

STN	Žeriavy Všeobecný návrh Časť 3-6: Medzné stavy a overovanie spôsobilosti častí strojov Hydraulické valce	STN EN 13001-3-6 27 0043
------------	---	--

Cranes - General design - Part 3-6: Limit states and proof of competence of machinery - Hydraulic cylinders

Táto norma obsahuje anglickú verziu európskej normy.

This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 07/26

Obsahuje: EN 13001-3-6:2026

Oznámením tejto normy sa ruší

STN EN 13001-3-6+A1 (27 0043) zo septembra 2021

142670

Úrad pre normalizáciu, metrológiu a skúšobníctvo Slovenskej republiky, 2026

Slovenská technická norma a technická normalizačná informácia je chránená zákonom č. 60/2018 Z. z. o technickej normalizácii v znení neskorších predpisov.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 13001-3-6

March 2026

ICS 23.100.20; 53.020.20

Supersedes EN 13001-3-6:2018+A1:2021

English Version

**Cranes - General design - Part 3-6: Limit states and proof
of competence of machinery - Hydraulic cylinders**

Appareils de levage à charge suspendue - Conception
générale - Partie 3-6 : États limites et vérification
d'aptitude des éléments de mécanismes - Vérins
hydrauliques

Krane - Konstruktion allgemein - Teil 3-6:
Grenzzustände und Sicherheitsnachweis von
Maschinenbauteilen - Hydraulikzylinder

This European Standard was approved by CEN on 16 February 2026.

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, Türkiye 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

EN 13001-3-6:2026 (E)**Contents**

Page

European foreword.....	4
Introduction	5
1 Scope	6
2 Normative references	6
3 Terms, definitions, symbols and abbreviated terms.....	7
3.1 Terms and definitions	7
3.2 Symbols and abbreviated terms	7
3.3 Terminology.....	9
4 General.....	12
4.1 Documentation.....	12
4.2 Materials for hydraulic cylinders	12
4.2.1 General requirements	12
4.2.2 Additional mechanical properties	12
5 Proof of static strength.....	13
5.1 General.....	13
5.2 Limit design stresses.....	15
5.2.1 General.....	15
5.2.2 Limit design stress in structural members.....	15
5.2.3 Limit design stresses in welded connections.....	16
5.3 Linear stress analysis	16
5.3.1 General.....	16
5.3.2 Typical load cases and boundary conditions	16
5.3.3 Cylinder tube	18
5.3.4 Cylinder bottom.....	19
5.3.5 Piston rod welds.....	21
5.3.6 Cylinder head.....	21
5.3.7 Cylinder tube and piston rod threads.....	21
5.3.8 Thread undercuts and locking wire grooves	22
5.3.9 Oil connector welds.....	22
5.3.10 Connecting interfaces to crane structure	23
5.4 Nonlinear stress analysis	23
5.4.1 General.....	23
5.4.2 Standard cylinder with end moments	23
5.4.3 Support leg.....	23
5.5 Execution of the proof	24
5.5.1 Proof for load bearing components.....	24
5.5.2 Proof for bolted connections.....	24
5.5.3 Proof for welded connections.....	25
6 Proof of fatigue strength.....	25
6.1 General.....	25
6.2 Stress histories.....	25
6.3 Execution of the proof	27
6.4 Limit design stress range	27
6.5 Details for consideration.....	27

6.5.1	General	27
6.5.2	Bottom weld.....	28
6.5.3	Notch stress at oil connectors	30
6.5.4	Cylinder head	31
6.5.5	Piston rod	33
6.5.6	Cylinder head bolts	35
6.5.7	Cylinder head flange weld	35
6.5.8	Mechanical interfaces	37
7	Proof of elastic stability	38
7.1	General	38
7.2	Critical buckling load	38
7.3	Limit compressive design force.....	40
7.4	Execution of the proof.....	40
Annex A	(informative) Critical buckling load for common buckling cases.....	41
A.1	General	41
A.2	Buckling case A	42
A.3	Buckling case B	42
A.4	Buckling case C	43
A.5	Buckling case D.....	43
A.6	Buckling case E	43
A.7	Buckling case F	44
A.8	Buckling case G	44
Annex B	(informative) Second order analysis of two important cases	45
B.1	Compressed cylinder with end moments and angular misalignment.....	45
B.2	Compressed cylinder with lateral end force and angular misalignment	46
B.3	Axial stresses for cases in B.1 and B.2	47
Annex C	(informative) Shell section forces and moments for cylinder bottom	48
Annex D	(informative) Fatigue analysis of bottom weld for more complex cases	51
Annex E	(informative) Overview of standards published by CEN/TC 147	54
E.1	General	54
E.2	Selecting a suitable standard	54
Annex F	(informative) List of hazards	56
Annex ZA	(informative) Relationship between this European Standard and the essential requirements of Regulation (EU) 2023/1230 aimed to be covered.....	57
Bibliography		58

EN 13001-3-6:2026 (E)**European foreword**

This document (EN 13001-3-6:2026) has been prepared by Technical Committee CEN/TC 147 “Cranes - Safety”, the secretariat of which is held by SFS.

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 September 2026, and conflicting national standards shall be withdrawn at the latest by September 2026.

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 13001-3-6:2018+A1:2021.

EN 13001-3-6:2026 includes the following significant technical changes with respect to EN 13001-3-6:2018+A1:2021:

- clause on materials for hydraulic cylinders was restructured (4.2);
- the general requirements changed to apply to all cylinder materials (4.2.1);
- the requirement for elongation was changed (4.2.1);
- conditions for flattening test of tube material were changed (4.2.2);
- conservative default value for efficiency of active cylinders was changed (5.1);
- the requirement for plates loaded perpendicularly was changed (5.2.2);
- the specific resistance factor for material was changed (5.2.2).

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, which is an integral part of this document.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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, Türkiye and the United Kingdom.

Introduction

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 the case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate in 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.

EN 13001-3-6:2026 (E)**1 Scope**

This document is to be used together with the other generic parts of the EN 13001 series of standards, see Annex E, as well as pertinent crane type product EN standards, and as such they specify general conditions, requirements and methods to, by design and theoretical verification, prevent mechanical hazards of hydraulic cylinders that are part of the load carrying structures of cranes. Hydraulic piping, hoses and connectors used with the cylinders are not within the scope of this document, as well as cylinders made from other material than carbon steel.

NOTE 1 Specific requirements for particular crane types are given in the appropriate European product standards, see Annex E.

The significant hazardous situations and hazardous events that could result in risks to persons during intended use are identified in Annex F. Clauses 5 to 7 of this document provide requirements and methods to reduce or eliminate these risks:

- a) exceeding the limits of strength (yield, ultimate, fatigue);
- b) elastic instability (column buckling).

NOTE 2 EN 13001-3-6 deals only with the limit state method in accordance with EN 13001-1.

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 10164:2018, *Steel products with improved deformation properties perpendicular to the surface of the product — Technical delivery conditions*

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

EN 13001-3-1:2025, *Cranes — General design — Part 3-1: Limit states and proof competence of steel structure*

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

EN ISO 5817:2023, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections (ISO 5817:2023)*

EN ISO 8492:2013, *Metallic materials — Tube — Flattening test (ISO 8492:2013)*

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

ISO 724:2023, *ISO general purpose metric screw threads — Basic dimensions*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN