UDC 621.882.3 : 620.191 July 1991

Fasteners

Surface discontinuities

Nuts

English version of DIN EN 493 : 1992

DIN EN 493

Verbindungselemente; Oberflächenfehler; Muttern

Supersedes DIN 267 Part 20, October 1984 edition, and DIN 267 Part 21, June 1981 edition.

European Standard EN 493 : 1992 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

Following the publication of a series of European Standards on hexagon nuts based on ISO Standards, there is a growing demand for a European Standard dealing with surface discontinuities that may occur during the manufacture and processing of nuts. An ISO Standard (ISO 6157-2) covering this matter is currently in preparation. Since its date of publication cannot be predicted, CEN/TC 185 decided to prepare a European Standard based on ISO 6157-2 (at present at the stage of draft) as well as on two further committee drafts dealing with the widening test and the cone proof load test on nuts (both methods have been included in normative annexes to the present standard).

In the foreword to EN 20 898-2 (identical to ISO 898-2), reference is made to the present standard, which points out that there is a connection between the European Standards on hexagon nuts and the European Standard on surface discontinuities on nuts. It is intended to adopt ISO 6157-2, together with the ISO Standards on the widening and the cone proof load tests on nuts, once published, as a European Standard, which will then supersede EN 493.

The DIN Standards corresponding to the European Standard and International Standards referred to in clause 2 of the EN are as follows:

European Standard/ISO Standard	DIN Standard
EN 20 898-2	DIN ISO 898 Part 2
ISO 468	DIN 4763
ISO 898-6	DIN EN 20 898 Part 6
ISO 2320	DIN 267 Part 15
ISO 3269	DIN ISO 3269 *)

*) At present at the stage of draft.

Continued overleaf.

EN comprises 12 pages.

Standards referred to

(and not included in **Normative references**)

DIN 267 Part 15	Fasteners; technical delivery conditions; prevailing torque type nuts
DIN 4763	Grading of values for surface roughness parameters
DIN ISO 898 Part 2	Mechanical properties of fasteners; nuts with specified proof load values
DIN EN 20898 Part 6	Mechanical properties of fasteners; nuts with specified proof load values; fine pitch thread
ISO/DIS 6157-2	Fasteners; surface discontinuities; nuts with thread sizes M 5 to M 39
ISO/DIS 10485	Cone proof load test on nuts

Previous editions

DIN 267 Part 20: 05.81, 10.84; DIN 266: 03.31; DIN 589: 07.31, 01.34; DIN Kr 550: 03.36; DIN 267 Parts 1 and 2: 04.37; DIN 267: 06.40, 01.43, 01.54, 12.60; DIN 267 Part 4: 05.68, 10.71; DIN 267 Part 21: 06.81.

Amendments

In comparison with DIN 267 Part 20, October 1984 edition, the following amendments have been made.

a) The opening width of forging cracks is no longer specified.
b) Limits for cracks in the locking element have been specified.
c) The permissible depth of shear bursts is no longer specified.
d) The permissible depth of bursts is no longer specified.
e) A maximum seam depth for all thread sizes has been specified.
f) The permissible seam width is no longer specified.
g) R_a (instead of R_z) has been specified as the surface roughness parameter for tool marks.
h) Sampling shall be carried out as specified in ISO 3269.
i) Specifications for the widening test and the cone proof load test have been included in annexes.

In comparison with DIN 267 Part 21, June 1981 edition, the following amendments have been made.

a) Comparative measurements for nuts of highly ductile material are no longer specified.
b) Specifications for nuts of free cutting steel are no longer included.

International Patent Classification

F 16 B 37/00
F 16 B 39/42
F 16 B 43/00
G 01 B 21/30
G 01 M 13/00

Editor's note

This standard reproduces the official text of the English version of EN 493 as issued by CEN. In its preparation for publication as DIN EN 493 (English version), one point has been noted which we consider to be in need of correction. This has been marked +). The suggested amendment is given below and will be forwarded to the responsible CEN Secretariat for its consideration.

In presentation, orthography, punctuation and hyphenation, the aim has been to implement the PNE Rules consistently. Obvious errors (e.g. redundancies and omissions) have been rectified without further reference.

Suggested amendment

For ease of comprehension, the last paragraph of A.3 should be amended to read: 'The nut shall be deemed to have failed if it breaks completely before the minimum specified widening value is reached. In cases of doubt, the nut may be severed at a point opposite the fracture and, if it then falls into two separate parts, be deemed to have failed.'

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 493

May 1992

UDC 621.882.3 : 620.191

Descriptors: Fasteners, nuts, appearance, surface defects, limits.

English version

Fasteners

Surface discontinuities

Nuts

Eléments de fixation; défauts de surface; écrous

Verbindungselemente; Oberflächenfehler; Muttern

This European Standard was approved by CEN on 1992-05-15.

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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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 493 : 1992 E

Foreword

This European Standard has been prepared by CEN/TC 185 'Threaded and non-threaded mechanical fasteners and accessories' and was submitted to the Unique Acceptance Procedure.

National standards identical to this European Standard shall be published, and conflicting national standards withdrawn, by 1992-11-30 at the latest.

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

1 Scope

1.1 This European Standard establishes limits for various types of surface discontinuities on nuts with

- nominal thread diameters from 5 up to and including 39 mm
- product grades A and B
- all property classes according to EN 20 898-2, ISO 898-6 *) and ISO 2320 unless otherwise specified in product standards or by the purchaser.

1.2 In case of the permissible limits for surface discontinuities indicated in clause 3, properties according to EN 20 898-2, ISO 898-6 *) and ISO 2320, as appropriate, must be satisfied. In addition, the dimensional requirements specified in the relevant product standard must be satisfied.

NOTES: The figures in clause 3 are examples only. They apply by analogy to other types of nuts.

For clarity, some of the figures show the surface discontinuities in an exaggerated manner.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendment to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 20 898-2	Mechanical properties of fasteners. Part 2: Nuts with specified proof load values
ISO 468 : 1982	Surface roughness; parameters, their values and general rules for specifying requirements
ISO 898-6 : 1988	Mechanical properties of fasteners; nuts with specified proof load values, fine pitch thread *)
ISO 2320 : 1983	Prevailing torque type steel hexagon nuts; mechanical and performance properties
ISO 3269 : 1988	Fasteners; acceptance inspection

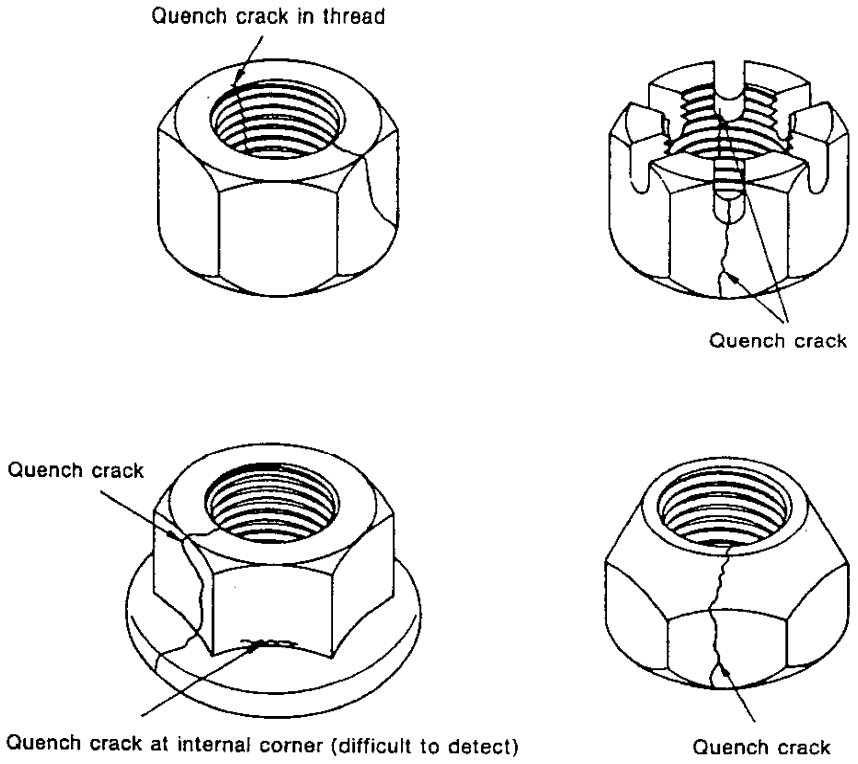
3 Types, causes and appearance of and limits for surface discontinuities

3.1 Cracks

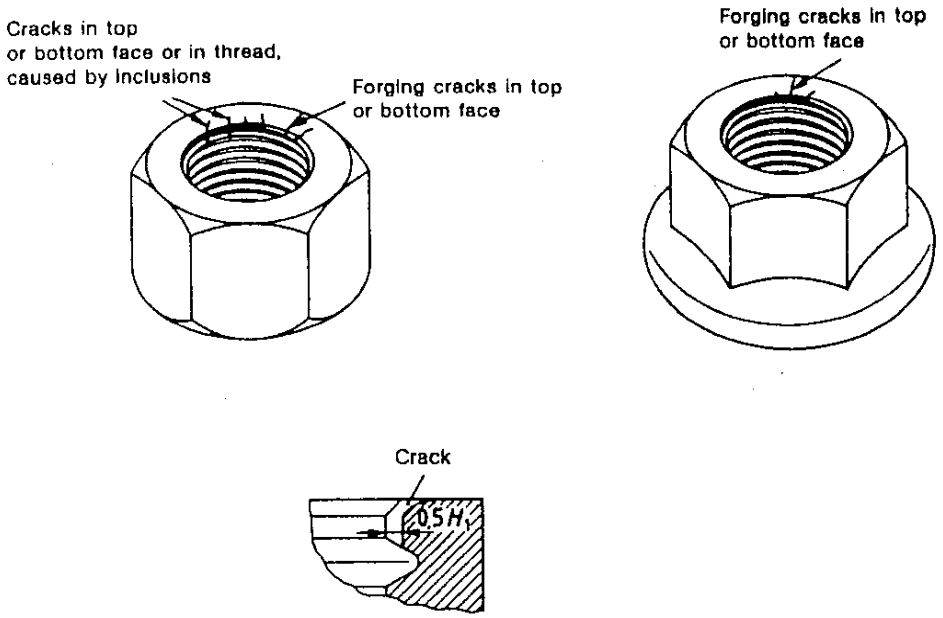
A crack is a clean (crystalline) fracture passing through or across the grain boundaries and may possibly follow inclusions for foreign elements. Cracks are normally caused by overstressing the metal during forging or other forming operations, or during heat treatment, or may have been present in the raw material.

*) Adopted as EN 20 898-6.

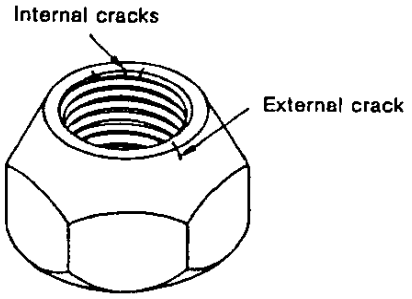
3.1.1 Quench cracks

Cause	Quench cracks may occur during heat treatment. Such cracks usually appear as irregular and branched pathways on any surface of the nut.
Appearance	
Limits	Quench cracks of any depth, any length or in any location are not permitted.

3.1.2 Forging cracks and inclusion cracks

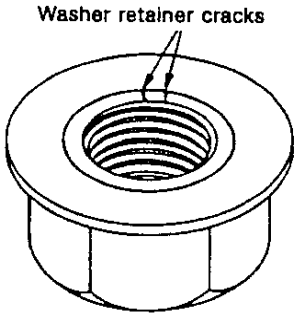
Cause	Forging cracks may occur during the cut-off or forging operations and are located only in the top and bottom face of the nuts or in the intersection of the face and flat. Inclusion cracks are caused by non-metallic inclusions inherent in the raw material.
Appearance	
Limits	Cracks located in the top and bottom faces shall be permitted provided that: – there are no more than two forging cracks which extend across the full width of the bearing face neither of which shall exceed a depth of 0,05 d (in the case of flange nuts, cracks in the area between s and d_w are not permitted); – no crack extends into the tapped hole beyond the first full thread; – no crack in the first full thread exceeds a depth of 0,5 H_1. d – nominal thread diameter d_w – external diameter of the bearing face H_1 – effective thread height, $H_1 = 0{,}541\,P$ (P = pitch of thread) s – width across flats

3.1.3 Cracks in the locking element of all metal prevailing torque type nuts

Cause	Cracks in the locking element of all metal prevailing torque type nuts may occur during the cut-off, forging or deflecting process and are either on the external or internal face.
Appearance	
Limits	Cracks in the locking element resulting from the forging process shall be permitted provided that all mechanical and functional requirements are met and that – there are no more than two cracks which extend over the full width of the crown circle, neither of which shall exceed a depth of 0,05 d, – no crack extends into the tapped hole beyond the first full thread, – no crack in the first full thread exceeds a depth of 0,5 H_1. Cracks in the locking element resulting from the deflecting process are not permitted. d – nominal thread diameter $H_1 = 0{,}541\ P$

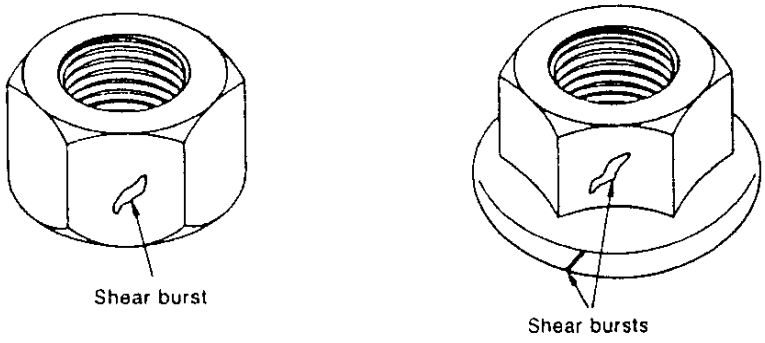
3.1.4 Cracks in the washer retainer

A crack in the washer retainer is an opening in a lip or hub of metal used for securing a washer on a nut.

Cause	Washer retainer cracks may occur when pressure is applied to the lip or hub during assembly of the washer.
Appearance	
Limits	Washer retainer cracks are permissible if limited to the contour of the lip or hub used for retaining purposes provided that the washer is securely held and able to rotate freely.

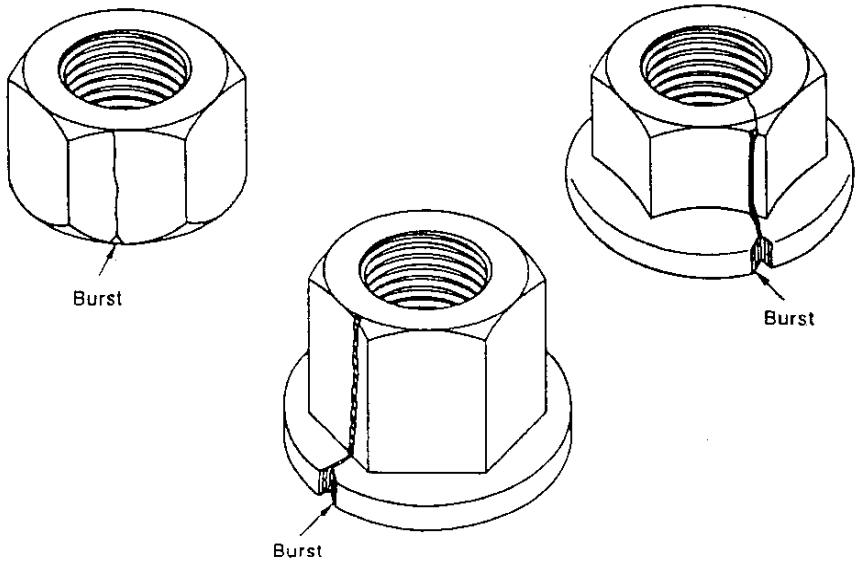
3.2 Shear bursts

Shear bursts are open breaks in the surface of the metal.

Cause	Shear bursts occur, for example, during forging operations on the external surfaces of nuts and at the periphery of flange nuts. Shear bursts are located at approximately 45° to the axis of the nut.
Appearance	
Limits	No shear burst in the flats of hexagon nuts shall extend into the bearing faces of the nut or crown circle of the flange nut. Shear bursts occurring at the intersection of two wrenching flats shall not reduce the width across corners below specified minimum values. Shear bursts at the periphery of the flange of flange nuts are allowed providing they do not extend into the minimum diameter of the bearing face, d_w.

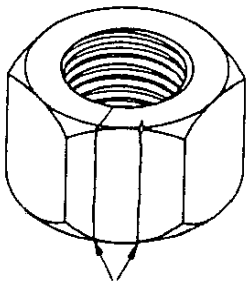
3.3 Bursts

Bursts are open breaks in the surface of the metal.

Cause	Bursts may occur, for example, during forging operations on the external surfaces of nuts and at the periphery of flanged nuts because of surface discontinuities in the raw material.
Appearance	
Limits	If a burst occurs in connection with a seam resulting from the raw material, the seam may extend into the crown circle (see 3.4), but not the burst. Bursts occurring at the intersection of two wrenching flats shall not reduce the width across corners below specified minimum values. No burst located at the intersection of top or bottom face with a wrenching flat shall have a width greater than 0,25 mm + 0,02 s. Bursts at the periphery of the flange of flange nuts are allowed providing they do not extend into the minimum diameter of the bearing face, d_w, and the width of the burst does not exceed 0,08 d_c. d_c – flange diameter s – width across flats

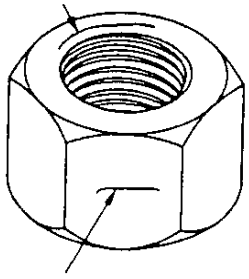
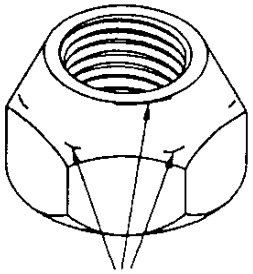
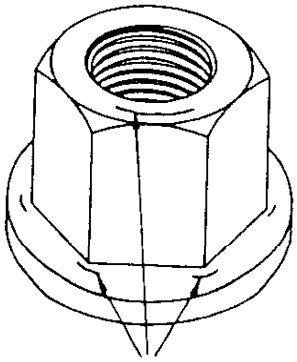
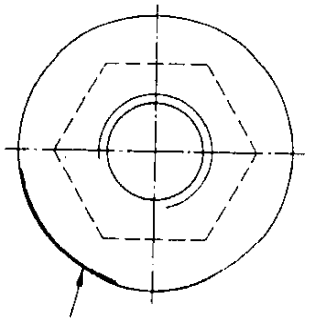
3.4 Seams

A seam is a longitudinal surface discontinuity in the form of an unwelded open fold in the material.

Cause	Seams are usually inherent in the raw material from which fasteners are made.
Appearance	 Seams
Limits	Seams shall be permitted provided that a depth from the surface of 0,05 d for all thread sizes is not exceeded. d – nominal thread diameter

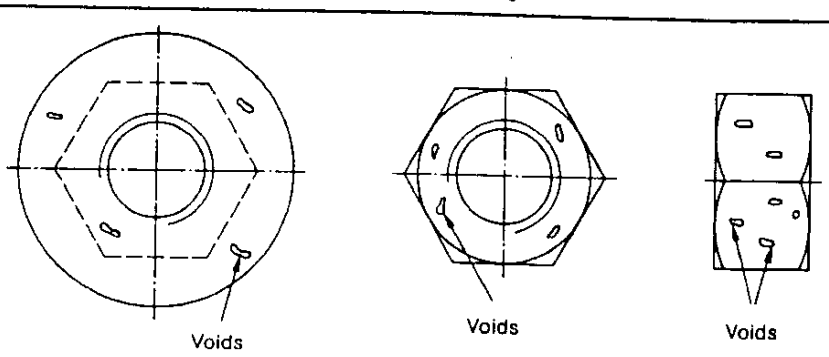
3.5 Folds

A fold is a doubling over of metal which occurs at the surface of the nut during forging.

Cause	Folds may be produced by material displacements during forging operations on nuts at or near the intersection of diameter changes or on the top or bottom face of the nut.
Appearance	Fold on top or bottom face  Fold on side  Folds  Folds  Fold at periphery of bearing face of flange nuts
Limits	Folds shall be permitted except that those located at the intersection of the flange periphery and bearing face of flange nuts shall not intrude into the bearing surface.

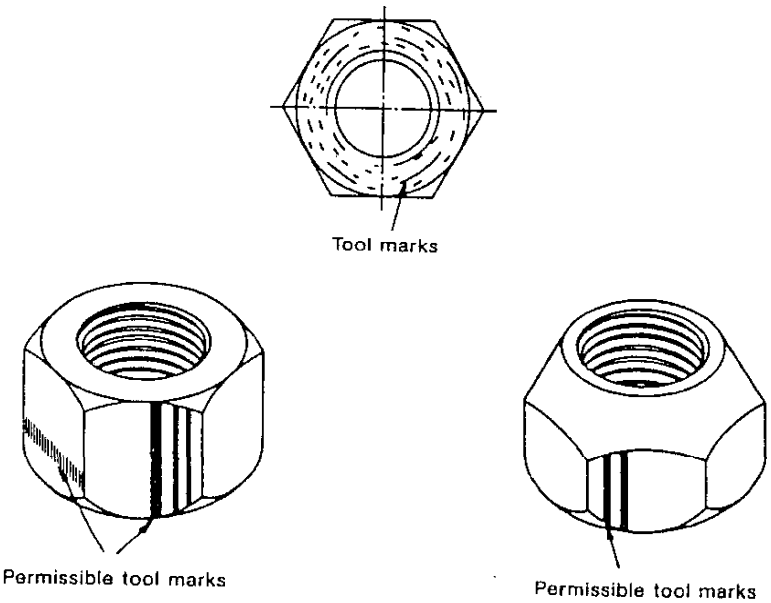
3.6 Voids

A void is a shallow pocket or hollow on the surface of a nut due to non-filling of metal during forging or upsetting.

Cause	Voids are produced by marks or impressions of chips (shear burrs) or by rust formation on the raw material. They are not planished during forging or upsetting.
Appearance	
Limits	Depth of voids: $\leq 0{,}02\ d$; 0,25 mm max. Area of all voids: The combined surface area of all voids on the bearing face shall not exceed 5 % of the bearing surface for nuts with thread diameters up to and including 24 mm, and 10 % of the bearing surface for nuts with thread diameters over 24 mm. d – nominal thread diameter

3.7 Tool marks

Tool marks are longitudinal or circumferential grooves of shallow depth.

Cause	Tool marks are produced by a relative motion of workpiece and manufacturing tool. Tool marks are most frequently elongated or circumferential.
Appearance	
Limits	Tool marks on the bearing surface shall not exceed a surface roughness, R_a, of 3,2 µm when tested in accordance with ISO 468. Tool marks on other surfaces are allowed.

3.8 Damage

Damage is any indentation on the nut surface.

Cause	Damage (e.g. dents, scrapes, nicks and gouges) is caused by external action during handling and transport.
Appearance	No precise geometrical shape, location or direction; identifiable as external action.
Limits	Damage as described above shall not cause rejection unless it impairs usability. Moreover, 1.2 applies. If necessary, special packing and handling procedures are to be used in order to avoid unacceptable damage during transport.

4 Inspection and evaluation procedure

Sampling shall be carried out in accordance with ISO 3269, using the following procedures.

4.1 Principles

For routine acceptance purposes, visual inspection procedures may be used to ensure that products conform to this standard.

For referee purposes, nuts shall satisfy the widening test; see annex A. The cone proof load test (see annex B) may be applied in addition to the widening test by agreement between manufacturer and user.

4.2 Non-destructive testing

A representative sample shall be taken from the lot in accordance with ISO 3269 and subjected to either ×10 magnification visual examination tests or other suitable tests (e.g. magnetic techniques or eddy current testing). If no unacceptable surface discontinuity is found, the lot shall be accepted. If a user requires 100 % examination, this shall be stated at the time of ordering.

4.3 Destructive testing

If, after removing the coating, surface discontinuities are found which are likely to exceed the allowable limits, parts with the most severe surface discontinuities shall be selected for destructive testing (see 4.1).

4.4 Evaluation

If, during visual inspection, a product is found with quench cracks or deflection cracks in the locking element or discontinuities which exceed the dimensional limits, the lot shall be subject to rejection.

If any part fails the appropriate destructive tests described in 4.1, the lot shall be subject to rejection.

Annex A (normative)
Widening test on nuts

A.1 Scope

This annex specifies the test procedure for evaluating the acceptability of surface discontinuities designated in this standard, excluding nuts made of free cutting steel.

A.2 Widening test

A.2.1 Principle

After removal of the thread up to the nominal diameter, a tapered mandrel is pushed into the nut. The widening is measured as percentage of the hole diameter.

A.2.2 Test mandrel

The test mandrel shown in figure A.1 shall be used for measurement of widening of 6 % and 4 %, respectively (see A.3). It shall have a minimum hardness of 45 HRC and the cone shall be polished (surface roughness, $R_a = 2{,}5\ \mu m$).

A.2.3 Test nut

The nut to be subjected to the widening test shall have the thread removed to a diameter equal to the nominal diameter of the thread.

A.2.4 Procedure

Prior to the test, lubricate the mandrel with molybdenum disulphide (MoS_2).

Insert the mandrel into the nut as shown in figure A.2 and apply a load axially in a slow and steady manner until the mandrel is pushed through the hole up to the cylindrical part. The mandrel shall be tightly clamped at the upper end. For referee purposes, the speed of insertion shall not exceed 25 mm/min.

A.3 Criteria

The total widening of nuts shall be

6 % for nuts of property classes 4 to 12 and

4 % for nuts of property classes 04 and 05.

Failure of a nut occurs when the wall of the nut breaks entirely before the minimum specified widening value is obtained. In cases of doubt, the fracture may be recognized when the nut is cut on the opposite side and then falls into two single parts. +)

A.4 Special cases

A.4.1 Prevailing torque type nuts

For prevailing torque type nuts, the minimum value of widening shall be 20 % below the values specified for hexagon nuts in A.3.

d – nominal thread diameter*)

m – nominal height of nut

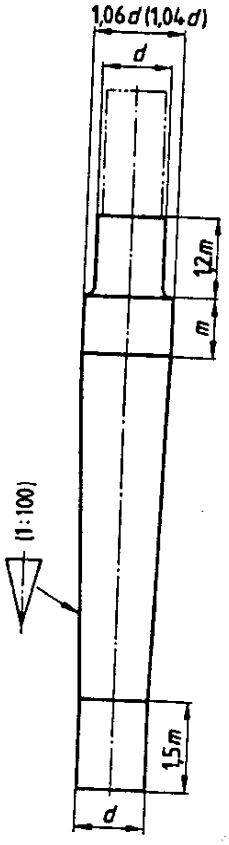


Figure A.1: Test mandrel for widening of nuts up to 6% (1,06 d) or up to 4% (1,04 d)

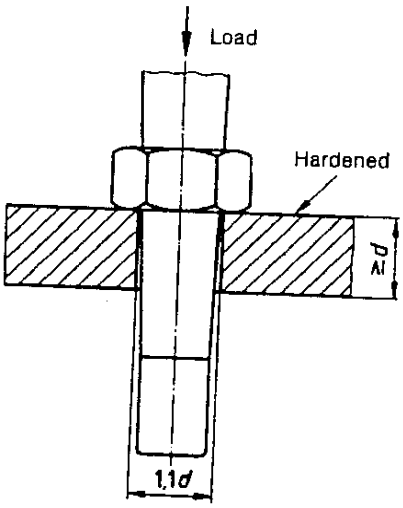


Figure A.2: Test assembly

*) For the testing of oversize tapped nuts, dimension d shall be enlarged according to the major diameter of the internal thread.

Annex B (normative)
Cone proof load test on nuts

B.1 Scope

This annex specifies the mechanical properties of nuts with

- nominal thread diameters from 5 up to and including 39 mm
- product grades A and B
- property classes 8 to 12

under the conditions of the cone proof load test.

B.2 Purpose and principle

The purpose of the test is to detect the presence of detrimental seams or cracks. The use of a conical washer exaggerates the influence of such defects on the loadbearing capacity of the nut by introducing a simultaneous dilating and stripping action.

B.3 Apparatus

B.3.1 Conical washer (see figure B.1) having a minimum hardness of 57 HRC. The contact point of the cone shall be flat and shall have a width of (0,13 ± 0,03) mm for nominal thread diameters ≤ 12 mm and a width of (0,38 ± 0,03) mm for nominal thread diameters > 12 mm.

B.3.2 Mandrel, hardened (min. 45 HRD) and threaded to tolerance class 6g except that the tolerance on the major diameter shall be the last quarter of the 6g range on the minimum material side.

B.4 Procedure

Assemble the nut and cone washer on the mandrel, as shown in figure B.2. The cone washer shall bear against a nut face which is flat and normal to the nut axis. Apply the specified cone proof load (see B.5) to the nut.

The speed of testing, as determined with a free-running crosshead, shall not exceed 3 mm per minute. The cone proof load shall be retained for 10 seconds.

B.5 Criteria

The nut shall support the proof load specified in EN 20 898-2 or ISO 898-6 *), as applicable, without stripping or rupture.

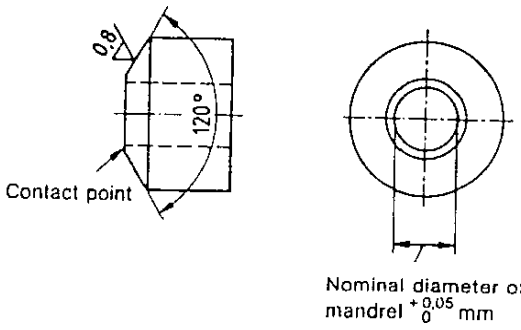


Figure B.1: Conical washer

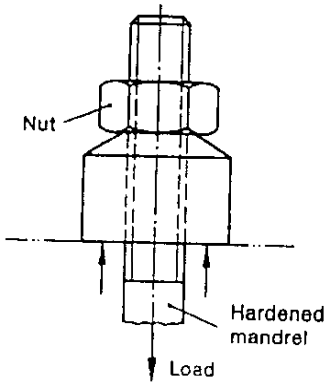


Figure B.2: Test assembly

*) Adopted as EN 20 898-6.