BS EN 20898-6 : 1992
ISO 898-6 : 1988

Mechanical properties of fasteners

Part 6. Nuts with specified proof load values — Fine pitch thread

The European Standard EN 20898-6 : 1992 has the status of a British Standard

Caractéristiques mécaniques de éléments de fixation — Partie 6: Ecrous avec charges d'épreuve spécifiées — Filetage à pas fin

UDC 621.882.3.082.11

Mechanische Eigenschaften von Verbindungselementen — Teil 6: Muttern mit festgelegten Prüfkräften — Feingewinde

BSi British Standards

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This British Standard, having been prepared under the direction of the General Mechanical Engineering Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 October 1992

The following BSI references relate to the work on this standard:
Committee reference GME/9
Draft for comment 84/77870 DC

ISBN 0 580 21308 0

Amendments issued since publication

Amd. No.	Date	Text affected

Contents

National foreword

This British Standard has been prepared under the direction of the General Mechanical Engineering Standards Policy Committee and is the English language version of EN 20898-6 : 1992, *Mechanical properties of fasteners — Part 6 : Nuts with specified proof load values — Fine pitch thread*, published by the European Committee for Standardization (CEN). EN 20898-6 was produced as a result of international discussion in which the UK took an active part. It is one of a series of standards that are under preparation based on ISO 898.

This Part is identical with ISO 898-6 : 1988 published by the International Organization for Standardization (ISO).

Compliance with a British Standard does not of itself confer immunity from legal obligations.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 20898-6

July 1992

UDC 621.882.3.082.11

Descriptors: Fasteners, nuts : Fasteners, specification, mechanical properties, tests, proof loads, designation, marking

English version

Mechanical properties of fasteners — Part 6 : Nuts with specified proof load values — Fine pitch thread

(ISO 898-6 : 1988)

Caractéristiques mécaniques des éléments de fixation — Partie 6 : Ecrous avec charges d'épreuve spécifiées — Filetage à pas fin (ISO 898-6 : 1988)

Mechanische Eigenschaften von Verbindungselementen — Muttern mit festgelegten Prüfkräften — Feingeweinde (ISO 898-6 : 1988)

This European Standard was approved by CEN on 1992-07-17. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 20898-6 : 1992 E

Foreword

In 1992, CEN Technical Committee CEN/TC 185 'Threaded and non threaded mechanical fasteners and accessories' the secretariat of which is held by DIN decided to submit the International Standard ISO 898-6 : 1988 'Mechanical properties of fasteners — Part 6 : Nuts with specified proof load values — Fine pitch thread' to the formal vote procedure. The result was positive.

In the countries bound to implement this European Standard a national standard identical to this European standard shall be published at the latest by 1993-01-31 and conflicting national standards shall be withdrawn at the latest by 1993-01-31.

According to the CEN/CENELEC Common Rules the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Portugal, Sweden, Switzerland and United Kingdom.

Mechanical properties of fasteners —

Part 6: Nuts with specified proof load values — Fine pitch thread

1 Scope and field of application

This part of ISO 898 specifies the mechanical properties of nuts with specified proof load values:

- with nominal thread diameters, d, from 8 mm up to and including 39 mm;
- of triangular ISO thread and with diameters and pitches according to ISO 68 and ISO 262 (fine pitch thread);
- with thread tolerances 6H according to ISO 965-1 and 965-2;
- with specific mechanical requirements;
- with widths across flats as specified in ISO 272 or equivalent;
- with nominal heights greater than or equal to 0,5 D;
- made of carbon or alloy steel.

It does not apply to nuts requiring special properties such as:

- weldability;
- corrosion resistance (see ISO 3506);
- ability to withstand temperatures above +300 °C or below −50 °C.

NOTES

1 Nuts made from free-cutting steel shall not be used above +250 °C.

2 In case of thread tolerances other or larger than 6H, decrease of the stripping strength should be considered.

Nominal thread diameter d	**Test load, %** Thread tolerances		
mm	6H	7H	6G
8 ≤ d ≤ 16	100	96	97,5
16 < d ≤ 39	100	98	98,5

2 References

ISO 68, *ISO general purpose screw threads — Basic profile.*

ISO 262, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts.*

ISO 272, *Fasteners — Hexagon products — Widths across flats.*

ISO 286-1, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits.*

ISO 724, *ISO metric screw threads — Basic dimensions.*

ISO 965-1, *ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data.*

ISO 965-2, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose bolt and nut threads — Medium quality.*

ISO 6157-2, *Fasteners — Surface discontinuities — Part 2: Nuts with thread sizes* M5 *to* M39.[1]

ISO 6506, *Metallic materials — Hardness test — Brinell test.*

ISO 6507-1, *Metallic materials — Hardness test — Vickers test — Part 1:* HV5 *to* HV100.

ISO 6508, *Metallic materials — Hardness test — Rockwell test (scales A — B — C — D — E — F — G — H — K).*

3 Designation system

3.1 Nuts with nominal heights ≥0,8 D (effective lengths of thread ≥0,6 D)

Nuts with nominal heights ≥0,8 D (effective lengths of thread ≥0,6 D) are designated by a number to indicate the maximum appropriate property class of bolts with which they may be mated.

Failure of threaded fasteners due to over-tightening can occur by bolt shank fracture or by stripping of the threads of the nut and/or bolt. Shank fracture is sudden and therefore easily noticed. Stripping is gradual and therefore difficult to detect; this introduces the danger of partly failed fasteners being left in assemblies.

1) At present at the stage of draft.

Table 1 — Designation system for nuts with nominal heights ⩾ 0,8 D

Property class of nut	Mating bolts		Nuts	
			style 1	style 2
	Property class	Nominal thread diameter range	Nominal thread diameter range	
		mm	mm	
6	⩽ 6.8	d ⩽ 39	d ⩽ 39	—
8	8.8	d ⩽ 39	d ⩽ 39	d ⩽ 16
10	10.9	d ⩽ 39	d ⩽ 16	d ⩽ 39
12	12.9	d ⩽ 16	—	d ⩽ 16

NOTE — In general, nuts of a higher property class can replace nuts of a lower property class. This is advisable for a bolt/nut assembly going into a stress higher than the yield stress or the stress under proofing load of the bolt.

It would therefore be desirable to design threaded connections so that their mode of failure would always be by shank fracture but unfortunately, because of the many variables which govern stripping strength (nut and bolt material strengths, thread clearances, across-flats dimensions, etc.) nuts would have to be excessively thick to guarantee this mode in all cases.

A bolt or screw assembled with a nut of the appropriate property class, in accordance with table 1, is intended to provide an assembly capable of being tightened to the bolt proofing load without thread stripping occurring.

However, should tightening beyond bolt proofing load take place, the nut design is intended to ensure at least 10 % of the overtightened assemblies fail through bolt breakage in order to warn the user that this installation practice is not appropriate.

NOTE — For more detailed information on the strength of screw thread assemblies, see the annex to ISO 898-2.

3.2 Nuts with nominal heights ⩾ 0,5 D and < 0,8 D (effective heights of thread ⩾ 0,4 D and < 0,6 D)

Nuts with nominal heights ⩾ 0,5 D and < 0,8 D (effective height of thread ⩾ 0,4 D and < 0,6 D) are designated by a combination of two numbers: the second indicates the nominal stress under proof load on a hardened test mandrel, while the first indicates that the loadability of a bolt/nut assembly is reduced in comparison with the loadability on a hardened test mandrel and also in comparison with a bolt/nut assembly as described in 3.1. The effective loading capacity is not only determined by the hardness of the nut and the effective height of thread but also by the tensile strength of the bolt with which the nut is assembled. Table 2 gives the designation system and the stresses under proof load of the nuts. Proof loads are shown in table 5. A guide for minimum expected stripping strengths of the joints when these nuts are assembled with bolts of various bolt classes is shown in table 6.

Table 2 — Designation system and stresses under proof load for nuts with nominal heights ⩾ 0,5 D and < 0,8 D

Property class of nut	Nominal stress under proof load	Actual stress under proof load
	N/mm²	N/mm²
04	400	380
05	500	500

4 Materials

Nuts shall be made of steel conforming to the chemical composition limits specified in table 3.

Table 3 — Limits of chemical composition

Property class		Chemical composition limits (check analysis), %			
		C max.	Mn min.	P max.	S max.
6	—	0,50	—	0,110	0,150
8	04[1)]	0,58	0,25	0,060	0,150
10[2)]	05[2)]	0,58	0,30	0,048	0,058
12[2)]	—	0,58	0,45	0,048	0,058

1) Nuts of this property class may be manufactured from free-cutting steel unless otherwise agreed between the purchaser and manufacturer. In such cases the following maximum sulfur, phosphorus and lead contents are permissible:

sulfur 0,34 %; phosphorus 0,11 %; lead 0,35 %

2) Alloying elements may be added if necessary to develop the mechanical properties of the nuts.

5 Mechanical properties

When tested by the methods described in clause 8, the nuts shall have the mechanical properties set out in table 4.

Table 4 — Mechanical properties

<table>
<tr><th rowspan="3">Nominal thread diameter
d</th><th colspan="10">Property class</th></tr>
<tr><th colspan="5">04</th><th colspan="5">05</th></tr>
<tr><th>Stress under proof load
S_p</th><th colspan="2">Vickers hardness
HV</th><th colspan="2">Nut</th><th>Stress under proof load
S_p</th><th colspan="2">Vickers hardness
HV</th><th colspan="2">Nut</th></tr>
<tr><th>mm</th><th>N/mm²</th><th>min.</th><th>max.</th><th>state</th><th>style</th><th>N/mm²</th><th>min.</th><th>max.</th><th>state</th><th>style</th></tr>
<tr><td>$8 \leq d \leq 39$</td><td>380</td><td>188</td><td>302</td><td>not quenched nor tempered</td><td>thin</td><td>500</td><td>272</td><td>353</td><td>quenched and tempered</td><td>thin</td></tr>
</table>

<table>
<tr><th rowspan="3">Nominal thread diameter
d</th><th colspan="15">Property class</th></tr>
<tr><th colspan="5">6</th><th colspan="10">8</th></tr>
<tr><th>Stress under proof load
S_p</th><th colspan="2">Vickers hardness
HV</th><th colspan="2">Nut</th><th>Stress under proof load
S_p</th><th colspan="2">Vickers hardness
HV</th><th colspan="2">Nut</th><th>Stress under proof load
S_p</th><th colspan="2">Vickers hardness
HV</th><th colspan="2">Nut</th></tr>
<tr><th>mm</th><th>N/mm²</th><th>min.</th><th>max.</th><th>state</th><th>style</th><th>N/mm²</th><th>min.</th><th>max.</th><th>state</th><th>style</th><th>N/mm²</th><th>min.</th><th>max.</th><th>state</th><th>style</th></tr>
<tr><td>$8 \leq d \leq 10$</td><td>770</td><td rowspan="2">188</td><td rowspan="4">302</td><td rowspan="4">not quenched nor tempered[1)]</td><td rowspan="4">1</td><td rowspan="2">955</td><td rowspan="2">250</td><td rowspan="4">353</td><td rowspan="4">quenched and tempered</td><td rowspan="4">1</td><td rowspan="2">890</td><td rowspan="2">195</td><td rowspan="2">302</td><td rowspan="4">not quenched nor tempered</td><td rowspan="2">2</td></tr>
<tr><td>$10 < d \leq 16$</td><td>780</td></tr>
<tr><td>$16 < d \leq 33$</td><td>870</td><td rowspan="2">233</td><td>1 030</td><td rowspan="2">295</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">–</td></tr>
<tr><td>$33 < d \leq 39$</td><td>930</td><td>1 090</td></tr>
</table>

1) For thread diameters above 16 mm, nuts may be quenched and tempered at the discretion of the manufacturer.

<table>
<tr><th rowspan="3">Nominal thread diameter
d</th><th colspan="15">Property class</th></tr>
<tr><th colspan="10">10</th><th colspan="5">12</th></tr>
<tr><th>Stress under proof load
S_p</th><th colspan="2">Vickers hardness
HV</th><th colspan="2">Nut</th><th>Stress under proof load
S_p</th><th colspan="2">Vickers hardness
HV</th><th colspan="2">Nut</th><th>Stress under proof load
S_p</th><th colspan="2">Vickers hardness
HV</th><th colspan="2">Nut</th></tr>
<tr><th>mm</th><th>N/mm²</th><th>min.</th><th>max.</th><th>state</th><th>style</th><th>N/mm²</th><th>min.</th><th>max.</th><th>state</th><th>style</th><th>N/mm²</th><th>min.</th><th>max.</th><th>state</th><th>style</th></tr>
<tr><td>$8 \leq d \leq 10$</td><td>1 100</td><td rowspan="2">295</td><td rowspan="2">353</td><td rowspan="2">quenched and tempered</td><td rowspan="2">1</td><td rowspan="2">1 055</td><td rowspan="2">250</td><td rowspan="4">353</td><td rowspan="4">quenched and tempered</td><td rowspan="4">2</td><td rowspan="2">1 200</td><td rowspan="2">295</td><td rowspan="2">353</td><td rowspan="2">quenched and tempered</td><td rowspan="2">2</td></tr>
<tr><td>$10 < d \leq 16$</td><td>1 110</td></tr>
<tr><td>$16 < d \leq 33$</td><td>–</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">1 080</td><td rowspan="2">260</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">–</td><td rowspan="2">–</td></tr>
<tr><td>$33 < d \leq 39$</td><td>–</td></tr>
</table>

NOTE – Minimum hardness is mandatory for heat-treated nuts and for nuts too large to be proof-load tested. For all other nuts, minimum hardness is not mandatory but is provided for guidance only.

Table 5 — Proof load values

Thread $d \times P$	Nominal stress area of the mandrel A_s	Property class							
		04	05	6	8		10		12
		Proof load ($A_s \times S_p$), N							
	mm²			style 1	style 1	style 2	style 1	style 2	style 2
M8 × 1	39,2	14 900	19 600	30 200	37 400	34 900	43 100	41 400	47 000
M10 × 1	64,5	24 500	32 200	49 700	61 600	57 400	71 000	68 000	77 400
M10 × 1,25	61,2	23 300	30 600	47 100	58 400	54 500	67 300	64 600	73 400
M12 × 1,25	92,1	35 000	46 000	71 800	88 000	82 000	102 200	97 200	110 500
M12 × 1,5	88,1	33 500	44 000	68 700	84 100	78 400	97 800	92 900	105 700
M14 × 1,5	125	47 500	62 500	97 500	119 400	111 200	138 800	131 900	150 000
M16 × 1,5	167	63 500	83 500	130 300	159 500	148 600	185 400	176 200	200 400
M18 × 1,5	215	81 700	107 500	187 000	221 500	—	—	232 200	—
M18 × 2	204	77 500	102 000	177 500	210 100	—	—	220 300	—
M20 × 1,5	272	103 400	136 000	236 600	280 200	—	—	293 800	—
M20 × 2	258	98 000	129 000	224 500	265 700	—	—	278 600	—
M22 × 1,5	333	126 500	166 500	289 700	343 000	—	—	359 600	—
M22 × 2	318	120 800	159 000	276 700	327 500	—	—	343 400	—
M24 × 2	384	145 900	192 000	334 100	395 500	—	—	414 700	—
M27 × 2	496	188 500	248 000	431 500	510 900	—	—	535 700	—
M30 × 2	621	236 000	310 500	540 300	639 600	—	—	670 700	—
M33 × 2	761	289 200	380 500	662 100	783 800	—	—	821 900	—
M36 × 3	865	328 700	432 500	804 400	942 800	—	—	934 200	—
M39 × 3	1 030	391 400	515 000	957 900	1 123 000	—	—	1 112 000	—

6 Proof load values

Proof load values are given in table 5.

The nominal stress area, A_s, is calculated as follows:

$$A_s = \frac{\pi}{4} \left(\frac{d_2 + d_3}{2} \right)^2$$

where

d_2* is the basic pitch diameter of the external thread;

d_3 is the minor diameter of the external thread

$$d_3 = d_1 - \frac{H}{6};$$

where

d_1* is the basic minor diameter of the external thread;

H is the height of the fundamental triangle of the thread.

7 Failure loads for nuts with nominal heights of ⩾ 0,5 D and < 0,8 D

The values of failure loads given for guidance in table 6 apply to different bolt classes. Bolt stripping is the expected failure mode for lower strength bolts, while nut stripping can be expected for bolts of higher property classes.

Table 6 — Minimum stripping strength of nuts in % of the proofing load of bolts

Property class of the nut	Stripping strength of nuts in % of the proofing load of bolts with property classes			
	6.8	8.8	10.9	12.9
04	85	65	45	40
05	100	85	60	50

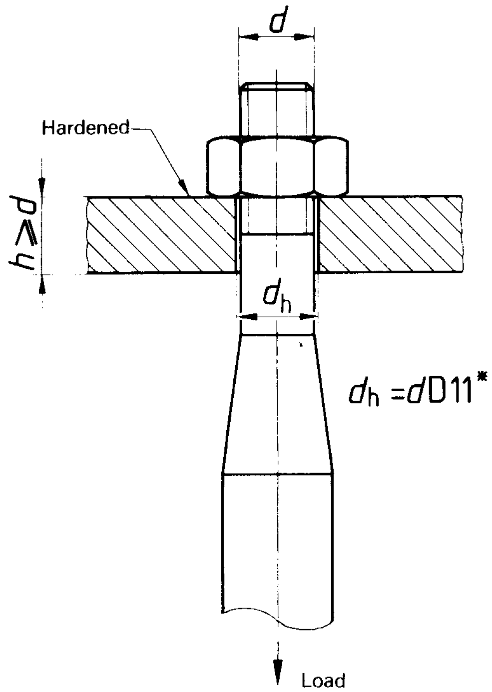
8 Test methods

8.1 Proof load test

The proof load test shall be used wherever the capacity of available testing equipment permits, and shall be the referee method.

* See ISO 724.

The nut shall be assembled on a hardened and threaded test mandrel as shown in figure 1 or 2. For referee purposes, the axial tensile test is decisive.



* D11 is extracted from ISO 286-1

Figure 1 — Axial tensile test

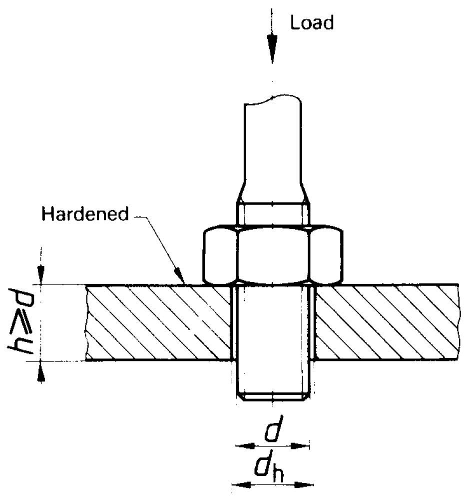


Figure 2 — Axial compressive test

The proof load shall be applied against the nut in an axial direction, and shall be held for 15 s. The nut shall resist the load without failure by stripping or rupture, and shall be removable by the fingers after the load is released. If the thread of the mandrel is damaged during the test, the test should be discarded. (It may be necessary to use a manual wrench to start the nut in motion. Such wrenching is permissible provided that it is restricted to one half turn and that the nut is then removable by the fingers.)

The hardness of the test mandrel shall be 45 HRC minimum.

Mandrels used shall be threaded to tolerance class 5h6g except that the tolerance of the major diameter shall be the last quarter of the 6g range on the minimum material side.

8.2 Hardness test

For routine inspection, hardness tests shall be carried out on one bearing surface of the nut and the hardness shall be taken as the mean of three values spaced 120° apart. In case of dispute, the hardness tests shall be carried out on a longitudinal section through the nut axis and with impressions placed as close as possible to the nominal major diameter of the nut thread.

The Vickers hardness test is the referee test, and where practicable a load of HV 30 shall be applied.

If Brinell and Rockwell tests are applied, the conversion tables in accordance with the appropriate ISO publications shall be used.

The Vickers hardness test shall be carried out in accordance with the requirements of ISO 6507-1.

The Brinell hardness test shall be carried out in accordance with the requirements of ISO 6506.

The Rockwell hardness test shall be carried out in accordance with the requirements of ISO 6508.

8.3 Surface integrity test

For the surface integrity test, see ISO 6157-2.

9 Marking

9.1 Symbols

Marking symbols are shown in tables 7 and 8.

9.2 Identification

Hexagon nuts of property classes equal to or higher than 8 and property class 05 shall be marked in accordance with the designation system described in clause 3, by indenting on the side or bearing surface, or by embossing on the chamfer. See figures 3 and 4. Embossed marks shall not protrude beyond the bearing surface of the nut.

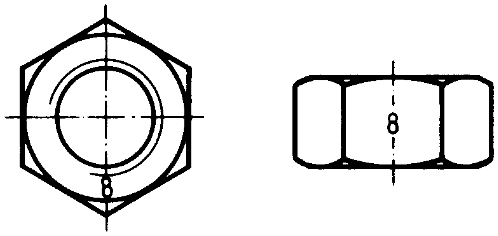


Figure 3 — Examples of marking with designation symbol

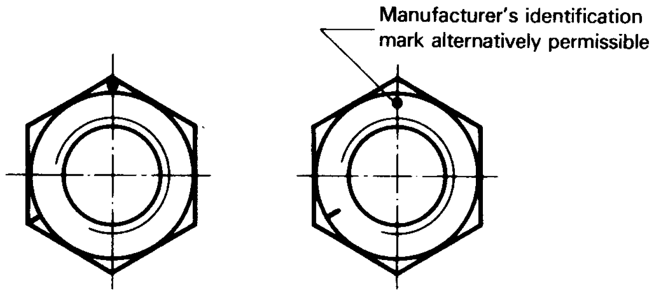


Figure 4 — Examples of marking with code symbol (clock-face system)

Table 7 — Marking symbols for nuts with property classes according to 3.1

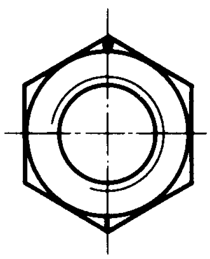
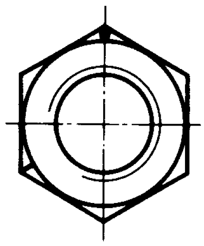
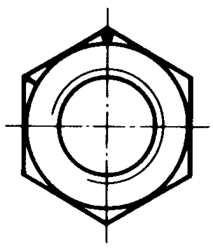
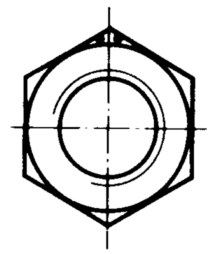
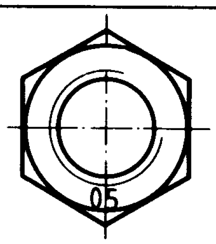
	Property class	6	8	10	12
Alternative marking	either designation symbol	6	8	10	12
	or code symbol (clock-face system)				

Table 8 — Marking for nuts with property classes according to 3.2

Property class	04	05
Marking	no marking	

9.3 Marking of left-hand thread

Nuts with a left-hand thread shall be marked as shown in figure 5 on one bearing surface of the nut by indenting.

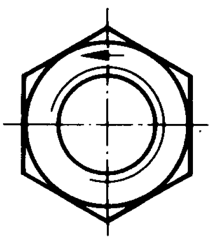
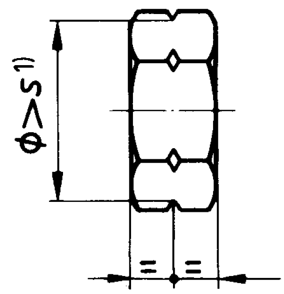


Figure 5 — Left-hand thread marking

Alternative marking for left-hand thread may be used as shown in figure 6.



1) s = width across flats

Figure 6 — Alternative left-hand thread marking

9.4 Alternative marking

Alternative or optional permitted marking as stated in 9.1 to 9.3 should be left to the choice of the manufacturer.

9.5 Trade (identification) marking

The trade (identification) marking of the manufacturer is mandatory on all products covered by the obligatory marking requirements for property classes, provided this is possible for technical reasons. Packages, however, shall be marked in any case.

blank

National annex NA (informative)

Committees responsible

The United Kingdom participation in the preparation of this European Standard was entrusted by the General Mechanical Engineering Standards Policy Committee (GME/-) to Technical Committee GME/9, upon which the following bodies were represented:

BEAMA Ltd.
British Constructional Steelwork Association Ltd.
British Industrial Fasteners Federation
British Railways Board
British Steel Industry
British Steel Industry (Wire Section)
Gauge and Tool Makers' Association
Ministry of Defence
Society of Motor Manufacturers and Traders Ltd.
Washer Manufacturers' Association of Great Britain

The following bodies also participated in the preparation of the standard, through subcommittees and panels:

British Turned-parts Manufacturers' Association
EEA (the Electronic and Business Equipment Association)
Institute of Metal Finishing
Metal Finishing Association
Stainless Steel Fabricators Association of Great Britain

National annex NB (informative)

Cross-references

Publication referred to	Corresponding British Standard
ISO 68 : 1973	BS 3653 *ISO metric screw threads*
ISO 262 : 1973	Part 1 : 1981 *Principles and basic data*
ISO 724 : 1978	
ISO 965-1 : 1980	
ISO 272 : 1982	BS 3692 : 1967 *Specification for ISO metric precision hexagon bolts, screws and nuts. Metric units*
	BS 4190 : 1967 *Specification for ISO metric black hexagon bolts, screws and nuts*
	BS 4395 *Specification for high strength friction grips bolts and associated nuts and washers for structural engineering* Part 1 : 1989 *General grade* Part 2 : 1969 *Higher grade bolts and nuts and general grade washers* BS 4929 *Specification for steel hexagon prevailing-torque type nuts* Part 1 : 1973 *Metric sizes*
ISO 286-1 : 1988	BS 4500 *ISO limits and fits* Part 1 *General tolerances and deviations* Section 1.1 : 1990 *Specification for bases of tolerances, deviations and fits*
ISO 6508 : 1986	BS 891 : 1989 *Methods for hardness test (Rockwell method) and for verification of hardness testing machines (Rockwell method)*

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ISBN 0 580 21308 0

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