



SLOVENSKI STANDARD
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Varnostna pravila za konstruiranje in vgradnjo dvigal (liftov) - 7. del: Dvigala z zobnikom in zobato letvijo

Safety rules for the construction and installation of lifts - Part 7: Rack and pinion lifts

Sicherheitsregeln für die Konstruktion und den Einbau von Aufzügen - Teil 7: Zahnstangenaufzüge

Règles de sécurité pour la construction et l'installation des ascenseurs - Partie 7: Ascenseurs à pignon et crémaillère

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EUROPEAN STANDARD
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ICS

English Version

Safety rules for the construction and installation of lifts - Part 7: Rack and pinion lifts

Règles de sécurité pour la construction et l'installation des ascenseurs - Partie 7: Ascenseurs à pignon et crémaillère

Sicherheitsregeln für die Konstruktion und den Einbau von Aufzügen - Teil 7: Zahnstangenaufzüge

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 10.

If this draft becomes a European Standard, 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.

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Foreword

This document (prEN 81-7:2009) has been prepared by Technical Committee CEN/TC 10 “Lifts, escalators and moving walks”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

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.

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

This standard covers the necessary additional precautions by replacing the relevant existing text of EN 81-1:1998 or adding new clauses as indicated.

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Introduction

Clauses **0.1 - 0.3.15** in EN 81-1:1998 apply except that **0.3.10** and **0.3.15** shall read as follows:

0.3.10 With the exception of the items listed below, a mechanical device built according to good practice and the requirements of the standard will not deteriorate to a point of creating hazard without the possibility of detection.

The following mechanical failures are considered:

- a) breakage and slackening of all linkage by auxiliary ropes,
- b) failure of one of the mechanical components for the electromechanical brake which take part in the application of the braking action on the drum or disk,
- c) failure of a component associated with the main drive elements and the pinion gear.

0.3.15 To ensure the correct functioning of the equipment in the machinery space(s), i.e. taking into account the heat dissipated by the equipment, the ambient temperature in the machinery space(s) is assumed to be maintained between + 5° C and 40° C.

0.3.16 The following clause is added:

The fixing system of guards, which have to be removed during maintenance and inspection, remains attached to the guard or to the equipment, when the guard is removed.

0.3.17 The following clause is added:

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Access ways to the working areas are adequately lit (see **0.2.5** in EN 81-1:1998).

0.3.18 The following clause is added: <https://standards.iteh.ai/catalog/standards/sist/fdef1013-bbc9-4b2c-a527-1c7325be3660/osist-pren-81-7-2009>

Minimum passageways required by building regulations are not obstructed by the open door/trap of the lift and/or any protection means for working areas outside of the well, where fitted according to the maintenance instructions (see **0.2.5**).

0.3.19 The following clause is added:

Where more than one person is working at the same time on a lift, an adequate means of communication between these persons is ensured.

1 Scope

1.1 This standard specifies the safety rules for the construction and installation of permanently installed new rack and pinion lifts with the drive unit attached to the car serving defined landing levels, having a car designed for the transportation of persons or persons and goods supported by rack and pinion and moving between guide rails inclined not more than 15° to the vertical. The maximum rated speed is 2 m/s.

1.2 In addition to the requirements of this standard supplementary requirements shall be considered in special cases (potentially explosive atmosphere, extreme climate conditions, seismic conditions, transporting dangerous goods, etc.)

1.3 This standard does not cover:

- a) lifts with drives other than those stated in **1.1**;
- b) installation of rack and pinion lifts in existing buildings¹ to the extent that space does not permit;
- c) important modifications (see annex E) to a lift installed before this standard is brought into application, and
- d) lifting appliances, such as paternosters, mine lifts, theatrical lifts, appliances with automatic caging, skips, lifts and hoists for building and public works sites, ships hoists, platforms for exploration or drilling at sea, construction and maintenance appliances;
- e) installations where the inclination of the guide rails to the vertical exceeds 15°;
- f) safety during transport, installation, repairs, and dismantling of lifts;
- g) lifts with rated speed $\leq 0,15$ m/s.

NOTE Exclusion mentioned under g) bases on the Machinery Directive 2006/42/EC

Noise and vibrations are not dealt within this standard because these are not relevant to the safe use of the lift.

However, this standard may usefully be taken as a basis.

1.4 This standard does not specify the additional requirements necessary for the use of lifts in case of fire.

2 Normative references

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

The normative references of EN 81-1:1998 apply with the following additions:

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

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)*

¹ Existing building is a building which is used or was already used before the order for the lift was placed. A building whose internal structure is completely renewed is considered as a new building.

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ISO 6336-1:2006, *Calculation of load capacity of spur and helical gears - Part 1: Basic principles, introduction and general influence factors.*

ISO 6336-2:2006, *Calculation of load capacity of spur and helical gears - Part 2: Calculation of surface durability (pitting).*

ISO 6336-3:2006, *Calculation of load capacity of spur and helical gears - Part 3: Calculation of tooth bending strength.*

ISO 6336-5:2003, *Calculation of load capacity of spur and helical gears - Part 5: Strength and quality of materials.*

3 Terms and definitions**3.1 Definitions**

For the purposes of this European Standard, the applicable definitions in EN 81-1:1998 section 3 apply with the following deviations and additions.

3.1.1**machinery (machinerie) (Triebwerk und Steuerung)**

cabinet (s) for control and drive system, drive unit, main switch(es) and means for emergency operations

3.1.2**machinery space (emplacement des machines) (Antriebsbereich)**

space(s) inside or outside the well where the machinery as a whole or in parts is placed

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3.1.3**pulley space (emplacement de poulies) (Aufstellungsort von Seilrollen)**

space(s) inside or outside of the well where pulleys are placed

3.1.4**rack and pinion lift (ascenseurs à pignon et crémaillere) (Zahnstangenaufzüge)**

lift in which the movement of the car is achieved by meshing of the pinion, moving by rotation on a fixed rack

3.1.5**rack and pinion safety gear (parachute à pignon et crémaillere) (Zahnstangenfangvorrichtung)**

a safety gear developing a force on the rack to provide a gradual stop of the car

3.2 Units and symbols

The requirements of EN 81-1:1998 section 4 apply.

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 14121-1:2007. Also shown are the subclause references to the safety requirements and/or protective measures in this standard. Before using this standard it is important to carry out a risk assessment of lifts to check that it has the hazards identified in this clause.

Table 1.1 – Additional hazards relating to this standard regarding the general design and construction of lifts for persons and materials

	Hazards	Relevant clauses in this standard
1	Mechanical hazards	
1.1	Crushing	
1.2	Shearing	
1.3	Cutting or severing	5.8.4, 5.8.10, 5.10.2
1.4	Entanglement	5.8.10
1.5	Drawing-in or trapping	5.8.5, 5.10.4
1.6	Impact	5.6.3, F.8
1.7	Stabbing or puncture	See 1.1 – 1.3
1.8	Friction or abrasion	See 1.1 – 1.3
1.9	High pressure fluid ejection	N/A
1.10	Ejection of parts	N/A
1.11	Loss of stability	5.6.1
1.12	Slip, trip and fall	
2	Electrical hazards	
2.1	Electrical contact	5.9, 5.10
2.2	Electrostatic phenomena	N/A
2.3	Thermal radiation	N/A
2.4	External influences	5.9.1
3	Thermal hazards	
3.1	Burns and scalds	
3.2	Health-damaging effects	N/A
4	Hazards generated by noise	
4.1	Hearing losses	
4.2	Interference with speech	
5	Hazards generated by vibration	
6	Hazards generated by radiation	
6.1	Electrical arcs	N/A
6.2	Lasers	N/A
6.3	Ionising radiation sources	N/A
6.4	Use of H F electromagnetic fields	N/A
7	Hazards generated by materials and substances processed, used or exhausted by machinery	
7.1	Contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	
7.2	Fire or explosion	
7.3	Biological and microbiological	N/A
8	Hazards generated by neglecting ergonomic principles in machine design	
8.1	Unhealthy postures or excessive effort	5.2.3
8.2	Inadequate consideration of human hand/arm or foot/leg anatomy	
8.3	Neglected use of personal protection equipment	
8.4	Inadequate area lighting	5.2.3.7, 5.9.6
8.5	Mental overload or underload, stress	5.2.4, 5.10.4
8.6	Human error	
9	Hazard combinations	5.6.3, 5.10.3
10	Hazards caused by failure of energy supply, breaking down of machinery parts and other functional disorders	
10.1	Failure of energy supply	5.8.4, 5.10.4
10.2	Unexpected ejection of machine parts or fluids	5.8.10
10.3	Failure or malfunction of control system	
10.4	Errors of fitting	Annex D Annex E
10.5	Overturn, unexpected loss of machine stability	See 1.11

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	Hazards	Relevant clauses in this standard
11	Hazards caused by missing and / or incorrectly positioned safety related measures / means	
11.1	Guards	See 1.1 – 1.5
11.2	Safety related (protection) devices	Annex E.1
11.3	Starting and stopping devices	5.10
11.4	Safety signs and signals	7.1
11.5	Information or warning devices	
11.6	Energy supply disconnecting devices	
11.7	Emergency devices	
11.8	Feeding/removal means of work pieces	
11.9	Essential equipment and accessories for safe adjusting and/or maintaining	
11.10	Equipment evacuating gases	

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Table 1.2 – Additional hazards relating to this standard regarding the particular hazards involving the mobility and/or load lifting ability of lifts for persons and materials

	Hazards	Relevant clauses in this standard
	Hazards due to mobility	
12	Inadequate lighting of moving / working area	See 8.4
13	Hazards due to sudden movement instability etc. during handling	
14	Inadequate/non-ergonomic design of operating position	See 8.2
15	Mechanical hazards	See 1
16	Hazards due to lifting operations	
16.1	Lack of stability	See 1.11
16.2	Derailment of the cage	
16.3	Loss of mechanical strength of machinery and lifting accessories	
16.4	Hazards caused by uncontrolled movement	5.5.6, 5.5.7
17	Inadequate view of trajectories of the moving parts	
18	Hazards caused by lightning	
19	Hazards due to loading / overloading	

Table 1.3 – Additional hazards relating to this standard regarding the particular hazards involving the lifting of persons by lifts for persons and materials

	Hazards to persons lifted by the lift	Relevant clauses in this standard
20	Overloading or overcrowding of the cage	
21	Unexpected movement of the cage in response to external controls or other movements of the machine	5.2.3.3
22	Excess speed	5.5.6, 5.5.7
23	Persons falling from the cage	
24	The cage falling or overturning	See 1.11 and 16.2
25	Excess acceleration or braking of the cage	5.5.6, 5.5.10
26	Due to imprecise markings	7

5 Safety requirements and for protective measures

5.1 Lift well

The requirements of EN 81-1:1998 section 5 apply.

5.2 Machinery and pulley spaces

5.2.1 General provisions

Machinery and pulleys shall be located in machinery and pulley spaces. These spaces and the associated working areas shall be accessible. Provisions shall be made to allow access to the spaces only to authorised persons (maintenance, inspection and rescue). The spaces and the associated areas shall be suitably protected against environmental influences to be taken into consideration and provisions made for suitable areas for maintenance/inspection work and emergency operation. See EN 81-1:1998, clauses **0.2.2**, **0.2.5** and **0.3.3**.

prEN 81-7:2009 (E)**5.2.2 Access**

5.2.2.1 The access way adjacent to any door/trap giving access to machinery and pulley spaces shall be:

- a) capable of being properly lit by a permanent electric light fixture(s) ;
- b) easy to use in complete safety in all circumstances without necessitating entry into private premises.

5.2.2.2 A safe access for persons to machinery and pulley spaces shall be provided. For preference this should be effected entirely by way of stairs. If it is not possible to install stairs, ladders satisfying the following requirements shall be used:

- a) the access to the machinery and pulley spaces shall not be situated more than 4 m above the level accessible by stairs;
- b) ladders shall be fastened to the access in such a way that they cannot be removed;
- c) ladders exceeding 1,50 m in height shall, when in position for access, form an angle between 65° and 75° to the horizontal and shall not be liable to slip or turn over;
- d) the clear width of the ladder shall be at least 0,35 m, the depth of the steps shall not be less than 25 mm and in the case of vertical ladders the distance between the steps and the wall behind the ladder shall not be less than 0,15 m. The steps shall be designed for a load of 1500 N;
- e) adjacent to the top end of the ladder there shall be at least one hand hold within easy reach;
- f) around a ladder, within a horizontal distance of 1,50 m, the risk of falling by more than the height of the ladder shall be prevented.

5.2.2.3 Access to machinery on the car roof or in the car

- a) A safe access for persons to machinery spaces shall be provided. For preference this should be effected by bringing the car roof or floor in level with a landing using the device for test and emergency operation.

5.2.3 Machinery inside the well**5.2.3.1 General provisions**

5.2.3.1.1 Machinery supports and working areas in inside the well shall be so constructed to withstand the loads and forces to which they are intended to be subjected.

5.2.3.1.2 In the case of wells partially enclosed at the exterior of buildings the machinery shall be suitably protected against the environmental influences to be taken into consideration.

5.2.3.1.3 The clear height for moving inside the well from one working area to another one shall not be less than 1,80 m.

5.2.3.2 Dimensions of working areas inside the well

5.2.3.2.1 The dimensions of working areas inside the well shall be sufficient to permit easy and safe working on equipment.

In particular there shall be provided at least a clear height of 2 m at working areas, and:

- a) a clear horizontal working area of at least 0,50 m x 0,60 m for maintenance and inspection of parts at points where this is necessary;
- b) a clear horizontal space in front of control panels and cabinets. This area is defined as follows:
 - 1) depth, measured from the external surface of the enclosures, at least 0,70 m ;

- 2) width, the greater of the following values : 0,50 m or the full width of the cabinet or panel ;

5.2.3.2.2 There shall be a clear vertical distance of at least 0,30 m above unprotected rotating parts of the machine. If the distance is less than 0,30 m guarding shall be provided according to 5.5.8.1 a).

See also **5.7.1.1** or **5.7.2.2** in EN 81-1:1998

5.2.3.3 Working areas in the car or on the car roof

5.2.3.3.1 Where maintenance/inspection work on the machinery is to be carried out from inside the car or from the car roof and if any kind of uncontrolled or unexpected car movement resulting from maintenance/inspection can be dangerous to persons, the following applies:

- a) any dangerous movement of the car shall be prevented by a mechanical device;
- b) all movement of the car shall be prevented by means of an electric safety device in conformity with **14.1.2** in EN 81-1:1998 unless the mechanical device is in its inactive position;
- c) when this device is in its active position, it shall be possible to carry out maintenance work and to leave the working area safely.

5.2.3.3.2 The necessary devices for emergency operation and for dynamic tests (such as brake tests, safety gear tests or buffer tests) shall be arranged so that they can be carried out from outside of the well in accordance with **5.2.4**

5.2.3.3.3 If inspection doors and/or traps are located in the walls of the car, they shall:

- a) have a sufficient dimensions to carry out the required work through the door/trap;
- b) be as small as possible to avoid falling into the well;
- c) not open towards the outside of the car; [oSIST prEN 81-7:2009](https://standards.iteh.ai/catalog/standards/sist/fdef1013-bbc9-4b2c-a527-c255b866e319/en-81-7:2009)
- d) be provided with a key-operated lock, capable of being reclosed and relocked without a key;
- e) be provided with an electrical safety device in conformity with **14.1.2**, in EN81-1:1998, checking the locked position;
- f) be imperforate and satisfy the same requirements for mechanical strength as the walls of the car.

5.2.3.4 Working areas outside of the well

When the machinery is in the well and is intended to be maintained/inspected from outside of the well, deviating from **5.2.1**, the working areas in accordance with **6.3.3.1** and **6.3.3.2** in EN 81-1:1998 can be provided outside of the well. Access to this equipment shall only be possible by a door/trap in conformity with **5.2.3.5.2**.

5.2.3.5 Doors and traps

5.2.3.5.1 Working areas inside the well shall be accessible through doors in the well enclosure. Doors shall be either the landing doors or doors satisfying the following requirements. They shall:

- a) have a minimum width of 0,60 m and a minimum height of 1,80 m ;
- b) not open towards the inside of the well ;
- c) be provided with a key-operated lock, capable of being reclosed and relocked without a key ;
- d) be capable of being opened from inside the well without a key, even when locked ;
- e) be provided with an electrical safety device in conformity with **14.1.2** in EN 81-1:1998, checking the closed position ;