SLOVENSKI STANDARD
oSIST prEN 13001-3-5:2024

01-julij-2024

Žerjavi - Konstrukcija, splošno - 3-5. del: Mejna stanja in dokaz varnosti kovanih in litih kavljev

Cranes - General design - Part 3-5: Limit states and proof of competence of forged and cast hooks

Krane - Konstruktion allgemein - Teil 3-5: Grenzzustände und Sicherheitsnachweis von geschmiedeten und gegossenen Haken

Appareils de levage à charge suspendue - Conception générale - Partie 3-5 : États limites et vérification des crochets forgés et moulés

Ta slovenski standard je istoveten z: **prEN 13001-3-5**

ICS:

53.020.20	Dvigala	Cranes
53.020.30	Pribor za dvigalno opremo	Accessories for lifting equipment

oSIST prEN 13001-3-5:2024 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 13001-3-5

April 2024

ICS 53.020.30; 53.020.20

Will supersede EN 13001-3-5:2016+A1:2021

English Version

Cranes - General design - Part 3-5: Limit states and proof of competence of forged and cast hooks

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 147.

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.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. prEN 13001-3-5:2024 E

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European foreword

This document (prEN 13001-3-5:2024) has been prepared by Technical Committee CEN/TC 147 “Cranes - Safety”, the secretariat of which is held by SFS.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 13001-3-5:2016+A1:2021.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For the relationship with EU Legislation, see informative Annex ZA or Annex ZB, which is an integral part of this document.

The hazards covered by this document are identified in Annex M.

This European Standard is one part of the EN 13001 series . The other parts are as follows:

— *Part 1: General principles and requirements*

— *Part 2: Load actions*

— *Part 3-1: Limit states and proof of competence of steel structures*

— *Part 3-2: Limit states and proof of competence of wire ropes in reeving systems*

— *Part 3-3: Limit states and proof of competence of wheel/rail contacts*

— *Part 3-4: Limit states and proof of competence of machinery — Bearings*[1]

— *Part 3-6: Limit states and proof of competence of machinery — Hydraulic cylinders*

For the relationship with other European Standards for cranes, see informative Annex L.

[1] Currently at Enquiry stage.

Introduction

This document has been prepared to provide a means for the mechanical design and theoretical verification of crane hooks to conform to essential health and safety requirements. This document also establishes interfaces between the user (purchaser) and the designer, as well as between the designer and the component manufacturer, in order to form a basis for selecting cranes and components.

This document is a type-C standard as stated in EN ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers)

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

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

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

1 Scope

This document covers the following parts of hooks and types of hooks:

— bodies of any type of hooks made of steel forgings or steel castings, including stainless steel;

— machined shanks of hooks with a thread/nut suspension.

Plate hooks, which are those assembled of one or several parallel parts of rolled steel plates, are not covered.

The following is a list of significant hazardous situations and hazardous events that could result in risks to persons during normal use and foreseeable misuse. Clauses 4 to 8 of this document are intended to reduce or eliminate the risks associated with the following hazards:

a) exceeding the limits of yield strength, ultimate strength, fatigue strength, brittle fracture;

b) exceeding temperature limits of material.

This document is not applicable to hooks installed in cranes manufactured before the date of its publication and serves as a reference base for product standards for particular crane types.

This part of EN 13001 deals only with the limit state method in accordance with EN 13001-1:2015.

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 1369:2012, *Founding — Magnetic particle testing*

EN 1370:2011, *Founding — Examination of surface condition*

EN 1371-1:2011, *Founding — Liquid penetrant testing — Part 1: Sand, gravity die and low pressure die castings*

EN 1559-1:2011, *Founding — Technical conditions of delivery — Part 1: General*

EN 10025-3:2019, *Hot rolled products of structural steels — Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels*

EN 10213:2007+A1:2016, *Steel castings for pressure purposes*

EN 10222-4:2017+A1:2021, *Steel forgings for pressure purposes — Part 4: Weldable fine grain steels with high proof strength*

EN 10228-1:2016, *Non-destructive testing of steel forgings — Part 1: Magnetic particle inspection*

EN 10228-2:2016, *Non-destructive testing of steel forgings — Part 2: Penetrant testing*

EN 10228-3:2016, *Non-destructive testing of steel forgings — Part 3: Ultrasonic testing of ferritic or martensitic steel forgings*

EN 10250-1:2022, *Open die steel forgings for general engineering purposes — Part 1: General requirements*

EN 10250-2:2022, *Open die steel forgings for general engineering purposes — Part 2: Non-alloy quality and special steels*

EN 10250-3:2022, *Open die steel forgings for general engineering purposes — Part 3: Alloy special steels*

EN 10254:1999, *Steel closed die forgings — General technical delivery conditions*

EN 10340:2007, *Steel castings for structural uses*

EN 12680-1:2003, *Founding — Ultrasonic examination — Part 1: Steel castings for general purposes*

EN 13001-1:2015, *Cranes — General design — Part 1: General principles and requirements*

EN 13001-2:2021, *Crane safety — General design — Part 2: Load actions*

EN 13001-3-2:2014, *Cranes — General design — Part 3-2: Limit states and proof of competence of wire ropes in reeving systems*

EN ISO 148-1:2016, *Metallic materials — Charpy pendulum impact test — Part 1: Test method (ISO 148-1:2016)*

EN ISO 642:1999, *Steel — Hardenability test by end quenching (Jominy test) (ISO 642:1999)*

EN ISO 643:2020, *Steels — Micrographic determination of the apparent grain size (ISO 643:2019, Corrected version 2023-11)*

EN ISO 683-2:2018, *Heat-treatable steels, alloy steels and free-cutting steels — Part 2: Alloy steels for quenching and tempering (ISO 683-2:2016)*

EN ISO 898-2:2022, *Fasteners — Mechanical properties of fasteners made of carbon steel and alloy steel - Part 2: Nuts with specified property classes (ISO 898-2:2022)*

EN ISO 21920-2:2022, *Geometrical product specifications (GPS) - Surface texture: Profile - Part 2: Terms, definitions and surface texture parameters (ISO 21920-2:2021, Corrected version 2022-06)*

EN ISO 6892-1:2019, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2019)*

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

CEN ISO/TR 15608:2017, *Welding — Guidelines for a metallic materials grouping system (ISO/TR 15608:2017)*

ISO 965-1:2013, *ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data*

ISO 4306-1:2007, *Cranes — Vocabulary — Part 1: General*

EN ISO 15614-1:2017, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2017, Corrected version 2017-10-01)*

3 Terms and definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and ISO 4306-1:2007, and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at https://www.electropedia.org/

3.1.1
hook shank
upper part of the hook, from which the hook is suspended to the hoist medium of the crane

3.1.2
hook body
lower, curved part of the hook below the shank

3.1.3
hook seat
bottom part of the hook body, where the load lifting attachment is resting

3.1.4
hook articulation
feature of the hook suspension, allowing the hook to tilt along the inclined load line

3.1.5
stand-alone hook
hook which is designed, manufactured and released to the market as a component or as part of a hook block, without connection to a specific crane or application

3.1.6
total deformation ratio
ratio of the area of the cast cross section to the forged cross section

Note 1 to entry: The following terms might also be used in technical literature for the same: reduction rate, reduction ratio, forging reduction.

3.2 Symbols and abbreviations

Table 1 — Symbols and abbreviations

Symbols, abbreviations	Description
A_{d1}	Cross section area of the unmachined shank
A_{d4}	Cross section area of the critical section of hook shank
A_v	Minimum impact toughness of material
a	Acceleration
a_1	Seat circle diameter
a_2	Throat opening
a_3	Height of the hook point
b_{max}	Maximum width in the critical hook body section
b_{ref}	Reference width
C	Total number of working cycles during the design life of crane
C_t	Relative tilting resistance of the hook suspension
c_e	Coefficient for load eccentricity
D	Cumulative damage in fatigue (Palmgren-Miner hypothesis)
d_1	Diameter of the unmachined shank
d_3	Principal diameter of thread
d_4	Diameter of the undercut section of the shank
d_5	Thread core diameter
e_R	Distance of the vertical load line from the centre line of the shank
F	Vertical force
F_H	Vertical force on hook due to occasional or exceptional loads
$F_{Rd,s,0}$	Basic limit design forces, static
$F_{Rd,s}$, $F_{Rd,f}$	Limit design forces, static/fatigue
$F_{Sd,s}$	Vertical design force for the proof of static strength
$F_{Sd,f}$	Vertical design force for the proof of fatigue strength
f_M, f_{MB}, f_{MS}	Factors of material type influence (forged/cast)
f_1, f_2, f_3	Factors of further influences
f_{Rd}	Limit design stress
f_y	Yield stress
f_u	Ultimate strength
g	Acceleration due to gravity, g = 9,81 m/s^2

Symbols, abbreviations	Description
$H_{Sd,s}$	Horizontal design force of hook
$H_{Sd,f}$	Horizontal design force for the proof of fatigue strength
h_1, h_2	Section heights of the hook body
h	Vertical distance from the seat bottom of the hook body to the centre of the articulation
h_s	Vertical distance from the seat bottom of the hook body to critical section of hook shank
i	Index for a lifting cycle or a stress cycle
I	Reference moment of inertia for curved beam
I_{d1}	Moment of inertia of the unmachined shank
I_{d4}	Moment of inertia of the critical section of hook shank
k_C	Conversion factor for stress spectrum and classified duty
k_h, k_s	Stress spectrum factors
kQ	Load spectrum factor, in accordance with EN 13001-1:2015
k_5*	Specific spectrum ratio factor with m = 5
lg	Log to the base of 10
M_1, M_2, M_3, M_4	Bending moments of hook shank
$M_{1,f,i}$, $M_{2,f,i}$, $M_{3,f,i}$	Bending moments of hook shank for the proof of fatigue strength, lifting cycle i
$M_{Sd,s}$	Static design bending moment
m	Slope parameter of the characteristic fatigue design curve
m_{RC}	Mass of rated hoist load
m_i	Mass of the hook load in a lifting cycle i
N	Total number of stress cycles/lifting cycles
N_D	Reference number of stress cycles, $N_D = 2 \times 10^6$
p	Pitch of thread
p_a	Average number of accelerations related to one lifting cycle
R	Radius of hook body curvature
R_a	Average depth of surface profile in accordance with EN ISO 21920-2:2022
R_z	Maximum depth of surface profile in accordance with EN ISO 21920-2:2022
r_9	Relief radius of the undercut
r_{th}	Thread bottom radius
s	Length of undercut
s_h, s_s	Stress history parameters

Symbols, abbreviations	Description
s_Q	Load history parameter
t	Depth of thread
T	Operation temperature
u_S, u_T	Depths of notches
α	Angle
α_S, α_T	Stress concentration factors
β	Angle or direction of hook inclination
β_n, β_{nS}, β_{nT}	Notch effect factors
ϕ_2	Dynamic factor for hoisting an unrestrained grounded load
ϕ_5	Dynamic factor for changes of acceleration of a movement
γ_n	Risk coefficient
γ_p	Partial safety factor
γ_m	General resistance coefficient
γ_{sm}	Specific resistance coefficient
γ_{Hf}, γ_{Sf}	Fatigue strength specific resistance factors
η_1	Edge distance of a hook body section
ν	Factor for load component
ν_h, ν_s	Relative numbers of stress cycles
μ	Factor for mean stress influence
σ_a	Shank stress due to axial force
σ_b	Shank stress due to bending moment
σ_m	Mean stress in a stress cycle
σ_A	Stress amplitude in a stress cycle
σ_{Sd}	Design stress
σ_M	Basic fatigue strength amplitude, un-notched piece
σ_p	Total stress range in a pulsating stress cycle
σ_W	Fatigue strength amplitude, notched piece
σ_{Tmax}, σ_{T1}, σ_{T2}	Transformed stress amplitudes
$\Delta\sigma_c$	Characteristic fatigue strength
$\Delta\sigma_{Rd}$	Limit fatigue design stress
$\Delta\sigma_{Sd,i}$	Stress range in a lifting cycle i
$\Delta\sigma_{Sd,max}$	Maximum stress range