International Standard

ISO 16224

Fasteners — Calculation methods for bolt/nut assemblies — Nut design

Fixations — Méthodes de calcul pour les assemblages vis/écrou — Conception des écrous

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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 document 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).

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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.

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

This first edition of ISO 16224 cancels and replaces the first edition (ISO/TR 16224:2012), which has been technically revised.

The main changes are as follows:

— the type of ISO document has been changed from Technical Report to International Standard;

— the title has been changed to “Fasteners — Calculation methods for bolt/nut assemblies — Nut design”;

— explanations for the loadability of bolt/nut assembly including the influencing factors have been moved to Annex A;

— some editorial corrections have been made on the Formulae (1), (6), (7) and (11);

— the deviations assumed for D_2 and D_1 have been amended (see Table 1);

— Figure 2 was amended to include the nuts with chamfers on both sides;

— the symbol θ was introduced to consider countersunk (chamfer) angles other than 90° (e.g. 110° to 120° for thin nuts);

— for the conversion from the nut material strength R_{mn} to Vickers hardness and vice versa in the range of 130 HV to 303 HV, a regression Formula was introduced, which gives similar values to the original Alexander’s calculation[15];

— the values of minimum hardness, HV_{min}, and corresponding stress under proof load S_p were recalculated and amended considering the above changes (see Tables 2 and 3);

— all the technical backgrounds for the specifications in ISO 898-2:2022 have been explained for traceability of the specified values of minimum hardness and the proof loads (see Annex B);

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— calculations for nuts with sizes M1,6 ≤ *D* < M5 and 39 mm < *D* ≤ 100 mm (not included in ISO 898-2) were added in order to standardize the new nut heights corresponding to style 1 and style 2 as specified in ISO 898-2 (see Annex C).

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.

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Fasteners — Calculation methods for bolt/nut assemblies — Nut design

1 Scope

This document specifies calculation methods for nuts designed to be mated with bolts, screws and studs in accordance with ISO 898-1, for use in bolted joints under tensile loading and for tightening with tension and torsion taking into account the three possible failure modes: bolt breaking, bolt thread stripping and nut thread stripping (see Clause 5).

The terms "bolt" and "nut" are used as the general terms in this document for externally threaded fasteners (i.e. bolts, screws and studs) and internally threaded fasteners (i.e. tapped holes), respectively.

This document is primarily applicable to steel hexagon nuts:

— with ISO metric thread (coarse pitch and fine pitch, see ISO 68-1);

— with diameter/pitch combinations according to ISO 261 and ISO 262;

— with thread tolerances according to ISO 965-1 and ISO 965-2;

— with nominal thread diameters 5 mm ≤ D ≤ 39 mm, and additionally with D < 5 mm and D > 39 mm (see Annex C);

— with a hexagon shape and width across flats $s \geq 1{,}4D$.

The calculation methods are also applicable to non-standard nuts or internally threaded parts with ISO metric threads. However, dimensional factors affecting the rigidity of nuts such as the width across flats, outer diameter of cylindrical nuts or other features (e.g. shape of flange) as well as thread tolerances can affect the loadability of the individual bolt/nut assemblies, see Annex A for influencing factors.

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 898-2, *Fasteners — Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes*

ISO 16047, *Fasteners — Torque/clamp force testing*

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/

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