

TECHNICAL REPORT

**ISO/TR
16224**

First edition
2012-04-01

Technical aspects of nut design

Aspects techniques de conception des écrous



Reference number
ISO/TR 16224:2012(E)

AVA Documents
Document Sharing Hub
© ISO 2012

ISO/TR 16224:2012(E)



COPYRIGHT PROTECTED DOCUMENT

© ISO 2012

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

Foreword	iv
1 Scope	1
2 Normative references	1
3 Symbols	1
4 Design principle	3
4.1 Possible fracture modes in bolt and nut assemblies subjected to tensile load	3
4.2 Calculation of the fracture loads in bolt and nut assemblies	3
4.3 Influencing factors on the loadability of bolt and nut assemblies	6
5 Calculation methods of bolt and nut assemblies in accordance with Alexander's theory	8
5.1 General	8
5.2 Minimum nut height for nuts with specific hardness range	9
5.3 Minimum hardness for nuts with specific nut height	10
5.4 Proof load	11
6 Comparison among specified values in ISO 898-2 and calculated results	11
6.1 General considerations for obtaining the specified values	11
6.2 Calculation of the minimum Vickers hardness (HV) and the stress under proof load (S_p) for individual nuts of style 1 and style 2	11
6.3 Consequences for ISO nut design	14
Bibliography	15

ISO/TR 16224:2012(E)

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.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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/TR 16224 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 12, *Fasteners with metric internal thread*.

Technical aspects of nut design

1 Scope

This Technical Report gives information concerning the design criteria for nuts specified in ISO 898-2 so that, under static tensile overload, the stripping fracture mode is prevented.

The design criteria are also applicable to non-standardized nuts or internally threaded elements with ISO metric screw threads (in accordance with ISO 68-1) mating with bolts. However, dimensional factors such as the width across flats or other features related to rigidity of nuts, and thread tolerances can affect the loadability of the individual bolt and nut assemblies. Therefore, it is intended that verification tests be carried out.

NOTE The terms “bolt” and “nut” are used as the general terms for externally and internally threaded fasteners, respectively.

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 68-1, *ISO general purpose screw threads — Basic profile — Part 1: Metric screw threads*

ISO 724, *ISO general-purpose metric screw threads — Basic dimensions*

ISO 898-1, *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 898-2, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread*

ISO 18265, *Metallic materials — Conversion of hardness values*

3 Symbols

The following symbols apply in this Technical Report.

A_s	actual stress area of the bolt, in mm ²
$A_{s,nom}$	nominal stress area of the bolt specified in ISO 898-1, in mm ²
A_{Sb}	shear area of the bolt threads, in mm ²
A_{Sn}	shear area of the nut threads, in mm ²
C_1	modification factor for nut dilation
C_2	modification factor for thread bending on the bolt stripping strength
C_3	modification factor for thread bending on the nut stripping strength
d	nominal thread diameter of the bolt, in mm
d_1	basic minor diameter conforming to ISO 724, in mm
d_2	basic pitch diameter of the thread according to ISO 724, in mm

ISO/TR 16224:2012(E)

d_3	minor (root) diameter of the bolt, in mm
d_A	equivalent diameter of the stress area A_s , in mm
D	nominal thread diameter of the nut, in mm
D_1	minor diameter of the nut, in mm
D_2	pitch diameter of the nut, in mm
D_c	countersink diameter of the nut, in mm
D_m	mean diameter of bell mouthed section of nut in the effective nut height or the length of thread engagement m_{eff} , in mm
F	tensile load, (general)
F_{Bb}	bolt breaking load, in N
F_m	ultimate tensile load, in N
F_p	proof load, in N
F_S	stripping load of bolt and nut assembly, in N
F_{Sb}	bolt thread stripping load, in N
F_{Sn}	nut thread stripping load, in N
F_u	ultimate clamp force, in N
F_y	yield clamp force, in N
h_c	height of chamfer per end, in mm
H	height of the fundamental triangle of the thread according to ISO 68-1, in mm
m	height of a nut, in mm
m_c	critical nut height giving same probabilities of stripping and breaking failure modes, in mm
m_{eff}	effective nut height, in mm
$m_{eff,c}$	critical effective nut height giving same probabilities of stripping and breaking failure modes, in mm
P	thread pitch, in mm
R_m	tensile strength of the bolt material according to ISO 898-1, in MPa
R_{mn}	tensile strength of the nut material, in MPa
R_s	strength ratio
s	width across flats of the nut, in mm
S_p	stress under proof load, in MPa
x	shear strength/tensile strength ratio
μ_{th}	coefficient of friction between threads
τ_{Bb}	shear strength of the bolt material, in MPa
τ_{Bn}	shear strength of the nut material, in MPa