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**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*



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# Contents

	Page
Foreword.....	v
Introduction.....	vii
<b>1 Scope.....</b>	<b>1</b>
<b>2 Normative references.....</b>	<b>2</b>
<b>3 Terms and definitions.....</b>	<b>2</b>
<b>4 Symbols.....</b>	<b>2</b>
<b>5 Designation systems.....</b>	<b>3</b>
5.1 Nut styles.....	3
5.2 Property classes.....	3
5.2.1 Regular nuts (style 1) and high nuts (style 2).....	3
5.2.2 Thin nuts (style 0).....	4
<b>6 Design of bolt and nut assemblies.....</b>	<b>4</b>
<b>7 Material, heat treatment, chemical composition and steel microstructure.....</b>	<b>4</b>
7.1 General.....	4
7.2 Heat treatment.....	5
7.3 Chemical composition.....	5
7.4 Steel microstructure.....	7
7.4.1 Non-quenched and tempered nuts.....	7
7.4.2 Quenched and tempered nuts.....	7
<b>8 Mechanical and physical properties.....</b>	<b>7</b>
8.1 General.....	7
8.2 Proof load.....	8
8.3 Hardness.....	9
8.4 Surface integrity.....	11
<b>9 Inspection.....</b>	<b>11</b>
9.1 Manufacturer's inspection.....	11
9.2 Supplier's inspection.....	11
9.3 Purchaser's inspection.....	11
9.4 Delivery of test results.....	12
<b>10 Test methods.....</b>	<b>12</b>
10.1 Proof load test.....	12
10.1.1 General.....	12
10.1.2 Applicability.....	12
10.1.3 Apparatus.....	12
10.1.4 Testing device.....	12
10.1.5 Test procedure.....	13
10.1.6 Test results and requirements.....	14
10.2 Hardness tests.....	14
10.2.1 General.....	14
10.2.2 Applicability.....	14
10.2.3 Test methods.....	14
10.2.4 Test procedures for routine inspection.....	14
10.2.5 Hardness determined in the thread.....	16
10.2.6 Hardness determined in the core.....	17
10.2.7 Uniformity of hardness for quenched and tempered nuts (QT).....	18
10.2.8 Requirements for non-quenched and tempered nuts (NQT).....	18
10.2.9 Requirements for quenched and tempered nuts (QT).....	18
10.3 Steel microstructure.....	19
10.3.1 General.....	19
10.3.2 Applicability.....	19

10.3.3	Test method .....	19
10.3.4	Test results and requirements .....	19
10.4	Retempering test .....	19
10.4.1	General .....	19
10.4.2	Test procedure .....	19
10.4.3	Test results and requirements .....	20
10.5	Surface discontinuity inspection .....	20
<b>11</b>	<b>Marking and labelling .....</b>	<b>20</b>
11.1	General requirements .....	20
11.2	Property class marking symbols for nuts with full loadability .....	20
11.3	Property class marking symbols for nuts with reduced loadability .....	21
11.4	Manufacturer's identification mark .....	21
11.5	Nut marking .....	21
11.6	Marking of the packages (labelling) .....	23
<b>Annex A (normative) Thread dimensions of the test mandrel .....</b>		<b>25</b>
<b>Annex B (informative) Design principles for nuts .....</b>		<b>27</b>
<b>Annex C (informative) Stress under proof load, <math>S_p</math> .....</b>		<b>29</b>
<b>Bibliography .....</b>		<b>31</b>

## 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](http://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](http://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 of 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 12, *Fasteners with metric internal thread*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 185, *Fasteners*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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

The main changes 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 specified 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 table 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 has 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 adjusted (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,
  - the test method for hardness determined in the thread has been improved and the 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 clarified (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 revised, 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.

A list of all parts in the ISO 898 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

ISO 898, the basic standard for fasteners with ISO metric thread made of carbon steel and alloy steel, was developed in several parts, and includes diameters 5 mm to 39 mm only for nuts. 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 are under development for bolts, screws, studs and nuts with sizes above 39 mm.

The nuts specified in this document result from the adequate combination of nut heights (regular, style 1 – high, style 2 – thin, style 0), diameter ranges, coarse or fine pitch thread, and property classes in relation to heat treatment (Non-Quenched and Tempered = NQT, or Quenched and Tempered = QT). 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.

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, and 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<sup>[20]</sup> in accordance with the Alexander's theory<sup>[21]</sup>, 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, diameter range and pitch) 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 behaviour 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 were deleted (property class 5 or 9 can be substituted by property class 6 or 10 respectively).





# 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, when tested at the ambient temperature range of 10 °C to 35 °C.

This document applies to nuts:

- with ISO metric thread (see ISO 68-1),
- with diameter/pitch combinations according to ISO 261 and ISO 262,
- with coarse pitch thread M5 to M39, and fine pitch thread M8×1 to M39×3,
- with thread tolerances according to ISO 965-1, ISO 965-2 or ISO 965-5,
- with specified property classes 04, 05, 5, 6, 8, 10 and 12 including proof load,
- of three different nut styles (see 5.1): regular nuts (style 1), high nuts (style 2) and thin nuts (style 0),
- with a minimum outside diameter or width across flats  $s \geq 1,45D$ ,
- able to mate with bolts, screws and studs with property classes in accordance with ISO 898-1 (see Annex B), and
- intended to be used in applications ranging from -50 °C to +150 °C, or up to +300 °C.

**WARNING — Nuts conforming to the requirements of this document are tested at the ambient temperature range of 10 °C to 35 °C and 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 possible that they do not retain the specified mechanical and physical properties at lower and/or elevated temperatures. Therefore, it is the responsibility of the user to determine the appropriate choices based on the service environment conditions of the assembly (see also 7.1).**

For additional specifications applicable to hot dip galvanized nuts, see ISO 10684.

For nuts designed for particular applications, see ISO/TR 16224.

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 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.

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 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/>

## 4 Symbols

$D$	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
$P$	pitch of the thread, mm
$s$	width across flats, mm
$S_p$	stress under proof load, MPa