



SLOVENSKI STANDARD
SIST EN 14439:2007

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Dvigala (žerjavi) – Varnost – Stolpna dvigala

Cranes - Safety - Tower cranes

Krane - Sicherheit - Turmdrehkrane

Appareils de levage a charge suspendue - Sécurité - Grues a tour

Ta slovenski standard je istoveten z: EN 14439:2006

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53.020.20 Dvigala

Cranes

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English Version

Cranes - Safety - Tower cranes

Appareils de levage à charge suspendue - Sécurité - Grues
à tour

Krane - Sicherheit - Turmdrehkrane

This European Standard was approved by CEN on 21 October 2006.

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

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

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Foreword

This document (EN 14439:2006) has been prepared by Technical Committee CEN/TC 147 “Cranes - Safety”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by June 2007, and conflicting national standards shall be withdrawn at the latest by June 2007

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.

To select a suitable set of crane standards for a given application see Annex G.

NOTE Some of the standards listed are in preparation.

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

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Introduction

This European Standard is a harmonised European Standard to provide one means for tower cranes to conform with the relevant Essential Health and Safety Requirements of the Machinery Directive 98/37/EC modified.

This European Standard is a type C standard as stated in EN ISO 12100-1:2003.

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

When provisions of this type 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 cranes that have been designed and built according to the provisions of this type C standard.

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1 Scope

This European Standard specifies safety requirements for tower cranes.

This European Standard applies to tower cranes for construction work, which are either erected by parts or self erecting cranes.

This European Standard is not applicable to mobile cranes, mobile harbour cranes, crawler cranes, slewing jib cranes, bridge and gantry cranes, offshore cranes, floating cranes, loader cranes, hand operated cranes or railway cranes.

This European Standard deals with all significant hazards, hazardous situations and events relevant to tower cranes, when used as intended and under conditions foreseen by the manufacturer. This European Standard specifies the appropriate technical measures to eliminate or reduce risks arising from the significant hazards (see Clause 4).

The significant hazards covered by this European Standard are identified in Clause 4.

This European Standard does not cover hazards related to:

- the lifting of persons by the tower crane itself;
- the climbing system.

The requirements related to Electromagnetic compatibility (EMC), the specific hazards due to external influence on electrical equipment, potentially explosive atmospheres and ionising radiation are not covered by this European Standard.

This European Standard is not applicable to tower cranes which are manufactured before the date of publication by CEN of this European Standard.

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 954-1:1996, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

EN 12077-2:1998, *Cranes safety — Requirements for health and safety — Part 2: Limiting and indicating devices*

EN 12644-1:2001, *Cranes — Information for use and testing — Part 1: Instructions*

EN 13135-1:2003, *Cranes — Safety — Design — Requirements for equipment — Part 1: Electrotechnical equipment*

EN 13135-2:2004, *Cranes — Equipment — Part 2: Non-electrotechnical equipment*

EN 13557:2003, *Cranes — Controls and control stations*

EN 13586:2004, *Cranes — Access*

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EN 60204-32, *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines (IEC 60204-32:1998)*

EN ISO 3744:1995, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane (ISO 3744:1994)*

EN ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 11201:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane (ISO 11201:1995)*

EN ISO 11203, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level (ISO 11203:1995)*

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)*

ISO 3864 (all parts), *Graphical symbols — Safety colours and safety signs*

ISO 4306-1:1990, *Cranes — Vocabulary — Part 1: General*

ISO 4306-3:2003, *Cranes — Vocabulary — Part 3: Tower cranes*

ISO 7752-3, *Cranes — Controls — Layout and characteristics — Part 3: Tower cranes*

ISO 8566-3, *Cranes — Cabins — Part 3: Tower cranes*

ISO 13200, *Cranes — Safety signs and hazard pictorials — General principles*

DIN 15018-1, *Cranes — Steel structures — Verification and analyses*

DIN 15018-2, *Cranes — Steel structures — Principles of design and construction*

DIN 15019-1, *Cranes — Stability for all cranes except non-rail mounted mobile cranes and except floating cranes*

FEM 1.001 (all parts), *Rules for the design of hoisting appliances*

FEM 1.003:1995, *Tower cranes — Graphical symbols*

FEM 1.005:2003, *Recommendation for the calculation of tower crane structures in out-of service conditions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100-1:2003, ISO 4306-1:1990 and ISO 4306-3:2003 and the following apply.

NOTE Definitions are in alphabetical order for the English version only.

3.1 rated capacity

load, having mass m_{NL} , which is lifted by the crane and suspended from the fixed load-lifting attachment(s). Mass m_{NL} is the sum of the pay load m_{PL} and the non-fixed load-lifting attachment(s) m_{NA} :

$$m_{NL} = m_{PL} + m_{NA}$$

The maximum net load that the crane is designed to lift for a given crane configuration and load location during normal operation.

3.2 tower crane

slewing jib crane with the jib located at the top of a tower which stays approximately vertical in the working position. This power-driven appliance is equipped with means for raising and lowering suspended loads and for the movement of such loads by changing the radius, slewing and/or travelling of the complete appliance.

NOTE 1 Certain appliances perform several, but not necessarily all of these movements.

NOTE 2 The appliance can be installed in a fixed position or equipped with means for displacement or climbing.

4 List of significant hazards

Table 1 contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this European Standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk. It also contains the corresponding cross-references to EN ISO 12100, and the relevant clauses in this European Standard that are necessary to reduce or eliminate the risks associated with those hazards.

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Table 1 — List of significant hazards and associated requirements

N°	Hazards	Relevant clause(s) in this European Standard
Hazards, hazardous situations and hazardous event		
1	Mechanical hazards due to machine parts or workpieces, e.g.	
	– Shape	5.4.1
	– Inadequacy of mechanical strength	5.2, 5.3.2
1.1	Crushing hazard	5.4.3, 5.4.4, 5.4.4.2
1.2	Shearing hazard	5.4.3
1.3	Cutting or severing hazard	5.4.3
1.4	Entanglement hazard	5.4.3, 5.4.3.1
1.5	Drawing-in or trapping hazard	5.4.3
1.6	Impact hazard	5.4.2, 5.4.1.8, 5.4.2.9, 5.4.3
1.9	High pressure fluid injection or ejection hazard (on cranes with hydraulic)	5.3.2
2	Electrical hazards due to:	
2.1	Contact of persons with live parts (direct contact)	5.3.1
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	5.3.1

N°	Hazards	Relevant clause(s) in this European Standard
2.3	Approach to live parts under high voltage	5.3.1
3	Thermal hazards , resulting in:	
3.1	Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by the radiation of heat sources	5.4.1
3.2	Damage to health by hot or cold working environment	5.4.1, 5.4.1.8
4	Hazards generated by noise	5.5, 7.2.5, Annex E
4.1	Hearing loss	5.5, 7.2.5, Annex E
4.2	Interference with speech communication	5.5, 7.2.5, Annex E
7	Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery	
7.2	Fire or explosion hazard	5.4.1
8	Hazards generated by neglecting ergonomic principles in machinery design as, e.g. hazards from:	
8.1	Unhealthy postures or excessive effort	5.4.4.4
8.2	Inadequate consideration of hand-arm foot-leg anatomy	5.4.1, 5.4.1.4
8.3	Neglected use of personal protection equipment	5.4.4, 5.4.4.5.1
8.4	Inadequate local lighting	5.4.1, 5.4.5
8.6	Human error, human behaviour	5.4.1, 5.4.1.2, 5.4.1.3, 5.4.2.5.1, 5.4.2.5.2, 5.4.2.6, 5.4.6
8.7	Inadequate design, location or identification of manual controls	5.4.1, 5.4.1.4
8.8	Inadequate design or location of visual display unit	5.4.1, 5.4.1.2
10	Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from:	
10.1	Failure/Disorder of the control system	5.4.1, 5.4.1.9, 5.4.2, 5.4.2.2
10.4	Other external influences (gravity, wind, etc)	5.2.1, 5.4.2.6, 5.4.2.10, 7.2.6
10.5	Errors in software	5.3.1
10.6	Errors made by the operator (due to mismatch of machinery with human characteristics and abilities)	5.4.1, 5.4.1.2, 5.4.1.3, 5.4.2.5.1, 5.4.2.5.2, 5.4.2.6, 5.4.6
13	Failure of the power supply	5.3.1
14	Failure of the control circuit	5.3.1
16	Break-up during operation	5.2, 5.3.2, 5.4.2.8, 5.4.3.2
17	Falling or ejected objects or fluids	5.4.3.2
18	Loss of stability/overtipping of machinery	5.2, 5.4.2, 5.4.2.3, 5.4.2.4, 5.4.2.7, 5.4.2.8
19	Slip, trip and fall of persons (related to machinery)	5.4.4, 5.4.4.3, 5.4.4.5
Additional hazards, hazardous situations and hazardous event due to mobility		
21	Linked to the work position (including driving station) on the machine	

N°	Hazards	Relevant clause(s) in this European Standard
21.1	Fall of persons during access to (or at/from) the work position	5.4.4, 5.4.4.3
21.3	Fire (flammability of cab, lack of extinguishing means)	5.4.1
21.4	Mechanical hazards at the work position: d) Break-up of parts rotating at high speed	5.4.3.1, 5.4.3.2, 5.4.4.2
21.5	Insufficient visibility from the work positions	5.4.1, 5.4.1.5
21.6	Inadequate lighting	5.4.1
21.7	Inadequate seating	5.4.1
21.8	Noise at the work position	5.5, 7.2.5
21.10	Insufficient means for evacuation/emergency exit	5.4.1, 5.4.4
22	Due to the control system	
22.1	Inadequate location of manual controls	5.3.1, 5.4.1, 5.4.1.3
22.2	Inadequate design of manual controls and their mode of operation	5.3.1, 5.4.1, 5.4.1.2
23	From handling of the Machine (lack of stability)	7.2, 7.2.4
25	From/to third persons	
25.2	Drift of part away from its stopping position	5.3.1, 5.3.2, 5.4.2
25.3	Lack or inadequacy of visual or acoustic warning means	7.3.2, 5.4.6
Additional hazards, hazardous situations and hazardous event due to lifting		
27	Mechanical hazard and hazardous events	
27.1	From load falls, collisions machine tipping caused by:	
27.1.1	Lack of stability	5.2
27.1.4	Unexpected/unintended movement of the load	5.3.1, 5.3.2, 5.4.2
27.1.6	Collision of more the one machine	5.4.2.8
27.2	From access of persons to load support	7.2.6
27.3	From derailment	5.3.2
27.4	From insufficient mechanical strength of parts	5.2, 5.3.2
27.5	From inadequate design of pulleys, drums	5.3.2
27.6	From inadequate selection of chains, ropes lifting and accessories and their inadequate integration into the machine	5.3.2.3
27.7	From lowering of load under control of friction brake	5.3.2
27.8	From abnormal conditions of assembly/testing/use/maintenance	6.3
28	Electrical hazards	
28.1	From lightning	5.3.1
29	Hazards generated by neglecting ergonomic principles	
29.1	Insufficient visibility from the driving position	5.4.1, 5.4.1.5

5 Safety requirements and/or protective measures

5.1 General

Tower cranes shall conform with the safety requirements and/or protective measures of this clause. In addition, the tower crane shall be designed according to the principles of EN ISO 12100 for hazards relevant but not significant, which are not dealt with by this European Standard.

5.2 Design requirements on the load bearing structure

5.2.1 General

Calculation (proof of strength and stability proof) shall be done using:

- the current standards (FEM 1.001 or DIN 15018-1, DIN 15018-2 and DIN 15019-1);
- Annex A for stability during erection or dismantling;
- FEM 1.005 for out of service stability.

NOTE EN 13001 can be used on trial. When the complete set of EN 13001 will be published and experience is available then WGP2 will revise EN 14439 to introduce its reference including the necessary adaptation for tower cranes.

5.2.2 Load effects

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5.2.2.1 Load effects acting on tower crane during the crane's life may be determined by calculation or by experiment and shall reflect realistic unfavourable operating conditions and sequences of actions by the crane driver.

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5.2.2.2 The loads, moments (bending and/or torsion) etc. may be derived from a rigid body kinetic model of the crane and the load models.

NOTE 1 Whilst the resulting variations of rotation or travel speeds are in relative good conformity with reality, the variations and instantaneous values of accelerations and resulting inner forces represent only mean values of the real process. For this reason sudden alterations of this mean values have to be amplified by dynamic factors to estimate the real values, corresponding to the data as defined under standards given in 5.2.1.

NOTE 2 Structural deformations are to be allowed for if they result in significant increases in stresses. Calculations shall be based on the assumption of a deformed system in a state of equilibrium (second order theory). The calculation may be made with an appropriate and recognised method e.g. FEM 1.001:1998, 3.5 and 9.11.

5.2.2.3 The group classification of a tower crane shall be in accordance with FEM 1.001, booklet 2:

- crane at least A3;
- jib at least E2.

When calculation is done using other standards (see 5.2.1), an equivalent classification is required.

5.2.2.4 Wind forces shall be determined with an appropriate and recognised method e.g. F.E.M. 1.001.

5.2.2.5 For travel gears of tower cranes, a verification of the energy absorption capacity of the buffers and of the effect of the buffer forces on the supporting structure may be dispensed with, on condition that the rated travelling speed is less than 40 m/min and that limit switches are installed in addition to buffer stops.

5.3 Design requirements for equipment

5.3.1 Electrotechnical equipment

The design requirements for electrotechnical equipment shall conform to EN 60204-32 and EN 13135-1.

5.3.2 Non-electrotechnical equipment: Design and selection of components and equipment

5.3.2.1 General

The design requirements for non-electrotechnical equipment shall conform to EN 13135-2.

5.3.2.2 Mechanisms

The mechanism group classifications in accordance with FEM 1.001:1998, booklet 2, Table T.2.1.3.4 shall be at least:

- hoisting winch or luffing gear M4;
- slewing gear M5;
- trolley travelling mechanism M3;
- travelling gear M3;

NOTE The mechanism used to change occasionally the position of the crane may be defined in group M2.

- Auxiliary winch only used for mounting and maintenance operations M1.

The mechanisms shall be calculated in accordance with FEM 1.001, booklet 4.

5.3.2.3 Ropes

Selection and calculation of running and stationary ropes shall be carried out from the maximum tensile force in the rope in accordance with FEM 1.001, booklet 4. The influences of dynamic effects and friction losses have to be considered.

The mechanism group classification in accordance with FEM 1.001, booklet 2 shall be at least:

- lifting or luffing ropes M4;
- trolley travel ropes M4, and M3 when rope braking is monitored (see 5.4.2.7);
- erection ropes M3;
- stationary ropes M3.

5.3.2.4 Rail wheels

Rail wheels shall be determined with an appropriate and recognised method, e.g. with FEM 1.001, booklets 4 and 9.