GB

NATIONAL STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

ICS 21.060.10

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GB/T 3098.2-2015

Replacing GB/T 3098.2-2010, GB/T 3098.4-2000

Mechanical properties of fasteners - Nuts

(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, MOD)

Issued on: December 10, 2015 **Implemented on: January 01, 2017**

Issued by: General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China;

Standardization Administration of the PRC.

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Foreword

GB/T 3098 “Mechanical properties of fasteners” is composed of the following parts:

- GB/T 3098.1 Mechanical properties of fasteners - Bolts, Screws and studs
- GB/T 3098.2 Mechanical properties of fasteners - Nuts;
- GB/T 3098.3 Mechanical properties of fasteners - Set screws;
- GB/T 3098.5 Mechanical properties of fasteners - Tapping screws;
- GB/T 3098.6 Mechanical properties of fasteners - stainless steel bolts, screws and studs;
- GB/T 3098.7 Mechanical properties of fasteners - Thread rolling screws
- GB/T 3098.8 Mechanical properties of fasteners - Components for bolted connections made mainly from materials with a high temperature strength;
- GB/T 3098.9 Mechanical properties of fasteners - Prevailing torque type steel hexagon nuts;
- GB/T 3098.10 Mechanical properties of fasteners - Bolts, screws, studs, and nuts made of non-ferrous metals;
- GB/T 3098.11 Mechanical properties of fasteners - Self-drilling tapping screws;
- GB/T 3098.12 Mechanical properties of fasteners - Cone proof load test on nuts;
- GB/T 3098.13 Mechanical properties of fasteners - Torsional test and minimum torques for bolts and screws with nominal diameters 1mm to 10mm
- GB/T 3098.14 Mechanical properties of fasteners - Fasteners - Mechanical properties - Widening test on nuts;
- GB/T 3098.15 Mechanical properties of fasteners - Nuts made of stainless steel;
- GB/T 3098.16 Mechanical properties of fasteners - Stainless steel set screws;

- GB/T 3098.17 Mechanical properties of fasteners - Preloading test for the detection of hydrogen embrittlement - Parallel bearing surface method;
- GB/T 3098.18 Mechanical properties of fasteners - Blind rivets testing;
- GB/T 3098.19 Mechanical properties of fasteners - Blind rivets with break pull mandrel;
- GB/T 3098.20 Mechanical properties of fasteners - Wing nuts with specified proof torque;
- GB/T 3098.21 Mechanical properties of fasteners - Stainless steel tapping screws;
- GB/T 3098.22 Mechanical properties of fasteners made of the fine grain non-heat treatment steel - Bolts, screws and studs;

This part is part 2 of GB/T 3098.

This part was drafted in accordance with the rules given in GB/T 1.1-2009.

This part replaces GB/T 3098.2-2000 “Mechanical properties of fasteners - Nuts - Coarse thread” and GB/T 3098.4-2000 “Mechanical properties of fasteners - Nuts - Fine pitch thread”.

As compared with GB/T 3098.2-2000 and GB/T 3098.4-2000, the main changes of this part are as follows:

- COMBINE the two standards, MODIFY the standard name;
- ADD the examples for selection and application of low temperature and high temperature steel, AND it may make reference to the contents of EN 10269, ASTM F 2281 and ASTM A 320/A 320M (SEE note 2 of Clause 1);
- SPEFICY the code used in this part (SEE Clause 3);
- SPECIFY the three types of nuts and their markings based on nut height (SEE 4.1);
- ADD the design requirements for the bolt-nut connection (SEE Clause 5, Appendix A);
- ADD that “when a thin nut is used as a lock nut, it shall be used together with a regular nut or high nut. During installation, it shall firstly tighten the thin nut on the assembly part, AND then tighten the regular nut or high nut on the thin nut”; (SEE Clause 5);

- In the reference documents, USE Chinese standards to replace international standards (SEE Clause 2);

- ISO 898-2 makes reference to “ISO286-2 Geometrical product specifications (GPS) - ISO code system for tolerances on linear sizes - Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts” (SEE Clause 2);

- In ISO 898-2, it specifies that “These tests shall be carried out in the manufacturing process or in the final inspection”, which is in contradiction with the provisions of 8.1 for the manufacturer's inspection, so it is not adopted in this part (SEE Clause 7, 8.1);

- In ISO 898-2, it does not specify the basis for hardness conversion; in this part, it specifies that if using the Brinell or Rockwell hardness test, it shall conduct conversion in accordance with ISO 18265:2013 (SEE 9.2.2).

This part was proposed by the China Machinery Industry Federation.

This part shall be under the jurisdiction of the National Standardization Technical Committee on Fasteners (SAC/TC 85).

The responsible drafting organization of this part: China Machine Productivity Promotion Center.

This participating drafting organizations of this part: Haiyan Yuxing Nut Co., Ltd., Shanghai Shenguang High Strength Bolt Co., Ltd., Shanghai Jinma High Strength Fastener Co., Ltd., Hebei Xinde Power Accessories Co., Ltd., Ningbo Jiulong Fastener Manufacturing Co., Ltd. Shandong Gaoqiang Fasteners Co., Ltd., Zhejiang Huarui Standard Parts Co., Ltd., Jinyi Industrial Co., Ltd., Machinery Industry General Parts Product Quality Supervision and Testing Center, Ningbo Mingli Fasteners Co., Ltd.

As for this part, the Secretariat of the National Standardization Technical Committee for Fasteners is responsible for interpretation.

This part replaces the standard previously issued as follows:

- GB/T 3098.2-1982, GB/T 3098.2-2000.

- GB/T 3098.4-1986, GB/T 3098.4-2000.

Mechanical properties of fasteners - Nuts

1 Scope

This part of GB/T 3098 specifies the mechanical and physical properties of the nuts with coarse thread and fine pitch thread made of carbon steel or alloy steel when tested at ambient temperature range of 10 °C to 35 °C.

Nuts conforming to the requirements of this part may not retain the specified mechanical and physical properties at elevated and/or lower temperature.

Note 1: The nuts conforming to the requirements of this part have been used in applications ranging from -50 °C to +150 °C. It is the responsibility of users to consult an experienced fastener material expert for temperatures outside the range of -50 °C to +150 °C and up to a maximum temperature of +300 °C.

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 F 2281 and ASTM A 320/A 320M.

This part is applicable to nuts:

a) Made of carbon steel or alloy steel;

b) With coarse thread M5 ≤ D ≤ M39, and fine pitch thread M8 x 1 ≤ D ≤ M39 x 3;

c) With the ordinary thread in accordance with GB/T 192;

d) With diameter/pitch combinations in accordance with GB/T 193 and GB/T 9144;

e) With the specified property classes, including proof load;

f) With the specified three nut styles: thin nuts, regular nuts, and high nuts;

g) With minimum height $m_{min} \geq 0.45D$;

h) With a minimum outside diameter or width across flats side $s_{min} \geq 1.45D$ (SEE Appendix A);

i) Able to mate with bolts, screws, and studs with property classes in accordance with GB/T 3098.1.

For technical requirements for surface treatment of hot dip galvanized nuts, SEE GB/T 5267.3.

This part does not specify requirements for properties such as:

- Prevailing torque properties (SEE GB/T 3098.9);

- Torque/clamp force properties (SEE GB/T 16823.3 for the test methods);

- Weldability;

- Corrosion resistance.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this document.

GB/T 90.3 Fasteners - Quality assurance system (GB/T 90.3-2010, ISO 16426:2002, IDT)

GB/T 192 General purpose metric screw threads - Basic profile (GB/T 192-2003, ISO 68-1:1998, MOD)

GB/T 193 General purpose metric screw threads - General plan (GB/T 193-2003, ISO 261:1998, MOD)

GB/T 228.1 Metallic materials - Tensile testing - Part 1: Method of test at room temperature (GB/T 228.1-2010, ISO6892-1:2009, MOD)

GB/T 230.1 Metallic materials - Rockwell hardness test - Part 1: Test methods (Scales A, B, C, D, E, F, G, H, K, N, T) (GB/T 230.1-2009, ISO 6508-1:2005, MOD)

GB/T 231.1 Metallic materials - Brinell hardness test - Part 1: Test methods (GB/T 231.1-2009, ISO 6506-1:2005, MOD)

GB/T 3098.1 Mechanical properties of fasteners - Bolts, screws and studs (GB/T 3098.1-2010, ISO 898-1:2009, MOD)

GB/T 3098.9 Mechanical properties of fasteners - Prevailing torque type steel nuts (GB/T 3098.9-2010, ISO 2320:2008, IDT)

GB/T 4340.1 Metallic materials - Vickers hardness test - Part 1: Test methods (GB/T 4340.1-2009, ISO 6507-1:2005, MOD)

GB/T 5267.3 Fasteners - Hot dip galvanized coatings (GB/T 5267.3-2008, ISO 10684:2004, IDT)

GB/T 5779.2 Fasteners - Surface discontinuities - Nuts (GB/T 5779.2-2000, idt ISO 6157-2:1995)

GB/T 6170 Hexagonal nuts, style 1 (GB/T 6170-2000, eqv ISO4032:1999)

GB/T 6175 Hexagonal nuts, style 2 (GB/T 6175-2000, eqv ISO4033:1999)

GB/T 9144 General purpose metric screw threads - Preferable plan (GB/T 9144-2003, ISO 262:1998, MOD)

GB/T 16823.3 Fasteners - Torque/clamp force testing (GB/T 16823.3-2010, ISO 16047:2005, IDT)

GB/T 16825.1 Verification of static uniaxial testing machines - Part 1: Tension/compression testing machines - Verification and calibration of the force-measuring system (GB/T 16825.1-2008, ISO 7500-1:2004, IDT)

ISO/TR 16224 Technical aspects of nut design

ISO 18265:2013 Metallic materials - Conversion of hardness values

3 Symbols

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

D: Nominal thread diameter of the nut, mm

d_h: Hole diameter of the grip, mm

F: Load, N

h: Thickness of the grip, mm

m: Height of the nut, mm

P: Pitch of the thread, mm

s: Width across flats, mm

A decrease of thread stripping strength occurs for nuts with a fundamental deviation greater than zero for tolerance class 6H (such as hot dip galvanized nuts: 6AZ, 6AX). Thin nuts (style 0) have a reduced loadability compared to regular nuts or high nuts, AND are not designed to provide resistance to thread stripping.

Thin nuts used as jam nuts shall be assembled together with a regular nut or high nut. In assemblies with jam nut, the thin nut is first tightened against assembled parts AND then the regular or high nut is tightened against the thin nut.

6 Materials

Table 3 specifies the material and heat treatment for different property classes of nuts.

Nuts with coarse thread and property classes 05, 8 [regular nuts (style 1) with D > M16], 10 and 12 shall be quenched and tempered.

Nuts with fine pitch thread and property classes 05, 6 (with D> M16), 8 [regular nuts (style 1)], 10 and 12 shall be quenched and tempered.

The chemical composition shall be assessed in accordance with the relevant standards.

Note: It is intended that national regulations for the restriction or prohibition of certain chemical elements be taken into account in the countries or regions concerned.

dispute, the test methods in accordance with the provisions of Clause 9 shall apply.

8.3 Purchaser's inspection

The purchaser may test the delivered nuts using the test methods as specified in Clause 9.

In case of dispute, unless otherwise specified, the test methods in accordance with the provisions of Clause 9 shall apply.

9 Test method

9.1 Proof load test

9.1.1 General

The proof load test consists of the following two main operations, namely:

a) Application of a specified proof load by means of a test mandrel (SEE Figure 1 and Figure 2), AND

b) Checking of the damage to the nut thread caused by the proof load, if any.

Note: For the proof load test for prevailing torque type nuts, SEE GB/T 3098.9 for an additional test procedure.

9.1.2 Applicability

This test is applicable to nuts with nominal diameters M5 ≤ D ≤ M39 AND for all property classes.

9.1.3 Apparatus

The tensile testing machine shall be in accordance with GB/T 16825.1, class 1 or better. Side thrust on the nut shall be avoided, e.g. by self-aligning grips.

9.1.4 Testing device

The grips and test mandrel shall comply with the following requirements:

a) Hardness of the grip: ≥ 45HRC;

b) Thickness of the grip: h ≥ 1D;

The axial tensile test or axial compressive test shall be carried out in accordance with GB/T 228.1. The speed of testing, as determined with a free-running cross-head, shall not exceed 3 mm/min.

The proof load as specified in Table 4 for nuts with coarse thread and in Table 5 for fine pitch thread shall be applied AND maintained for 15 s, AND then released.

Exceeding the proof load value shall be minimized.

The test mandrel threads shall be checked after each tested nut. If the thread of the test mandrel is damaged during the test, the test result shall not be valid AND a new test shall be carried out with a conforming mandrel.

9.1.6 Test results

The fact that nut fracture or thread stripping occurs shall be noted.

The fact that the nut has been removed only with the fingers or with the help of a wrench to one half turn maximum shall be noted.

9.1.7 Technical requirements

The nut shall be capable of withstanding the proof load specified in Table 4 or Table 5 without fracture by thread stripping or nut fracture.

The nut shall be removable using the fingers after the release of the proof load (and, if necessary, after a half turn maximum with a wrench).

In case of dispute, the axial tensile test, in accordance with Figure 1, shall be the arbitration method for acceptance.

9.2 Hardness test

9.2.1 Applicability

This test applies to nuts of all sizes and of all property classes.

9.2.2 Test methods

The hardness may be determined using the Vickers, Brinell, or Rockwell hardness test.

The Vickers hardness test shall be carried out in accordance with GB/T 4340.1. The Brinell hardness test shall be carried out in accordance with GB/T 231.1. The Rockwell hardness test shall be carried out in accordance with GB/T 230.1.

9.2.4.1 Quenched and tempered nuts

Surface hardness in accordance with 9.2.3.2 shall meet the requirements as specified in Table 6 for nuts with coarse thread AND in Table 7 for nuts with fine pitch thread.

In case of dispute:

a) For surface hardness in accordance with 9.2.3.2, Vickers hardness test with a load of 98 N (HV 10) shall be the arbitration test method AND the hardness shall meet the requirements as specified in Table 6 or Table 7;

b) For cone hardness, Vickers hardness test in accordance with 9.2.3.3 shall be the arbitration test method AND the hardness shall meet the requirements as specified in Table 6 or Table 7.

9.2.4.2 Non-quenched and tempered nuts

Nuts that are not quenched and tempered shall not exceed the maximum hardness as specified in Table 6 or Table 7. In case of dispute, Vickers hardness determination in accordance with 9.2.3.3 shall be the arbitration test method.

If the minimum hardness requirement is not met when tested in accordance with 9.2.3.2 or 9.2.3.3, this shall not be cause for rejection, provided the proof load requirements in accordance with 9.1.7 are met.

9.3 Surface defect inspection

Surface defect inspection shall be in accordance with the provisions of GB/T 5779.2.

10 Marking

10.1 General

Only those nuts meeting all relevant requirements of this part shall be designated in accordance with the designation system as specified in 4.2 AND marked in accordance with 10.2 to 10.6.

Alternative marking as specified in Table 9 shall be left to the discretion of the manufacturer.

10.2 Identification mark of the manufacturer

Appendix A

(Informative)

Design principles of nuts

A.1 Basic design principles of nuts

A bolted joint basically consists of two workpieces, which are clamped together using an externally threaded part (bolt or screw) on one side AND an internally threaded part or a nut on the other side.

An optimized bolted joint, consisting of a bolt, screw, or stud of a given property class in accordance with GB/T 3098.1 assembled with a regular or high nut of the mating property class in accordance with this part is able to provide a maximum preload, using the full strength of the bolt. In the case of over-tightening, the fracture occurs in the loaded threaded part of the bolt, which gives an obvious indication of a tightening failure.

Under the tensile load, the fracture mode of bolt and nut assemblies corresponds to the lowest value of the following three loads:

a) Thread stripping load in the nut;

b) Thread stripping load in the bolt, screw or stud;

c) Breaking load in the bolt, screw or stud (bolt breaking is the intended fracture mode of bolt and nut assemblies in case of overloading).

These three loads mainly depend on:

- Hardness, height, effective length of the full thread, diameter, pitch and thread tolerance class of the nut;

- Hardness, diameter, pitch and thread tolerance class of the bolt.

In addition, these three loads are linked. For example, an increase of hardness of the bolt can induce an increase of the thread stripping load in the nut. The hardness also determines the functional toughness of the nut and, therefore, an upper limit is specified for each property class.

The analytical basis for the calculation of the different stripping loads has been worked out in the publication by Alexander's “Analysis and Design of Threaded

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