SLOVENSKI STANDARD
SIST EN 13001-3-5:2016+A1:2021

01-september-2021

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 Sicherheitsnachweise 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: **EN 13001-3-5:2016+A1:2021**

ICS:

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

SIST EN 13001-3-5:2016+A1:2021 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13001-3-5:2016+A1

May 2021

ICS 53.020.20; 53.020.30

Supersedes EN 13001-3-5:2016

English Version

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

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

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

This European Standard was approved by CEN on 19 May 2016 and includes Amendment 1 approved by CEN on 12 April 2021.

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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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. EN 13001-3-5:2016+A1:2021 E

Contents

Page

European foreword

This document (EN 13001-3-5:2016+A1:2021) has been prepared by Technical Committee CEN/TC 147 “Crane — Safety”, the secretariat of which is held by DIN.

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 November 2021, and conflicting national standards shall be withdrawn at the latest by November 2021.

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 A1 EN 13001-3-5:2016 A1.

This document includes Amendment 1 approved by CEN on 21 April 2021.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

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.

A1 The major changes in this document compared to EN 13001-3-5:2016 are in 4.1, 4.2, 6.5.4, 6.6.4 and 8.2 so as to extend the scope of the standard to “cast hooks. A1

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*[2]

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

[1] Currently at Enquiry stage.

[2] Currently at Enquiry stage.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard has been prepared to provide a means for the mechanical design and theoretical verification of cranes to conform to essential health and safety requirements. This European Standard 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 European Standard is a type C standard as stated in EN ISO 12100.

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 or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines.

1 Scope

This European Standard is to be used together with EN 13001-1 and EN 13001-2 and, as such, they specify general conditions, requirements and methods to prevent by design and theoretical verification, mechanical hazards in crane hooks.

[A1] It is intended to be used together with the other generic parts of EN 13001 series of standards, see Annex L. [A1]

This European Standard covers the following parts of hooks and types of hooks:

— [A1] bodies of any type of hooks made of steel forgings or steel castings, including stainless steel; [A1]

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

Principles of this European Standard can be applied to machined shanks of hooks in general. However, stress concentration factors relevant to designs not given in this standard would have to be determined and applied.

[A1] The hazards covered by this document are identified by Annex M. [A1]

NOTE 1 [A1] Plate hooks, which are those, assembled of one or several parallel parts of rolled steel plates, are not covered in this document. [A1]

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 necessary to reduce or eliminate the risks associated with the following hazards:

a) [A1] exceeding the limits of yield strength, ultimate strength, fatigue strength, brittle fracture; [A1]

b) exceeding temperature limits of material.

[A1] The requirements of this document are stated in the main body of the document and are applicable to hook designs in general. [A1]

The commonly used hook body and shank designs listed in Annexes A, B and F are only examples and should not be referred to as requirements of this European Standard. Annex I gives guidance for the selection of a hook size, where a hook body is in accordance with Annex A or B. The selection of hook form is not limited to those shown in Annexes A and B.

This European Standard is applicable to cranes, which are manufactured after the date of approval of this European Standard by CEN, and serves as a reference base for product standards of particular crane types.

NOTE 2 This part of EN 13001 deals only with the limit state method in accordance with EN 13001–1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[A1] 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 10204:2004, *Metallic products — Types of inspection documents*

EN 10213:2017, *Steel castings for pressure purposes*

EN 10222-4:2017, *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 10250-1:1999, *Open die steel forgings for general engineering purposes — Part 1: General requirements*

EN 10250-2:1999, *Open die steel forgings for general engineering purposes — Part 2: Non-alloy quality and special steels*

EN 10250-3:1999, *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 13001-2:2014, *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 642:2016, *Steel — Hardenability test by end quenching (Jominy test) (ISO 642:1999)*

EN ISO 643:2012, *Steels — Micrographic determination of the apparent grain size (ISO 643:2012)*

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 898-2:2012, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread (ISO 898-2:2012)*

EN ISO 4287:1998, *Geometrical product specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters (ISO 4287:1997)*

EN ISO 6892-1:2016, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2016)*

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 6506-1:2014, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:2014)*

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)* A1

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.

3.1.1
hook shank
〈A1〉 upper part of the hook, from which the hook is suspended to the hoist medium of the crane 〈A1〉

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 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
A1 A_{d1}	Cross section area of the unmachined shank A1
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)
A1 d_1	Diameter of the unmachined shank A1
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
A1 $F_{Rd,s,0}$	Basic limit design forces, static A1
$F_{Rd,s}$, $F_{Rd,f}$	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
A1 f_M, f_{MB}, f_{MS}	Factors of material type influence (forged/cast) A1
f_1, f_2, f_3	Factors of further influences

Symbols, abbreviations	Description
f_{Rd}	Limit design stress
f_y	Yield stress
f_u	Ultimate strength
g	Acceleration due to gravity, g = 9,81 m/s^2
$H_{Sd,s}$	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
A1 I_{d1}	Moment of inertia of the unmachined shank A1
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
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 4287:1998
R_z	Maximum depth of surface profile in accordance with EN ISO 4287:1998

Symbols, abbreviations	Description
r_9	Relief radius of the undercut
r_{th}	Thread bottom radius
s	Length of undercut
s_h, s_s	Stress history parameters
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