SIST

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Varnostna pravila za konstruiranje in vgradnjo dvigal (liftov) - Posebne izvedbe osebnih in tovorno-osebnih dvigal - 77. del: Dvigala (lifti) za potresne razmere

Safety rules for the construction and installations of lifts - Particular applications for passenger and goods passenger lifts - Part 77: Lifts subject to seismic conditions

Sicherheitsregeln für Konstruktion und Einbau von Aufzügen - Besondere Anwendungen für Personen- und Lastenaufzüge - Teil 77: Aufzüge unter Erdbebenbedingungen

Règles de sécurité pour la construction et l'installation des élévateurs - Applications particulières pour les ascenseurs et les ascenseurs de charge - Partie 77: Ascenseurs soumis à des conditions sismiques

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European foreword

This document (EN 81-77:2018) 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of an identical text or by endorsement, at the latest by May 2019, and conflicting national standards shall be withdrawn at the latest by November 2020.

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

This document supersedes EN 81-77:2013.

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 EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

The main changes with respect to the previous edition (EN 81-77:2013) are as follows:

— updating of references and their associated requirements with regard to EN 81-20:2014;

— general editorial corrections since the last publication;

— replacement of the Annex ZA with regard to the commission mandate M/549/C(2016) 5844 Final and Directive 2014/33/EU;

— visual indication of seismic mode (chapter 5.10.3.8);

— replace mass P with PEC in proof of guide rails (Annex D).

This document is part of the EN 81 series of standards: “*Safety rules for the construction and installation of lifts*”.

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

0 Introduction

0.1 General

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

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

When provisions of this C standard are different from those which are stated in type A or 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.

0.2 General remarks

0.2.1 The object of this standard is to define additional safety rules related to passenger and goods lifts with a view to safeguarding persons and objects against the risks described below associated with the use, maintenance, inspection and emergency operation of lifts subject to seismic conditions.

0.2.2 The aim of this European Standard is to:

— avoid loss of life and reduce the extent of injuries;

— avoid people trapped in the lift;

— avoid damage;

— avoid environmental problems related to oil leakage;

— reduce the number of lifts out of service.

0.3 Principles

Risk analysis, terminology and technical solutions have been considered taking into account the methods of EN ISO 12100 and EN ISO 14798 standards.

0.4 Assumptions

It is assumed that negotiations have been made for each contract between the customer and the supplier/installer about the design acceleration (a_d) to be considered and the most effective position of the seismic detection system, if any, and of the primary wave detection system, if any. The building designer or the lift owner should provide the design acceleration (a_d) which will be documented in the information for the owner provided by the installer.

This European Standard covers only the effects of earthquakes on lifts and not the nature of them.

1 Scope

This document specifies the special provisions and safety rules for passenger and goods passenger lifts where these lifts are permanently installed in buildings that are in compliance with EN 1998-1 (Eurocode 8).

This document defines additional requirements to EN 81-20 and EN 81-50.

It applies to new passenger lifts and goods passenger lifts. However, it can be used as a basis to improve the safety of existing passenger and goods passenger lifts.

This document does not introduce any additional special provisions and safety rules for lifts which are in Seismic lift category 0 as defined in Annex A, Table A.1.

This document does not address other risks due to seismic events (e.g. fire, flood, explosion).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 81-20:2014, *Safety rules for the construction and installation of lifts - Lifts for the transport of persons and goods - Part 20: Passenger and goods passenger lifts*

EN 81-50:2014, *Safety rules for the construction and installation of lifts - Examinations and tests - Part 50: Design rules, calculations, examinations and tests of lift components*

EN 81-72:2015, *Safety rules for the construction and installation of lifts - Particular applications for passenger and goods passenger lifts - Part 72: Firefighters lifts*

EN 81-73:2016, *Safety rules for the construction and installation of lifts - Particular applications for passenger and goods passenger lifts - Part 73: Behaviour of lifts in the event of fire*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

ISO 7465:2007, *Passenger lifts and service lifts - Guide rails for lift cars and counterweights - T-type*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 81-20:2014 and EN 81-50:2014 and the following apply.

3.1
snag point
point of interference between flexible elements and fixed

Note 1 to entry: Examples of flexible elements are ropes, chains, travelling cable.

Note 2 to entry: Examples of fixed elements are guide rail brackets, guide rail clip bolts, fishplates, vanes, and similar devices.

3.2
design acceleration
a_d
horizontal acceleration to be used for calculation of forces – moments acting on lift systems and arising from seismic events

Note 1 to entry: See Annex B.

3.3
seismic lift categories
categories in which lifts have been divided, taking into account the design acceleration (a_d)

Note 1 to entry: Table A.1 shows the seismic lift categories.

3.4
primary wave
compressional wave that is longitudinal in nature

Note 1 to entry: Earthquake advance warning is possible by detecting the non-destructive primary waves that travel more quickly through the Earth's crust than do the destructive secondary waves. The amount of advance warning depends on the delay between the arrival of the primary wave and other destructive waves, generally in the order of seconds for distant, large quakes.

3.5
secondary wave
shear wave that is transverse in nature, its motion being perpendicular to the direction of wave propagation

Note 1 to entry: Secondary waves move through solids, unlike surface waves. They are destructive and arrive later than primary waves.

3.6
seismic trigger level
seismic acceleration which activates a seismic detection system

3.7
seismic mode
special mode in which the lift operates after detection of seismic trigger level

3.8
seismic stand-by mode
special mode in which the lift operates after detection of primary wave without the activation of the seismic detection system

3.9
normal operation
operation mode in which the lift operates when not in seismic mode or in seismic stand-by mode

3.10
retaining device
mechanical device securely fixed to a structural member of the lift car, counterweight or balancing weight frame, designed to retain the lift car and counterweight (balancing weight) within its guide rails during seismic activity

3.11
expansion joint
assembly designed to safely absorb the heat-induced expansion and contraction of various construction materials, to absorb vibration, or to allow movement due to ground settlement or earthquakes

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 (see Table 1).

Table 1 — List of significant hazards

No	Hazards as listed in EN ISO 12100:2010, Annex B	Relevant clauses
1	Acceleration, deceleration	5.4.1, 5.5, 5.8.2
	Angular parts	5.2
	Approach of a moving element to a fixed part	5.4.2, 5.5
	Machinery mobility	5.3, 5.9
	Moving elements	5.4.1, 5.4.3
	Rotating element	5.6.1, 5.6.2, 5.9
2	Failure of the power supply	5.10.2, 5.10.3.5
8	Human behaviour	Clause 6, Clause 7
9	Pollution	5.7, 5.9
	Failure of the control circuit	5.10.3.4, 5.10.3.5

5 Safety requirements and/or protective measures

5.1 General

Passenger and goods passenger lifts shall comply with the safety requirements and/or protective measures of the following clauses when the lifts are subject to seismic conditions. In addition, passenger and goods passenger lifts shall be designed according to the principles of EN ISO 12100 for hazards relevant but not significant that are not dealt with by this document.

If not differently specified, the following requirements apply to Seismic lift category 1, 2 and 3.

5.2 Lift well

In order to prevent that suspension ropes, overspeed governor ropes, travelling cables, compensation ropes and chains, swaying in the well get entangled with fixed equipment, snag points created by brackets, sills, devices and other equipment mounted in the well shall be protected according to Table 2.

Table 2 — Protection of snag points

Height of the well	Horizontal distance between snag points and lift parts	Lift parts	Protective measures	Remarks
≤ 20 m			Not necessary	
> 20 m ≤ 60 m	< 900 mm	Travelling cables	Install protection measures for example a protection wire in the corner of the rail bracket or other snag points near the travelling cables	Required if any portion of the loop is smaller than 900 mm from a snag point
	< 750 mm	Compensating Chain(s) Compensating rope(s) Counterweight overspeed governor rope	Install protection measures for example a protection wire in the corner of the rail bracket or other snag points	Full travel
	< 500 mm	Car overspeed governor rope	Install protection measures for example a protection wire in the corner of the rail bracket or other snag points	Full travel
	< 300 mm	Suspension ropes	Install protection measures for example a protection wire in the corner of the rail bracket or other snag points	Full travel
> 60 m	Protect all snag points independently from horizontal distance	Travelling cables Compensating Chain(s) Compensating rope(s) Counterweight overspeed governor rope Car overspeed governor rope Suspension ropes	Install protection measures for example a protection wire in the corner of the rail bracket or other snag points	Full travel

5.3 Machinery and pulley spaces

Where buildings are designed with expansion joints subdividing the structure into dynamically independent units, all the lift machinery including the landing entrances and the well of the lift shall be located on the same side of an expansion joint (see EN 81-20:2014, 0.4.2).

5.4 Car

5.4.1 Mass of the car for lift design calculations

For lift design calculations, the forces generated by the design acceleration (a_d) shall be calculated taking into account:

— for passenger lifts, the mass of the car plus 40 % of the rated load evenly distributed;

— for goods passenger lifts, the mass of the car plus 80 % of the rated load evenly distributed.

5.4.2 Car retaining devices

For lifts in lift categories 2 and 3, the car frame shall be provided with upper and lower retaining devices able to hold the car frame on its guide rails.

The retaining devices shall be placed in such a way to distribute loads in a similar way as the guide shoes. The retaining devices shall either be integrated or mounted close to the fixing of the guide shoes.

When the car is centre located between the guide rails, the clearances d_1, d_2 and d_3 (Figure 1 a)) between the retaining device and the guide rail shall not exceed 5 mm and the dimensions chosen shall not cause accidental tripping of the safety gear during an earthquake.

The depth of the retaining device (z_1) shall be limited to avoid collision with guide rail attachments or other fixed devices, but long enough to guarantee a minimum overlapping length between retaining devices and the guide rail blade during an earthquake. The required depth of the retaining devices is also correlated with the type of guide rail through the allowable deflection of the guide rail (see 5.8.2).

During an earthquake, the minimum overlapping length (z_3) between retaining devices and the guide rail blade shall be at least 5 mm (Figure 1 b)).

The car structure and retaining devices shall withstand the loads and forces imposed on them including forces generated by the design acceleration (a_d), without permanent deformation.