INTERNATIONAL STANDARD

ISO 20332

First edition
2008-12-15

Cranes — Proof of competence of steel structures

Appareils de levage à charge suspendue — Vérification d'aptitude des structures en acier

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

Reference number
ISO 20332:2008(E)

© ISO 2008

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

COPYRIGHT PROTECTED DOCUMENT

© ISO 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-
36dc22d0df03/iso-20332-2008

© ISO 2008 – All rights reserved

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

© ISO 2008 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 20332 was prepared by Technical Committee ISO/TC 96, *Cranes*, Subcommittee SC 10, *Design principles and requirements*.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

© ISO 2008 – All rights reserved

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

Cranes — Proof of competence of steel structures

1 Scope

This International Standard sets forth general conditions, requirements, methods and parameter values for performing proof-of-competence determinations of the steel structures of cranes based upon the limit state method. It is intended to be used together with the loads and load combinations of the applicable parts of ISO 8686.

This International Standard is general and covers cranes of all types. Other International Standards may give specific proof-of-competence requirements for particular crane types.

Proofs of competence, by theoretical calculations and/or testing, are intended to prevent hazards related to the performance of the structure by establishing the limits of strength, e.g. yield, ultimate, fatigue, brittle fracture.

According to ISO 8686-1, there are two general approaches to proof-of-competence calculations: the limit state method employing partial safety factors, and the allowable stress method employing a global safety factor. The allowable stress method is a permitted alternative to the limit state method as set forth in this International Standard.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Proof-of-competence calculations for components of accessories (e.g. hand rails, stairs, walkways, cabins) are not covered by this International Standard. However, the influence of such attachments on the main structure needs to be considered.

ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

NOTE Proof of competence for elastic stability is to be covered by another International 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.

ISO 148-1:2006, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 273:1979, *Fasteners — Clearance holes for bolts and screws*

ISO 286-2:1988, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts,* corrected by ISO 286-2:1988/Cor 1:2006

ISO 404:1992, *Steel and steel products — General technical delivery requirements*

ISO 898-1:—[1)], *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*

ISO 4301-1:1986, *Cranes and lifting appliances — Classification — Part 1: General*

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

1) To be published. (Revision of ISO 898-1:1999)

© ISO 2008 – All rights reserved

ISO 5817:2003, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections,* corrected by ISO 5817:2003/Cor 1:2006

ISO 8686 (all parts), *Cranes — Design principles for loads and load combinations — Part 1: General*

ISO 9013:2002, *Thermal cutting — Classification of thermal cuts — Geometrical product specification and quality tolerances*

ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

ISO 17659:2002, *Welding — Multilingual terms for welded joints with illustrations*

3 Terms, definitions, symbols and abbreviations

For the purposes of this document, the terms and definitions given in ISO 12100-1, ISO 12100-2, ISO 17659 and ISO 4306-1:2007, Clause 6, and the following terms, definitions, symbols and abbreviations (see Table 1) apply.

3.1
grade of steel
marking that defines the strength of steel, usually defining yield stress, f_y, sometimes also ultimate strength, f_u

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3.2
quality of steel
marking that defines the impact toughness and test temperature of steel

ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-
50dc22d6df95/iso-20332-2008

Table 1 — Main symbols and abbreviations used in this International Standard

Symbols	Description
A	Cross-section
A_{eq}	Equivalent area for calculation
A_n	Net cross-sectional area at bolt or pin holes
A_r	Minor area of the bolt
A_S	Stress area of the bolt
a	Geometric dimension
a_{hi}	Geometric dimension for weld penetration
a_r	Effective weld thickness
b	Geometric dimension
b_c	Geometric dimension
b_{eff}	Effective dimension for calculation
b_l	Geometric dimension
C	Total number of working cycles
c	Geometric dimension

© ISO 2008 – All rights reserved

Table 1 (*continued*)

Symbols	Description
D_A	Diameter of the sheet
D_i	Inner diameter of hollow pin
D_o	Outer diameter of hollow pin
d	Diameter (shank of bolt, pin)
d_h	Diameter of the hole
d_w	Diameter of the contact area of the bolt head
d_o	Diameter of the hole
E	Modulus of elasticity
e_1, e_2	Edge distances
F	Force
F_b	Tensile force in bolt
$F_{b, Rd}$	Limit design bearing force
$F_{b,Sd}$; $F_{bi,Sd}$	Design bearing force
ΔF_b	Additional force
F_{cr}	Reduction in the compression force due to external tension
$F_{cs,Rd}$	Limit design tensile force
F_d	Limit force
$F_{e,t}$	External force (on bolted connection)
F_k	Characteristic value (force)
F_p	Preloading force in bolt
$F_{p, d}$	Design preloading force
F_{Rd}	Limit design force
F_{Sd}	Design force of the element
$F_{s, Rd}$	Limit design slip force per bolt and friction interface
$F_{t, Rd}$	Limit design tensile force per bolt
$F_{t, Sd}$	External tensile force per bolt
$F_{v, Rd}$	Limit design shear force per bolt/pin and shear plane
$F_{v, Sd}$	Design shear force per bolt/pin and shear plane
$F_{\sigma,\tau}$	Acting normal/shear force
f_d	Limit stress
f_k	Characteristic value (stress)
f_{Rd}	Limit design stress
f_u	Ultimate strength of material
f_{ub}	Ultimate strength of bolts
f_{uw}	Ultimate strength of the weld

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

© ISO 2008 – All rights reserved

Table 1 (*continued*)

Symbols	Description
$f_{w, Rd}$	Limit design weld stress
f_y	Yield stress of material or 0,2 % offset yield strength
f_{yb}	Yield stress of bolts
f_{yk}	Yield stress (minimum value) of base material or member
f_{yp}	Yield stress of pins
h	Thickness of workpiece
h_d	Distance between weld and contact area of acting load
K_b	Stiffness (slope) of bolt
K_c	Stiffness (slope) of flanges
k_m	Stress spectrum factor based on m of the detail under consideration
k^*	Specific spectrum ratio factor
l_k	Effective length for tension
l_r	Effective weld length
l_w	Weld length
l_1	Effective length for tension without threat
l_2	Effective length for tension with threat
M_{Rd}	Limit design bending moment
M_{Sd}	Design bending moment
m	(negative inverse) slope constant of log σ/log N curve
N	Number of stress cycles to failure by fatigue for the stress cycle described by $\sigma_{a,i}$ and $\sigma_{m,j}$
N_{ref}	Number of cycles at the reference point
N_t	Total number of occurrences
NC	Notch class
NDT	Non destructive testing
n_i	Number of stress cycles with stress amplitude of range i
n_{ij}	Number of stress cycles of class ij
$n_{ij}^{(r)}$	Number of stress cycles of class ij occurring each time task r is carried out
$\hat{n}$	Total number of stress cycles
P_s	Probability of survival
p_1, p_2	Distances between bolt centres
Q	Mass of the maximum hoist load
q	Impact toughness parameter
R	Constant stress ratio selected for one-parameter classification of stress cycles
R_d	Design resistance

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

© ISO 2008 – All rights reserved

Table 1 (*continued*)

Symbols	Description
r	Radius of wheel
S	Class of stress history parameter, s
S_d	Design stresses or forces
s_m	Stress history parameter
T	Temperature
TIG	Tungsten inert gas
t	Thickness
U	Class of working cycles
u	Shape factor
v	Diameter ratio
W_{el}	Elastic section modulus
α	Characteristic factor for bearing connection
α_r	Relative number of working cycles for each task r
α_w	Characteristic factor for limit weld stress
α_1, α_2	Angles between the horizontal line and the line of N = constant in the σ_a–σ_m plane
γ_{mf}	Fatigue strength specific resistance factor
γ_m	General resistance factor
γ_p	Partial safety factor
γ_R	Total resistance factor
γ_{Rb}	Total resistance factor of bolt
γ_{Rc}	Total resistance factor for tension on sections with holes
γ_{Rm}	Total resistance factor of members
γ_{Rp}	Total resistance factor of pins
γ_{Rs}	Total resistance factor of slip-resistance connection
γ_{Rw}	Total resistance factor of welding connection
γ_s	Specific resistance factor
γ_{sb}	Specific resistance factor of bolt
γ_{sm}	Specific resistance factor of members
γ_{sp}	Specific resistance factor of pins
γ_{ss}	Specific resistance factor of slip-resistance connection
γ_{st}	Specific resistance factor for tension on sections with holes
γ_{sw}	Specific resistance factor of welding connection
$\Delta\delta$	Additional elongation

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

© ISO 2008 – All rights reserved

Table 1 (*continued*)

Symbols	Description
δ_p	Elongation from preloading
Θ_i	Incline of diagonal members
κ	Dispersion angle
λ	Width of contact area in weld direction
μ	Slip factor
ν	Relative total number of stress cycles (normalized)
ν_D	Ratio of diameters
σ	Indicate the respective stress
$\Delta\sigma$	Stress range
$\Delta\sigma_i$	Stress range i
$\Delta\hat{\sigma}$	Maximum stress range
σ_b	Lower extreme value of stress cycle
$\Delta\sigma_c$	Characteristic fatigue strength (normal stress)
σ_m	Constant mean stress selected for one-parameter classification of stress cycles
$\sigma_{m,j}$	Mean stress of range, j, resulting from rainflow or reservoir method
$\Delta\sigma_{Rd}$	Limit design stress range (normal)
$\Delta\sigma_{Rd,1}$	Limit design stress range for $k^* = 1$
σ_{Sd}	Design stress (normal)
$\Delta\sigma_{Sd}$	Design stress range (normal)
σ_u	Upper extreme value of stress cycle
$\sigma_{w,\,Sd}$	Design weld stress (normal)
σ_x, σ_y	Normal stress component in direction x, y
$\hat{\sigma}_a$	Maximum stress amplitude
min σ, max σ	Extreme values of stresses
τ	Shear stress
$\Delta\tau_c$	Characteristic fatigue strength (shear stress)
τ_{Sd}	Design stress (shear)
$\Delta\tau_{Sd}$	Design stress range (shear)
$\Delta\tau_{Rd}$	Limit design stress range (shear)
$\tau_{w,\,Sd}$	Design weld stress (shear)
ϕ_i	Dynamic factor

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-56dc22d0df93/iso-20332-2008

© ISO 2008 – All rights reserved

4 General

4.1 General principles

Proof-of-competence calculations shall be done for components, members and details exposed to loading or repetitive loading cycles that could cause failure, cracking or distortion interfering with crane functions.

NOTE See ISO 8686 for further information applicable to the various types of crane. Not all calculations are applicable for every crane type.

4.2 Documentation

The documentation of the proof of competence shall include

— design assumptions including calculation models,

— applicable loads and load combinations,

— material properties,

— weld quality classes in accordance with ISO 5817, and

— properties of connecting elements.

4.3 Alternative methods

iTeh STANDARD PREVIEW
(standards.iteh.ai)

The competence may be verified by experimental methods in addition to, or in coordination with, the calculations. The magnitude and distribution of loads during tests shall correspond to the design loads and load combinations for the relevant limit states.

ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-3bdc22d01f03/iso-20332-2008

Alternatively, advanced and recognized theoretical or experimental methods generally may be used, provided that they conform to the principles of this International Standard.

4.4 Materials of structural members

It is recommended that steels in accordance with the following International Standards be used:

— ISO 630 as amended [1];

— ISO 6930-1 [7];

— ISO 4950 [3];

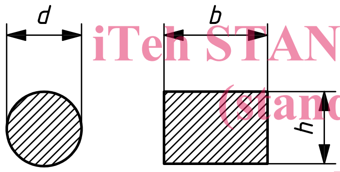
— ISO 4951-1, ISO 4951-2 and ISO 4951-3 [4], [5], [6].

Where other steels are used, the specific values of strengths f_u and f_y have to be known. The mechanical properties and the chemical composition shall be specified according to ISO 404. When used in welded structures, the weldability shall be demonstrated.

When verifying the grade and quality of the steel (see referenced International Standards) used for tensile members, the sum of impact toughness parameters, q_i, shall be taken into account. Table 2 gives q_i for various influences. The required impact energy/test temperatures in dependence of $\sum q_i$ are shown in Table 3 and shall be specified by the steel manufacturer on the basis of ISO 148-1.

© ISO 2008 – All rights reserved

Table 2 — Impact toughness parameters, q_i

i	**Influence**		q_i
1	Temperature T (°C) of operating environment	$0 \leqslant T$	0
		$-20 \leqslant T < 0$	1
		$-40 \leqslant T < -20$	2
		$-50 \leqslant T < -40$	4
2	Yield stress f_y (N/mm^2)	$f_y \leqslant 300$	0
		$300 < f_y \leqslant 460$	1
		$460 < f_y \leqslant 700$	2
		$700 < f_y \leqslant 1\,000$	3
		$1\,000 < f_y$	4
3	Material thickness t (mm)	$t \leqslant 10$	0
	Equivalent thickness t for solid bars:	$10 < t \leqslant 20$	1
		$20 < t \leqslant 50$	2
		$50 < t \leqslant 100$	3
	$t = \frac{d}{1,8}$ for $\frac{b}{h} < 1,8$: $t = \frac{b}{1,8}$	$t > 100$	4
4	Stress concentration and notch class $\Delta\sigma_c$ (N/mm^2) (see Annex D)	$\Delta\sigma_c > 125$	0
		$80 < \Delta\sigma_c \leqslant 125$	1
		$56 < \Delta\sigma_c \leqslant 80$	2
		$\Delta\sigma_c \leqslant 56$	3

NOTE For environmental temperatures below –50°C, special measures are required.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97cc-d47e-4e94-8da2-36dc22d0df93/iso-20332-2008

Table 3 — Impact toughness requirement for $\sum q_i$

	$\sum q_i \leqslant 3$	$4 \leqslant \sum q_i \leqslant 6$	$7 \leqslant \sum q_i \leqslant 9$	$\sum q_i \geqslant 10$
Impact energy/ test temperature requirement	27 J / + 20°C	27 J / 0°C	27 J / – 20°C	27 J / – 40°C

 © ISO 2008 – All rights reserved

4.5 Bolted connections

4.5.1 Bolt materials

For bolted connections, bolts of the property classes (bolt grades) ISO 898-1:—, 4.6, 5.6, 8.8, 10.9 or 12.9, shall be used. Table 4 shows nominal values of the strengths.

Table 4 — Property classes (bolt grades)

Property class (bolt grade)	4.6	5.6	8.8	10.9	12.9
f_{yb} (N/mm^2)	240	300	640	900	1 080
f_{ub} (N/mm^2)	400	500	800	1 000	1 200

Where necessary, the designer should ask the bolt provider to demonstrate compliance with the requirements for protection against hydrogen brittleness relative to the property classes (bolt grades) 10.9 and 12.9. Technical requirements can be found in ISO 15330, ISO 4042 and ISO 9587.

4.5.2 General

For the purposes of this International Standard, bolted connections are connections between members and/or components utilizing bolts where the following applies:

— bolts shall be tightened sufficiently to compress the joint surfaces together, when subjected to vibrations, reversals or fluctuations in loading, or where slippage can cause deleterious changes in geometry;

— other bolted connections can be made wrench tight;

— the joint surfaces shall be secured against rotation (e.g. by using multiple bolts).

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 20332:2008
https://standards.iteh.ai/catalog/standards/sist/a08a97ee-d97e-4e94-8da2-
36dc22d0df93/iso-20332-2008

4.5.3 Shear and bearing connections

For the purposes of this International Standard, shear and bearing connections are those connections where the loads act perpendicular to the bolt axis and cause shear and bearing stresses in the bolts and bearing stresses in the connected parts, and where the following applies:

— the clearance between the bolt and the hole shall conform to ISO 286-2:1988, tolerances h13 and H11, or closer, when bolts are exposed to load reversal or where slippage may cause deleterious changes in geometry;

— in other cases, wider clearances according to ISO 273 may be used,

— only the unthreaded part of the shank shall be considered in the bearing calculations;

— special surface treatment of the contact surfaces is not required.

4.5.4 Friction grip type (slip resistant) connections

For the purposes of this International Standard, friction grip connections are those connections where the loads are transmitted by friction between the joint surfaces, and where the following applies:

— high strength bolts of property classes (bolt grades) ISO 898-1:—, 8.8, 10.9 or 12.9 shall be used;

— bolts shall be tightened by a controlled method to a specified preloading state;

— the surface condition of the contact surfaces shall be specified and taken into account accordingly;

— in addition to standard holes, oversized and slotted holes may be used.

© ISO 2008 – All rights reserved