SLOVENSKI STANDARD
oSIST prEN ISO 898-2:2021

01-november-2021

Vezni elementi - Mehanske lastnosti veznih elementov, narejenih iz ogljikovega jekla in jeklene zlitine - 2. del: Matice z določenimi razredi trdnosti (ISO/DIS 898-2:2021)

Fasteners - Mechanical properties of fasteners made of carbon steel and alloy steel - Part 2: Nuts with specified property classes (ISO/DIS 898-2:2021)

Mechanische Verbindungselemente - Mechanische Eigenschaften von Verbindungselementen aus Kohlenstoffstahl und legiertem Stahl - Teil 2: Muttern mit festgelegten Festigkeitsklassen (ISO/DIS 898-2:2021)

Fixations - Caractéristiques mécaniques des fixations en acier au carbone et en acier allié - Partie 2: Écrous de classes de qualité spécifiées (ISO/DIS 898-2:2021)

Ta slovenski standard je istoveten z: **prEN ISO 898-2**

ICS:

21.060.20 Matice Nuts

oSIST prEN ISO 898-2:2021 **en,fr,de**

DRAFT INTERNATIONAL STANDARD

ISO/DIS 898-2

ISO/TC **2**/SC **12** Secretariat: **DIN**

Voting begins on: **2021-08-30**

Voting terminates on: **2021-11-22**

Fasteners — Mechanical properties of fasteners made of carbon steel and alloy steel —

Part 2: Nuts with specified property classes

Fixations — Caractéristiques mécaniques des fixations en acier au carbone et en acier allié —

Partie 2: Écrous de classes de qualité spécifiées

ICS: 21.060.20

This document is circulated as received from the committee secretariat.

ISO/CEN PARALLEL PROCESSING

Reference number
ISO/DIS 898-2:2021(E)

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Published in Switzerland

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

ISO 898-2 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 12, *Fasteners with metric internal thread*.

This fourth edition cancels and replaces the third edition (ISO 898-2:2012) which has been technically revised.

The main changes compared to the previous edition are as follows:

— property class 9 has been deleted completely, and nuts with fine pitch thread and property class 5 have been deleted (see Introduction);

— nuts with fine pitch thread in style 2 and property class 12 have been added for diameters 18 mm to 39 mm (see Tables 4, 6 and 10);

— styles have been more precisely defined for standard hexagon nuts according to their minimum height, and styles have been specified for other nuts according to their minimum design thread height (see 5.1);

— additional statements for thin nuts and jam nuts have been added (see Clause 6);

— additional statements for hot dip galvanized nuts have been added by referencing ISO 10684;

— in relation to material, heat treatment and steel microstructure (see Clause 7):

  - the minimum carbon content has been added (see Tables 3 and 4),
  - the minimum manganese content has been specified to 0,25 % for all Non-Quenched and Tempered nuts (NQT) and has been raised to 0,45 % for all Quenched and Tempered nuts (QT) (see Tables 3 and 4),
  - the footnote for free cutting steel has been reworked (see Tables 3 and 4),

- the minimum tempering temperature has been added for QT nuts (see Tables 3 and 4), and a reference retempering test has been added (see 10.4),
- for nuts that may optionally be quenched and tempered at the manufacturer's discretion, detailed specifications have been added (see 7.2),
- specifications for steel microstructure have been added for NQT and QT nuts (see 7.4.1, 7.4.2 and 10.3);

— in relation to proof load:

- the proof load values for nuts with coarse pitch thread and property classes 6 and 8 have been raised for sizes M27 to M39 (see Introduction, Table 5 and Annex C),
- the maximum hole diameter for the grip has been corrected for diameters 5 mm and 6 mm (see Table 11), and reference to additional proof load specifications have been added for prevailing torque nuts (see 10.1);

— in relation to hardness:

- the reference Vickers hardness values have been recalculated, and conversion into Brinell and Rockwell hardness has been improved (see Introduction and 8.3),
- hardness determined on the bearing surface (see 10.2.4 a) and hardness determined in the transverse section at mid-height of the nut (see 10.2.4 b) have been added for routine inspection only;
- the test method for hardness determined in the thread has been improved and the reference test force has been specified according to the pitch dimension (see 10.2.5),
- for QT nuts, the test methods for hardness in the core (see 10.2.6) and uniformity of hardness (see 10.2.7) have been added,
- requirements for hardness have been improved (see 10.2.8 and 10.2.9);

— inspection documents have been referenced in accordance with ISO 16228 for fasteners (see 9.4);

— marking and labelling have been improved, and all nuts conforming to this document are to be marked whatever their shape (see Clause 11);

— Annex B, *Design principles for nuts*, has been improved;

— Annex C, *Nominal stress under proof load*, has been added.

More detailed background for the main technical improvements is given in Introduction.

Introduction

ISO 898, the basic standard for fasteners with ISO metric thread made of carbon steel and alloy steel, was developed in several parts for diameters 5 mm to 39 mm. Property classes are specified in the ISO 898 series in relation to materials and mechanical properties, so that nuts in accordance with ISO 898-2 are matching with bolts, screws and studs specified in ISO 898-1 and with flat washers specified in ISO 898-3, as necessary, in order to design suiTable assemblies for a given application.

More parts will be developed in the future for bolts, screws, studs and nuts with sizes above 39 mm.

In order to assure the necessary material strength in relation to property classes:

— Quenched and Tempered nuts (QT) are specified with a minimum carbon content and a minimum tempering temperature, are characterized by a homogeneous martensitic structure;

— Non-Quenched and Tempered nuts (NQT) are also specified with a minimum carbon content but are characterized by a non-quenched microstructure.

Some property classes (in relation to nut style, diameter and coarse or fine pitch thread) specified as NQT may be optionally quenched and tempered as specified in 7.2, and in this case all requirements for QT nuts apply.

For fully loadable non-standard nuts which are to meet the requirements of this document, the relevant style 1 or style 2 is assigned in relation to their minimum design thread height.

Nut loadability is primarily checked by proof load. For nuts with coarse pitch thread and property classes 6 and 8, proof load values have been raised for sizes M27 to M39 due to the latest calculations of Masaya Hagiwara [20] in accordance with the Alexander's theory [21], see ISO/TR 16224. For those nuts it was necessary to develop full strength in relation to the mating bolts, screws and studs specified in ISO 898-1, the difference between the proof loads of ISO 898-2:2012 and the recalculated values being more than 5 % (see Annex C).

The Vickers hardness values specified for each individual group (consisting of property class, style, pitch and diameter ranges) have been chosen according to the same latest calculations, but adjusted to conventional figures taken over from the former versions of Parts 2 and 6 which were merged in 2012.

ISO 18265 presents no hardness to tensile strength correlation for steel in work hardened condition, which is typical for cold forged high volume NQT nuts: therefore, minimum hardness is just informative for NQT nuts and does not constitute a criterion in case of dispute. The maximum hardness of 334 HV is specified in order to prevent unexpected manufacturing processes which can lead to brittle behavior of the NQT nuts: this limit is therefore mandatory and valid in case of dispute. However, it should be noted that work hardening is usually not severe enough to reach 302 HV when typical material and forging processes are used; nevertheless, inappropriate hardness testing or scattering due to just local properties is also covered by this specified limit of 334 HV.

Due to missing or decreasing market needs, nuts of property class 5 with fine pitch thread in style 1 and nuts of property class 9 with coarse pitch thread in style 2 were deleted (property class 5 or 9 can be substituted by property class 6 or 10 respectively).

Nuts of property class 10 with fine pitch thread in style 1 for diameters 18 mm to 39 mm were deleted but though, nuts of property class 12 with fine pitch thread in style 2 have been added for diameters 18 mm to 39 mm.

Fasteners — Mechanical properties of fasteners made of carbon steel and alloy steel —

Part 2:
Nuts with specified property classes

1 Scope

This document specifies the mechanical and physical properties of nuts made of non-alloy steel or alloy steel, for three different nut styles in accordance with 5.1:

— regular nuts (style 1),

— high nuts (style 2),

— thin nuts (style 0),

in combination with:

— coarse pitch thread M5 ≤ D ≤ M39, and fine pitch thread 8 mm ≤ D ≤ 39 mm,

— specified property classes 04, 05, 5, 6, 8, 10 and 12 including proof loads,

and able to be mated with bolts, screws and studs with property classes in accordance with ISO 898-1.

These combinations are based on bolt/nut compatibility, manufacturing processes and market needs. If other combinations are needed, e.g. for nuts designed for particular applications, see ISO/TR 16224.

Nuts conforming to the requirements of this document are tested at the ambient temperature range of 10 °C to 35 °C. It is possible that they do not retain the specified mechanical and physical properties at elevated and/or lower temperatures.

NOTE 1 Nuts conforming to the requirements of this document are used in applications ranging from −50 °C to +150 °C, however these nuts are also used outside this range and up to +300 °C for specific applications. It is the responsibility of the user to determine the appropriate choice, and consulting an experienced fastener materials expert is recommended outside the range of −50 °C to +150 °C (several factors need to be taken into account, e.g. steel composition, duration of exposure at elevated or low temperature, the effect of the temperature on the fastener mechanical properties and clamped parts).

NOTE 2 Information for the selection and application of steels for use at lower and elevated temperatures is given for instance in EN 10269, ASTM A320/A320M and ASTM A194/A194M.

This document applies to the nuts specified above, with:

— triangular ISO metric thread in accordance with ISO 68-1,

— diameter/pitch combinations in accordance with ISO 261 and ISO 262,

— thread tolerances in accordance with ISO 965-1, ISO 965-2 or ISO 965-5, and

— minimum outside diameter or width across flats s ≥ 1,45D (see Annex B).

For hot dip galvanized nuts, additional requirements are specified in ISO 10684.

This document does not specify requirements for functional properties such as:

— prevailing torque properties (see ISO 2320),

— torque/clamp force properties (see ISO 16047 for test method),

— weldability, or

— corrosion resistance.

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 1891-4, *Fasteners — Vocabulary — Part 4: Control, inspection, delivery, acceptance and quality*

ISO 2320, *Fasteners — Prevailing torque steel nuts — Functional properties*

ISO 6157-2, *Fasteners — Surface discontinuities — Part 2: Nuts*

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

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*

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

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 10684, *Fasteners — Hot dip galvanized coatings*

ISO 16228, *Fasteners — Types of inspection documents*

3 Terms and definitions

No terms and definitions are listed in this document.

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

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

4 Symbols

For the purposes of this document, the following symbols apply.

D	nominal thread diameter of the nut (basic major diameter of the internal thread), mm
d_h	hole diameter of the grip, mm
F	force, N
F_P	proof load, N
h	thickness of the grip, mm
m	height of the nut, mm
$m_{th,design}$	design thread height of the nut, mm