4.8
27.7	From lowering of the load under the control of the friction brake	5.4.2 5.4.3
27.8	From abnormal conditions of assembly / testing / use / maintenance	7, 6.3
27.9	From the effect of load on the persons (impact by load or counterweight)	5.8.5, 5.8.7

(to be continued)

Table 1 (concluded)

	Hazards	Relevant clauses in EN 81-41
34	Mechanical hazards and hazardous events due to:	
34.1	Inadequate mechanical strength – inadequate working coefficients	5.1.6, 5.1.8, 5.1.10, 5.4.4, 5.4.5, 5.4.6, 5.4.7, 5.4.8, 5.4.9, 5.4.10, 5.6.4, 5.9
34.2	Failing of loading control (include overload device)	5.1.7
34.3	Failing of controls in person carrier (function, priority)	5.5.7, 5.5.11, 5.5.15.3
34.4	Over-speed of persons carrier	5.1.5, 5.3, 5.4.2
34.5	Loss of integrity of fixings	5.1.10, 5.8.4.7, 5.8.5
35	Falling of person from person carrier	5.6.4.3, 5.6.4.4, 5.8.5
36	Falling or overturning of person carrier	
36.1	Preventing of falling or overturning	5.1.6, 5.1.7, 5.3
36.2	Acceleration and braking	5.1.5, 5.3, 5.4.2
37	Human error, human behaviour	7.3

5 Safety requirements and/or protective measures

5.1 General requirements for lifting platforms

5.1.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of EN ISO 12100 (all parts) for hazards relevant but not significant, which are not dealt with in this document (e.g. sharp edges).

It shall be ensured that the dimensions specified in this standard are maintained, despite wear. Consideration shall also be given to the need for protection against the effects of corrosion. The transmission of noise and vibration to any surrounding walls and other supporting structures shall be minimised.

All materials shall be asbestos free.

5.1.2 Pattern of use

The mechanical design of the lifting platform shall take account of the frequency of usage to which it will be subjected.

NOTE See Assumptions - negotiations.

5.1.3 Guarding

Components (for example gearing of the drive unit) shall be guarded to prevent the risk of personal injury. Access panels shall be secured by means requiring the use of a tool or key for their release. Their fixing systems shall remain attached to the guards or to the machinery when the guards are removed.

Guarding shall be designed and constructed in accordance with EN 953, EN ISO 13857 and EN 349.

5.1.4 Access for maintenance, repair and inspection

5.1.4.1 Working areas on the platform

5.1.4.1.1 General

Where machinery is to be maintained or inspected from the platform and if this work requires movement of the platform or is likely to result in uncontrolled and unexpected platform movement, the following applies.

5.1.4.1.2 Any kind of uncontrolled and unexpected movement of the platform resulting from maintenance/inspection that can be dangerous to persons carrying out maintenance/inspection work shall be prevented by a mechanical device. Such device shall ensure a minimum 300 mm clear space between the parts of the platform and rigid parts of the liftway where there is a risk of crushing. Monitoring of this device to ensure that the device is in the passive position before normal operation, shall be by means of an electrical safety device in accordance with 5.5.11.

5.1.4.1.3 Any necessary devices for emergency operation and for dynamic tests (such as brake tests, traction tests, safety gear tests) shall be arranged so that they can be operated from outside of the enclosed liftway.

5.1.4.2 Working areas under the platform

5.1.4.2.1 Where the lifting platform is to be maintained or inspected from underneath the platform the following applies:

- a) If a clear space of 500 mm minimum is not available under the platform when at its lowest position, a manually positioned mechanical blocking device shall be provided to enable the platform to be held in a raised position and to create a free distance of at least 500 mm between the floor of the working area and the lowest parts of the platform. The device shall be able to stop the platform travelling downwards at rated speed with maximum working load.
- b) The blocking device shall be in position before entering the pit and shall be provided with an electric safety device that detects the correct positioning of the mechanical blocking device and which will disable the car and landing controls and enable any inspection control station. The function shall be clearly marked with its intended purpose and position.
- c) The opening of any door providing access to the pit shall be by use of a key, see 5.8.6, and prevent normal operation of the lifting platform; visible information shall be available if the blocking device is not in its active position. The return of the platform to normal service shall only be made by operation of a reset device placed outside of the liftway and accessible to authorised persons only.
- d) Where it is necessary to move the platform from the pit, an inspection control station according to 5.5.18 shall be available for use.
- e) The floor of the pit shall be able to support the loads and forces (N) imposed to it and to support at any position the mass of 2 persons, each counting for 1 000 N without permanent deformation.

5.1.4.2.2 When the platform is in the position according to 5.1.4.2.1 a), it shall be possible to leave the working area easily and safely.

5.1.4.2.3 Any necessary devices for emergency operation and for dynamic tests, such as brake tests, traction tests, safety gear tests, shall be arranged so that they can be operated from outside of the enclosed liftway.

5.1.4.3 Working areas outside of the enclosed liftway

When the machinery is in the enclosed liftway and is intended to be maintained/inspected from outside of the enclosed liftway, access to this equipment shall only be possible by a door/trap in conformity with 5.6.6.

5.1.4.4 Machinery outside of the enclosed liftway

5.1.4.4.1 If any part of machinery is located outside of the liftway e.g. control panel, drive machine, it shall be located inside a cabinet.

5.1.4.4.2 The machinery cabinet shall consist of imperforate walls, floor, roof and door(s).

The door(s) shall:

- a) not open towards the inside of the cabinet;

- b) be provided with a key-operated lock;
- c) be capable of being re-closed and re-locked without a key.

The only permissible openings are:

- i) necessary openings for the functioning of the lift between the liftway and the machinery cabinet;
- ii) vent openings for escape of gases and smoke in the event of fire. These openings when accessible to non-authorised persons shall comply with the following requirements:
 - protection according to EN ISO 13857:2008, Table 5, against contact with danger zones;
 - IP2XD according to EN 60529.

5.1.5 Rated speed

The rated speed of the lifting platform shall not be greater than 0,15 m/s.

5.1.6 Rated load

The rated load shall be calculated at not less than 250 kg/m² of the clear loading area, excluding handrails.

NOTE 250 kg/m² takes account of the surface and the load of a person alone using electrically powered class A or B wheelchairs.

The maximum permissible rated load shall be 500 kg.

The minimum values shall be as follows:

- a) lone user either standing or in a type A wheelchair: 250 kg;
- b) user in a type A or B wheelchair with an attendant: 315 kg.

Type A or type B wheelchairs as defined in EN 12183 and/or EN 12184.

NOTE See Table 2.

5.1.7 Load control

The platform shall be fitted with a device to prevent normal starting, excluding re-levelling of hydraulic drives in the event of overload on the platform. The overload is considered to occur when the rated load is exceeded by 75 kg.

In the event of overload:

- a) users shall be informed by an audible and visible signal on the platform;
- b) doors shall remain unlocked or unlockable in the unlocking zone.

5.1.8 Platform dimensions

5.1.8.1 The clear loading area of the platform including any sensitive edge, photo cell or light curtain, but excluding hand rails, shall not exceed 2 m².

5.1.8.2 For new buildings the plan dimensions of the platform floor, including any sensitive edge, photo cells or light curtain, but excluding handrails, to accommodate a standard type A or type B wheelchair according to EN 12183 and/or EN 12184, shall be equal to or greater than those given in Table 2.

For existing buildings where space is not available, other dimensions may be considered. Local building regulations should be observed.

Table 2 — Minimum dimensions of platform

Dimensions in millimetres

Principal use	Minimum plan dimensions (width × length)	Minimum rated load kg
Type A and B wheelchairs with an attendant and adjacent entrances	1 100 × 1 400	385
Type A and B wheelchairs with an attendant	900 × 1 400	315
Lone user, either standing or in a type A wheelchair	800 × 1 250	250

5.1.8.3 In buildings with public access, the platform length shall not be less than 1 400 mm, to enable sufficient space for an attendant.

5.1.9 Mechanical strength of the platform

Mechanical strength of the platform shall be such that foreseeable misuse (e.g.: too many persons) is taken into consideration. Therefore the platform and its associated suspension attachments, shall be designed to support the maximum static load as determined in Table 3 + 25 % i.e. giving a static test coefficient of 1,25 (see 4.1.2.3 of the machinery directive).

Table 3

Maximum static load, mass kg	Maximum available platform area m ²	Maximum static load mass kg	Maximum available platform area m ²
100	0,37	525	1,45
180	0,58	600	1,60
225	0,70	630	1,66
300	0,90	675	1,75
375	1,10	750	1,90
400	1,17	800	2,00
450	1,30		
For intermediate loads the area is determined by linear interpolation			

5.1.10 Resistance to operating forces

5.1.10.1 The complete lifting platform installation shall resist, without permanent deformation, the forces imposed on it during normal operation, during the application of the safety devices and at impact on mechanical stops when travelling at the rated speed. However, local deformation that does not affect the operation of the lifting platform arising from the safety gear gripping device is permissible.

5.1.10.2 Guiding components, their attachments and joints shall withstand deflections due to uneven loading without affecting normal operation.

5.1.10.3 A fatigue stress analysis shall be made for all load bearing components and joints, which are critical to fatigue. This analysis shall take into account the degree of stress fluctuation and the number of stress cycles, which can be a multiple of the number of load cycles.

Each load cycle shall be at the worst case condition and at least consist of one start (acceleration from rest to rated speed), 5 m travel and one stop (deceleration from rated speed).

The analysis shall be made by test and shall be conducted at 33,33% without load, with 33,33 % half of the load and 33,33% at rated load.

The minimum number of load cycles shall be 50 000.

Fixings shall be specified to ensure that their integrity is maintained during normal operation.

5.1.11 Protection of equipment against harmful external influences

5.1.11.1 General

All mechanical and electrical components shall be protected from the harmful and hazardous effects of external influences that will be encountered at the proposed installation site, e.g.:

- the ingress of water and solid bodies;
- the effects of humidity, temperature, corrosion, atmospheric pollution, solar radiation, etc.;
- the actions of flora, fauna, etc.

5.1.11.2 Protection

Moisture shall be prevented from entering the liftway or drainage shall be provided.

The protection shall be designed and constructed and the lifting platform shall be installed in such a manner that the influences mentioned in 5.1.11.1 do not prevent the lifting platform from operating safely and reliably.

It shall not be possible for moisture to accumulate on the enclosed liftway floor.

5.1.11.3 Guarding of equipment from mechanical damage

Guarding shall be designed and constructed in accordance with EN 953, EN ISO 13857 and EN 349.

5.1.12 Degree of protection for outdoor use

For outdoor use, lifting platforms shall have a sufficient degree of protection for electrical equipment depending on site conditions, see assumptions, which is not less than IP54 as defined in EN 60529.

5.2 Platform support/guide system (including any scissor mechanism)

5.2.1 Platform support/guide system

5.2.1.1 Platform support/guide system shall be provided to retain and guide the platform throughout its travel. The system shall ensure that a maximum horizontal clearance of 20 mm between the inner surface of the enclosed liftway enclosure and platform components, on its accessible open sides, is maintained throughout the entire travel of the platform, under maximum working load conditions.

5.2.1.2 The platform support system shall ensure that the platform edges cannot tilt more than ± 10 mm from the horizontal when:

- a) the rated load is distributed over half of the length of the platform; and
- b) the rated load is distributed over half of the width of the platform.

5.2.1.3 Platform support/guide system structural members shall be made of metal.

5.2.1.4 General provisions concerning guide rails

The guide rails, their joints and attachments shall be sufficient to withstand the loads and forces imposed on them in order to ensure a safe operation of the lift.

The aspects of safe operation of the lift concerning guide rails are:

- a) platform guidance shall be assured;
- b) deflections shall be limited to such an extent, that due to them:
 - unintended unlocking of the doors shall not occur;
 - operation of the safety devices shall not be affected; and
 - collision of moving parts with other parts shall not be possible.

Stresses shall be limited taking into account the distribution of the rated load in the platform as given in G.2, G.3 and G.4 of EN 81-1:1998 or according to the intended use.

NOTE Annex G of EN 81-1:1998 describes a method of selecting guide rails.

5.3 Safety gear and over-speed governor

5.3.1 Safety gear

5.3.1.1 General

The lifting platform shall be provided with a safety gear. The safety gear shall operate to stop and sustain the platform with the maximum static load as defined in Table 3.

There are two exceptions to this requirement as follows:

- a) direct acting hydraulic jack drives do not require a safety gear (see 5.4.10.12 and 5.4.10.13);
- b) when the platform is driven by a self-sustaining rotating screw or nut, together with a safety nut (see 5.4.6).

The safety gear shall be fitted on the platform, except on lifting platforms driven by guided chain where the safety gear may be fitted remote from the platform, provided the requirements of 5.4.8 for the guided chain drive are fulfilled.

When the safety gear is applied, no decrease in the tension of any rope or chain or other mechanism used for applying the safety gear or motion of the platform in the downward direction shall release the safety gear.

The safety gear shall be capable of stopping and sustaining the platform, carrying its rated load, within a distance of 150 mm from where the safety gear is engaged.

The safety gear shall be designed to grip the guide rail, or equivalent element, securely.

Any shaft, jaw, wedge or support that forms part of the safety gear and that is stressed during its operation shall be made of metal.

The application of the safety gear shall not cause the platform to change inclination by more than 5°.

5.3.1.2 Actuation

The safety gear shall be mechanically tripped before the platform exceeds a speed of 0,3 m/s by an over-speed governor, except on indirectly suspended hydraulic lifts where the safety gear may be tripped by a safety rope which is independent of the means of suspension or by slackening or breaking of a suspension rope or chain.

If the over-speed governor derives its drive from a main suspension chain, or rope, the safety gear shall also be operated by a mechanism actuated by breaking, or slackening of, the means of suspension.

5.3.1.3 Release

When a safety gear has tripped its release shall require the intervention of a competent person.

Release of the safety gear shall only be possible by raising the platform. After its release, the safety gear shall remain functional for further use.

5.3.1.4 Access for inspection

The safety gear shall be accessible for inspection and testing.

5.3.1.5 Electrical checking

When the safety gear is engaged, an electrical device conforming to 5.5.11 and activated by the safety gear shall immediately initiate stopping and shall prevent the starting of the machine.

5.3.2 Over-speed governor

5.3.2.1 General

Any friction drive to the over-speed governor shall be independent of the main friction drive on friction drive lifting platforms.

The over-speed governor or another device shall, by means of an electric safety device in conformity with 5.5.12, initiate the stopping of the lift machine at the latest at the moment the tripping speed of the over-speed governor is reached.

If after release of the safety gear (5.3.1.3) the over-speed governor does not automatically reset itself, an electric safety device in conformity with 5.5.11 shall prevent the starting of the lift while the over-speed governor is not in the reset position.

The breakage or excessive rope stretch of the governor rope shall cause the machine to stop by means of an electric safety device in conformity with 5.5.11.

The tensile force in the over-speed governor rope produced by the governor, when tripped, shall be at least the greater of the following two values:

- twice that necessary to engage the safety gear; or
- 300 N.

5.3.2.2 Over-speed governor rope, safety rope

The rope shall be a wire rope designed for that purpose.

The minimum breaking load of the rope shall be related by a safety factor of at least 8:

- a) to the tensile force produced in the rope of the over-speed governor or the safety rope when tripped taking into account a friction factor $\mu_{\max}$ equal to 0,2 for traction type over-speed governor;
- b) to the force required to operate the safety gear or clamping device for safety ropes.

The nominal rope diameter shall be at least 6 mm.

The ratio between the pitch diameter of the pulleys for the over-speed governor rope and the nominal rope diameter shall be at least 30.

5.4 Driving units and drive systems

5.4.1 General requirements

5.4.1.1 The selected drive system shall be in accordance with one of the systems specified in 5.4.4 to 5.4.10.

5.4.1.2 All types of drive systems, except hydraulic, shall be powered in both directions of travel.

5.4.1.3 Safety factors used in the design of geared drive units shall be maintained, even after taking full account of the effects of wear, calculated using the designed life of the lifting platform.

Unless forming an integral part of its shaft or driving unit every sheave, rope drum, spur gear, worm and worm wheel or brake drum shall be fixed to its shaft or other driving unit by one of the following methods:

- a) sunk keys;
- b) splines;
- c) cross pinning;

Gearing shall be guarded using imperforate material.

5.4.1.4 If chain or belt intermediate drives are employed, then the following conditions shall be met.

- a) the output drive gearing shall be on the load side of the chain or belt intermediate drive and either;
 - b) the output drive gearing shall be self-sustaining;
- or
- c) the brake shall be on the load side of the chain or belt intermediate drive and a minimum of 2 belts or chains shall be used. The integrity of the chain or belt shall be monitored electrically.

5.4.1.5 As an alternative to the conditions stated in 5.4.1.4, a system with two chains intermediate drive may be used. The intermediate chain shall be monitored by an electric safety device according to 5.5.11 that disconnects the supply to the motor and brake in the event of breakage of any chain.

5.4.1.6 Rope suspension or chain suspension systems shall incorporate a device that, in the event of a slack rope or chain, shall operate an electric safety device according to 5.5.11 that shall initiate a break in the electrical supply to the motor and brake and thus prevent any movement of the platform until the rope or chain is correctly re-tensioned.

5.4.1.7 Protection for traction sheaves, pulleys and sprockets.

For traction sheaves, pulleys, chain wheels and sprockets, provisions shall be made to avoid:

- a) bodily injury;
- b) the ropes/chains leaving the pulleys/sprockets, if slack;
- c) the introduction of objects between ropes/chains and pulleys/sprockets.

The devices used shall be constructed so that the rotating parts are visible, and do not hinder examination and maintenance operation. If they are perforated the gaps shall comply with EN ISO 13857:2008, Table 4.

The dismantling shall be necessary only in the following cases:

- d) replacement of a rope/chain;
- e) replacement of a pulley/sprocket.

5.4.2 Braking system

5.4.2.1 General

An electro-mechanical friction brake shall be fitted (except on hydraulically driven lifting platforms which conform to 5.4.10) which shall be capable of bringing the lifting platform smoothly to rest and holding it firmly in position with 25 % over load and capable of holding the platform firmly with the maximum static load stated in Table 3. The brake shall be mechanically applied and electrically held off. The brake shall not be released in normal operation unless the electrical supply is simultaneously applied to the lifting platform motor.

5.4.2.2 Electro-mechanical brake

5.4.2.2.1 General

Brake linings shall be of flame retardant, self-extinguishing material and shall be so secured that normal wear will not weaken their fastenings. Residual magnetism shall not prevent the brake from being applied when the electrical supply to the driving motor is interrupted.

5.4.2.2.2 All the mechanical components of the brake which take part in the application of the braking action on the drum or disk shall be installed in two sets. If one of the components is not working a sufficient braking effort to slow down the platform, travelling downwards at rated speed and with rated load shall continue to be exercised.

Any solenoid plunger is considered to be a mechanical part, any solenoid coil is not.

5.4.2.2.3 In the case of self-sustaining drive systems, 5.4.2.2.2 may be omitted.

5.4.2.2.4 Any brake capable of being released by hand shall require constant effort to keep the brake held off.

5.4.2.2.5 If coil springs are used to apply the brake shoes, such springs shall be in compression and supported.

5.4.2.2.6 The component on which the brake operates shall be coupled to the drum or sprocket or nut or screw by direct and positive mechanical means, unless the final driving element is self-sustaining or the drive system complies with 5.4.1.5.

5.4.2.2.7 The interruption of the current to the brake shall be effected by at least two independent electrical devices, whether or not they are those, which cause the interruption of the current feeding the lift machine. If

one of the contactors has not opened the main contacts whilst the lift is stationary, further movement of the platform shall be prevented, at the latest, before the next change in the direction of motion.

5.4.2.2.8 When the motor of the lift functions as a generator, it shall not be possible for the electric device operating the brake to be fed by the driving motor.

5.4.2.3 Stopping / levelling accuracy

Under intended use:

- The stopping accuracy of the lifting platform shall be ± 10 mm.
- A re-levelling accuracy of ± 20 mm shall be maintained.
- Stopping distances shall be no greater than 20 mm in response to operation of an electric safety device.

5.4.3 Emergency/manual operation

An emergency control device shall be provided.

The maximum time to move the platform to the nearest landing where the door can be opened shall be 15 min.

This emergency operation shall only be possible by an authorised or competent person from a position outside the liftway but with full control of the movement.

Where emergency operation is achieved by means of a manually operated hand-winding device, an electric safety device shall provide protection against inadvertent operation of the normal controls when under emergency operation. Where the manual effort is greater than 30 N to overcome the release of the brake by emergency hand-winding, there shall be provided a means of releasing the brake. Controlled descent shall be possible under all circumstances.

Emergency operation on hydraulic lifts shall comply with 5.4.10.17.

Alternatively, a standby power supply or device may be used for operation. The standby power supply shall be capable of bringing the platform with maximum working load to a landing. An electric safety device shall provide protection against inadvertent operation of the normal controls when under emergency operation. When on emergency electrical operation, the following conditions shall be met:

Maximum speed not greater than 0,05 m/s.

- Hold to run platform controls;
- the following electric safety devices may be bridged:
 - slack rope device;
 - emergency stop;
 - safety gear electric safety device and over-speed governor electric safety device;
 - sensitive edges, photo cells or light curtains.

A label, indicating the direction of travel, in accordance with 7.3.1.6.2 shall be provided.

5.4.4 Additional requirements for rack and pinion drive

5.4.4.1 General

The platform shall be supported, raised and lowered by means of one or more pinions, meshing with the rack. The drive shall be by means of one or more motors.

Steps shall be taken to prevent the penetration of foreign bodies between each drive or safety pinion and geared rack.

5.4.4.2 Load distribution

When there is more than one drive pinion in mesh with the rack, then either a self-adjusting means shall be provided to effectively share the loading on each drive pinion or the drive system shall be so designed as to accommodate all normal conditions of load distribution between the pinions.

5.4.4.3 Pinion

The driving pinion shall be designed with a safety factor not less than 2 against the endurance limit for tooth strength. Each pinion shall possess a minimum safety factor of 1,4 against the endurance limit for pitting. The safety factors used in the design of any driving pinion shall be maintained, even after taking full account of the effects of dynamic loading, wear and fatigue likely to arise during the designed life of the driving pinion and associated components. Undercutting of the gear teeth shall be avoided. The pinion shall be fixed slip free and wear free to the output shaft in accordance with 5.4.1.3.

5.4.4.4 Rack

5.4.4.4.1 The racks shall be securely attached. Joints in the rack shall be accurately aligned to avoid faulty meshing or damage to teeth.

5.4.4.4.2 The rack shall be made of material having properties matching those of the pinion in terms of wear and shall be designed according to ISO 6336 (all parts), with regard to tooth strength and pitting. If the rack is subjected to a compressive load, a minimum factor of safety of 3 against buckling shall apply.

The rack shall possess a minimum safety factor of 2,0 against the static limit for tooth strength, taking into account the maximum wear as stated in the manufacturer's instruction handbook.

5.4.4.5 Rack/pinion engagement

5.4.4.5.1 Means shall be provided to maintain the rack and all the driving and safety device pinions in correct mesh under every load condition. Such means shall not rely upon the platform guide rollers or shoes.

The correct mesh shall be when the pitch circle diameter of the pinion is coincident with, or not more than 1/3 of the module beyond the pitch line of the rack.

5.4.4.5.2 Further means shall be provided to ensure that in the event of failure of the means provided in accordance with 5.4.4.5.1, the pitch circle diameter of the pinion shall never be more than 2/3 of the module out beyond the pitch line of the rack.

5.4.4.5.3 Means shall be provided to ensure that the width of the rack is always in full lateral engagement with pinion teeth of full form.

5.4.4.5.4 Further means shall be provided to ensure that in the event of failure of the means specified in 5.4.4.5.3, not less than 90 % of the width of the rack shall be in lateral engagement with pinion teeth of full form.

5.4.4.5.5 The pinion teeth and the rack teeth shall be square to each other in all planes, within a tolerance of $\pm 0,5^\circ$.

5.4.5 Additional requirements for rope and chain suspension drive

5.4.5.1 General

The following two methods of drive are permissible:

- a) use of a drum and ropes; or
- b) use of sprockets and chains.

5.4.5.2 Ropes and chains

5.4.5.2.1 Platforms and balancing weights shall be suspended from steel wire ropes, or steel chains with parallel links (Galle type) or roller chains.

5.4.5.2.2 The ropes shall correspond to the following requirements:

- a) the nominal diameter of the ropes shall be at least 6 mm;
- b) the other characteristics (construction, extension, ovality, flexibility, tests...) shall at least correspond to those specified in EN 12385-4.

5.4.5.2.3 Chains shall comply with the requirements of ISO 606.

5.4.5.2.4 The safety factor of the suspension ropes/chains shall be minimum; 12 for ropes and 10 for chains.

5.4.5.2.5 The minimum number of ropes/chains shall be two. Ropes/chains shall be independent.

5.4.5.3 Rope/chain terminations

5.4.5.3.1 The junction between the rope/chain and the termination shall be able to resist at least 80 % of the minimum breaking load of the rope/chain.

5.4.5.3.2 The ends of the ropes shall be fixed to the platform, balancing weight or suspension points by means according to EN 13411 (all parts), or any other system with equivalent safety.

5.4.5.4 Pulley, drum and sprocket

5.4.5.4.1 The ratio between the pitch diameter of pulleys or drums and the nominal diameter of the suspension ropes shall be at least 25, regardless of the number of strands.

5.4.5.4.2 The drum shall be helically grooved and the grooves shall be suited to the ropes used. There shall only be one layer of rope wound on the drum. When the platform rests on its fully compressed cushioned stops, one and a half turns of rope shall remain in the grooves of the drum. The angle of deflection (fleet angle) of the ropes in relation to the grooves shall not exceed 4 °.

5.4.5.4.3 All driving sprockets shall be made from metal and have a minimum of 16 machine-cut teeth. A minimum of 8 teeth shall be engaged. The minimum angle of engagement shall be 140 °.

5.4.5.4.4 Means shall be provided to avoid jamming owing to miss feeding or slackening of the chains and to prevent the chains from leaving the sprockets or riding over the teeth of the sprockets.

Guards shall be fitted to prevent trapping hazards between sprocket and chain or chain and any other part.

5.4.5.5 Distribution of load between the ropes or the chains

5.4.5.5.1 An automatic device shall be provided for equalizing the tension of suspension ropes or chains, at least at one of their ends.

5.4.5.5.2 For chains engaging with sprockets, the ends fixed to the platform as well as the ends fixed to the balancing weight shall be provided with such equalization devices.

5.4.5.5.3 For chains in the case of multiple return sprockets on the same shaft, these sprockets shall be able to rotate independently.

5.4.5.5.4 If springs are used to equalize the tension they shall work in compression.

5.4.6 Additional requirements for screw and nut drive

5.4.6.1 Precautions against free fall and descent with excessive speed of the platform

5.4.6.1.1 Devices, or combinations of devices and their actuation, according to Table 4, shall be provided to prevent the platform from:

- a) free fall; or
- b) descent with excessive speed.

Table 4 — Combinations of precautions against free fall of the platform and descent with excessive speed

FREE FALL	DESCENT WITH EXCESSIVE SPEED
Safety nut (5.4.6.1.4)	Stopping safety device according to 5.4.6.1.3 tripped by an over speed governor according to 5.3.2. OR Self-sustaining screw and nut system.

Other devices, or combinations of devices and their actuation, shall only be used if they give at least the same safety level as achieved by those of Table 4.

5.4.6.1.2 Self sustaining screw and nut system

The friction coefficient of a self sustaining screw and nut system shall be calculated to be not more than 0,06.

NOTE The figure above is based on a friction factor of 0,075 and with a safety factor of 1,25.

5.4.6.1.3 Stopping safety device

5.4.6.1.3.1 Introduction

When required by 5.4.6.1.1, the stopping safety device shall satisfy the following conditions:

5.4.6.1.3.2 General provisions

The stopping safety device shall operate only in the downward direction, and be capable of stopping the relative rotation between screw and nut with the platform carrying the maximum working load, at the tripping speed of the over speed governor and maintaining it stationary.

5.4.6.1.3.3 Conditions of use for different types of stopping safety device

Stopping safety devices shall be of the progressive type.

5.4.6.1.3.4 Methods of tripping

5.4.6.1.3.4.1 The tripping of stopping safety devices shall be by means according to 5.4.6.1.1.