BS EN 3388:2009

Aerospace series — Fasteners, externally threaded, in heat resisting nickel base alloy NI-PH2601 (Inconel 718) — Classification 1 275 MPa/650 °C — Manufacturing method optional — Technical specification

ICS 49.030.20

BSI British Standards

National foreword

This British Standard is the UK implementation of EN 3388:2009.

The UK participation in its preparation was entrusted to Technical Committee ACE/12, Aerospace fasteners and fastening systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2010

ISBN 978 0 580 63775 9

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 3388

April 2009

ICS 49.030.20

English Version

Aerospace series - Fasteners, externally threaded, in heat resisting nickel base alloy NI-PH2601 (Inconel 718) - Classification 1 275 MPa/650 °C - Manufacturing method optional - Technical specification

Série aérospatiale - Eléments de fixation, filetés, en alliage base nickel résistant à chaud NI-PH2601 (Inconel 718) - Classification : 1 275MPa/650 °C - Mode de fabrication non imposé - Spécification technique

Luft- und Raumfahrt - Verbindungselemente mit Außengewinde aus hochwarmfester Nickelbasislegierung NI-PH2601 (Inconel 718) - Klasse : 1 275 MPa/650 °C - Herstellverfahren nach Wahl - Technische Lieferbedingungen

This European Standard was approved by CEN on 5 October 2008.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 3388:2009: E

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Foreword

This document (EN 3388:2009) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by October 2009.

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1 Scope

This standard specifies the technical and quality assurance requirements for externally threaded fasteners in material NI-PH2601 (Inconel 718) of tensile strength class 1 275 MPa at room temperature, maximum test temperature of material 650 °C.

The externally threaded fasteners specified herein may be manufactured by machining from bar or by forging at the manufacturer's option, if forged there is no requirement for control of grainflow.

Primarily for Aerospace applications it is applicable to such externally threaded fasteners when referenced on the product standard or drawing.

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 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3452, *Non-destructive testing — Penetrant inspection — General principles.*

ISO 3534:1977, *Statistics — Vocabulary and symbols.*

ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture.*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T).*

ISO 7961, *Aerospace — Bolts — Test methods.*

ISO 9000, *Quality management systems — Fundamentals and vocabulary.*

EN 2952, *Aerospace series — Heat resisting alloy NI-PH2601 — Solution treated and cold worked — Bar for forged fasteners — $D \leq 50$ mm — 1 270 MPa $\leq R_m \leq$ 1 550 MPa.* [1)]

EN 2961, *Aerospace series — Heat resisting alloy NI-PH2601 — Solution treated — Bar for machined fasteners — $D \leq 50$ mm — $R_m \geq$ 1 270 MPa.* [1)]

EN 3219, *Aerospace series — Heat resisting nickel base alloy (Ni-P100HT) — Cold worked and softened — Bar and wire for continuous forging or extrusion for fasteners — $3 \leq D \leq 30$ mm.* [1)]

EN 9100, *Aerospace series — Quality management systems — Requirements (based on ISO 9001:2000) and Quality systems — Model for quality assurance in design, development, production, installation and servicing (based on ISO 9001:1994).*

1) Published as ASD Prestandard at the date of publication of this standard.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
production batch
quantity of finished parts fabricated by the same process from a single material cast (single heat of alloy), having the same basic part number and diameter, heat treated together to the same specified condition and produced as one continuous run

3.2
inspection lot
quantity of parts from a single production batch of the same part number which completely defines the part

3.3 Surface discontinuities

3.3.1
crack
rupture in the material which may extend in any direction and which may be intercrystalline or transcrystallyne in character

3.3.2
seam
longitudinal surface defect in the form of an unwelded open fold in the material

3.3.3
lap
surface defect caused by folding over metal fins or sharp corners and then rolling or forging them into the surface

3.3.4
inclusion
non-metallic particles originating from the material making process. They may exist as discrete particles or strings of particles extending longitudinally

3.4
test temperature
ambient temperature, unless otherwise specified

3.5
simple random sampling
the taking of *n* items from a population of *N* items in such a way that all possible combinations of *n* items have the same probability of being chosen

[ISO 3534, see definition]

3.6
critical defect
defect that according to judgment and experience is likely to result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the considered product or that is likely to prevent performance of the function of a major end item

[ISO 3534, see definition]

3.7
major defect
defect other than critical, that is likely to result in a failure or to reduce materially the usability of the considered product for its intended purpose

[ISO 3534, see definition]

3.8
minor defect
defect that is not likely to reduce materially the usability of the considered product for its intended purpose, or that is a departure from established specification having little bearing on the effective use or operation of this product

[ISO 3534, see definition]

3.9
sampling plan
plan according to which one or more samples are taken in order to obtain information and possibly to reach a decision

[ISO 3534, see definition]

3.10
limiting quality (LQ_{10})
in a sampling plan, a quality limit which corresponds to a specified and relatively low probability of acceptance in this case 10 % probability of acceptance; it is the limiting lot quality characteristic that a lot of this quality would occur

When expressed as a per cent defective, it may be referred to as a lot tolerance per cent defective.

[ISO 3534, see definition]

3.11
acceptable quality limit (AQL)
quality limit which in a sampling plan corresponds to a specified but relatively high probability of acceptance

It is the maximum per cent defective (or the maximum number of defects per hundred units) that, for purposes of sampling inspection, can be considered satisfactory as a process average.

[ISO 3534, see definition]

3.12
finished part
part ready for use, inclusive of any possible treatments and/or surface coatings, as specified in the dimensional standard or drawing

4 Certification and quality assurance

4.1 Qualification

4.1.1 Purpose

The purpose of acceptance tests is to check, as simply as possible, by a method representative of actual use conditions, with the uncertainty inherent to statistical sampling, that the bolts constituting the batch satisfy the requirements of this standard.

4.1.2 Conditions

The acceptance tests are summarized in Table 3. They shall be performed on each batch. Table 1 specifies, the test method and sampling plan to be used for each test. Bolts from the batch to be tested shall be selected by simple random sampling.

Each bolt may be submitted to several tests.

The bolts to be subjected to destructive tests may be those on which non-destructive tests have been performed.

4.2 Quality system certification

4.2.1 Purpose

The purpose of quality system certification is to ensure that the manufacturer has demonstrated the acceptability of his quality system and his ability for continuing production of parts to this standard, to the required limit of quality.

4.2.2 Requirements and procedure

The requirements and procedures for quality system certification shall be to the requirements of ISO 9000 and EN 9100.

4.3 Responsibility for inspection and tests

The manufacturer is responsible for the performance of all inspection and test requirements as specified herein. Each manufacturer will use their own or exceptionally, any other facilities approved in accordance with 4.2 for the implementation of these inspection and test requirements.

4.4 Inspection and test report

A test report showing actual numerical values shall be provided at the purchaser's option as part of the terms of the purchase order.

Table 1 — Technical requirements and test methods

Clause	Characteristic	Requirement	Inspection and test method	Q/A [a]	Sample size
5.1	**Material**	Material NI-PA2601 to specification EN 2952, EN 2961 or EN 3219 supplied by an approved source: shall be used for the manufacture of bolts to this standard.	As stated in the material specification.		
5.2	**Dimensions, tolerances and tolerances of form and position; threads and quality**			A	Tables 4 and 5
5.2.1	**Dimensions**	The dimensions of the finished parts shall conform to the product standard or drawing.	All dimensions shall be controlled by an approved system of gauging.		
5.2.2	**Tolerances of form and position**	Tolerances of form and position shall conform to the product standard or drawing.	Tolerances of form and position shall be controlled by an approved system of gauging.		
5.2.3	**Threads**	Threads shall conform to the product standard or drawing.	Threads shall be gauged by an approved system of gauging.		
5.3	**Manufacturing**	Parts may be manufactured by machining from material EN 2961 or by forging from material EN 2952 or EN 3219.			

continued

Table 1 *(continued)*

Clause	Characteristic	Requirement	Inspection and test method	Q/A [a]	Sample size
5.3.1	**Machined from bar parts**	Parts manufactured from material in the softened, cold worked and solution treated condition shall be semi-finish machined and then precipitation heat treated per 5.3.3.2 prior to final machining, and thread rolling. Parts manufactured from material in the softened, cold worked, solution treated and precipitation treated condition shall be finish machined, thread rolled, etc. without further heat treatment.			
5.3.2	**Forged parts**	Forged parts may be formed by hot or cold forging. If hot forged, the forging temperature shall not exceed 1 150 °C and shall be air cooled. The heating equipment for forging shall be of a type which ensures a consistent temperature throughout the batch. The forged blanks shall be solution treated and precipitation treated.			
5.3.3	**Heat treatment**	The heat treatment medium or atmosphere shall not cause any surface contamination except as permitted by 5.5.2. Any scale which will not be removed by subsequent machining shall be removed by abrasive blasting.	The heat treatment equipment shall be approved. The equipment for abrasive blasting shall be approved.		
5.3.3.1	**Solution heat treatment**	Forged parts shall be solution treated at a temperature of 930 °C – 1 010 °C, holding at the selected temperature within ± 15 °C for not less than 1 hour, and air cool or faster.			

continued

Table 1 *(continued)*

Clause	Characteristic	Requirement	Inspection and test method	Q/A [a]	Sample size
5.3.3.2	**Precipitation heat treatment**	Before thread rolling the parts the parts shall be precipitation treated at (720 ± 5) °C holding at heat for 8 hours, furnace cooling at (55 °C ± 5) °C per hour to (620 °C ± 5) °C, holding at 620 °C for 8 hours followed by air or faster. Instead of the 55 °C per hour cooling rate to 620 °C, parts may be furnace cooled at any rate provided the time at 620 °C is adjusted to give a total precipitation time of approximately 18 hours.			
5.3.4	**Removal of surface contamination**	After solution and precipitation treatment the parts shall have all the shank and bearing surface of the head ground: a) for the removal of all surface contamination and oxide penetration; b) to obtain a clean, smooth surface.			
5.3.5	**Threads**	Threads shall be formed on the solution treated, precipitation treated and machined parts by a single thread rolling operation.			
5.3.6	**Cold rolling**	If specified on the product standard parts shall, after completion of solution, precipitation treatment and machining, have the fillet radius cold rolled sufficiently to remove all evidence of machining. Cold rolling the head to shank fillet radius may cause distortion of fillet area. Any such distortion shall be in accordance with the requirements of Figure 1 unless otherwise specified on the product standard or drawing. For parts with compound radii between head and shank, cold work only the radius that blends with the head, however it is acceptable for work to extend over the compound radius. The fillet shall not show evidence of seams or inclusions.	Dimensional check (see 5.5.2) and visual examination. See 5.5.3.1.	A	Tables 4 and 5

continued

Table 1 *(continued)*

Clause	Characteristic	Requirement	Inspection and test method	Q/A [a]	Sample size
5.3.7	**Surface roughness**	The surface roughness shall be as specified on the product standard or drawing prior to protective treatment.	The surface roughness of the thread shall be determined by visual comparator method, see ISO 4288.	A	Tables 4 and 5
5.3.8	**Surface coating**	Where applicable, all surfaces shall be coated as specified on the product standard or drawing.	See applicable coating specification.		Tables 4 and 5
5.4	**Mechanical properties**				
5.4.1	**Tensile strength**	The finished parts shall withstand the minimum tensile loads specified in Table 4.	Tensile tests are not applicable to the following: a) protruding head bolts of grip length less than 2 D; b) countersunk head bolts of overall length less than 3 D or bolts having an overall length less 18 mm. In such cases acceptability shall be based on the results from test bars of the same material heat treated within the same process cycle.		
5.4.1.1	**Ambient temperature tensile strength**		The parts shall be tested to destruction in accordance with ISO 7961, test 3.1.	A	Table 6 column B or Table 8
5.4.2	**Hardness**	The hardness of the finished parts shall be uniform and within the range Rockwell C36–C45, but hardness of the threaded section and of the head to shank fillet area may be higher as a result of the cold working operations.	For hardness testing, see ISO 6508-1.	A	Table 6 column A
5.5	**Metallurgical properties**		NOTE The same test sample may be utilized for more than one test provided that none of the characteristics of the samples are altered during the examination procedure.		

continued

Table 1 *(continued)*

Clause	Characteristic	Requirement	Inspection and test method	Q/A [a]	Sample size
5.5.1	**Surface hardening**	Parts shall have no change in hardness from core to surface except as produced during cold working of the head to shank fillet radius and during rolling of threads.	Microscopic examination (× 100). Specimens shall be taken from the finished bolts, screws or studs as shown in Figure 5. The specimens shall be etched in a suitable solution. In case of dispute over the results of the microscopic examination, microhardness testing shall be used as a referee method; a Vickers hardness reading within 0,08 mm of an unrolled surface which exceeds the reading in the core by more than 30 points shall be evidence of non-conformance to this requirement.	A	Table 6 column B
5.5.2	**Surface contamination**	The bearing surface of the head, the head to shank fillet, shank diameter and threads shall be free from surface oxide. Depth of oxide penetration on the unmachined surfaces of the head shall not be greater than 0,025 mm.	Macroscopic examination (see 5.5.1).	A	Table 6 column B
5.5.3	**Discontinuities**	Finished parts having discontinuities exceeding the limitations specified herein shall be rejected. Care shall be exercised to avoid confusing cracks with other discontinuities. Cracked parts and those having discontinuities transverse to axis (i.e at angle more than 10° to the longitudinal axis) shall be rejected and be destroyed.	The finished parts shall be subjected to penetrant flaw detection in accordance with ISO 3452. Parts showing indications which are considered significant will be subjected to microexamination at a suitable magnification (× 100).	A	Penetrant Tables 4 and 5 micro Table 6 column B
5.5.3.1	**Head and shank discontinuities**	Bolts heads shall not possess seams or inclusions along the top or sides exceeding 0,2 mm in depth. Close tolerance shank parts shall have no discontinuities in the shank. Parts with non-close tolerance shanks having longitudinal defects in the shank of depth and width greater than 0,05 mm and/or length exceeding 5 mm shall be rejected. Discontinuities shall not be permitted in the head to shank fillet. There shall be no evidence of surface inclusions in the head to shank fillet.	See 5.5.3.		See 5.5.3

continued

Table 1 *(continued)*

Clause	Characteristic	Requirement	Inspection and test method	Q/A [a]	Sample size
5.5.3.2	**Thread discontinuities**	Threads shall have no multiple or single laps at the root or on the flanks below the pitch diameter (see Figure 2). The root shall not contain seams, notches, slivers, folds, roughness or oxide scale. Faults with depth less than 20 % of the basic thread height (see Table 7) are permissible on the thread crest and on that part of the non-loaded flank which is situated above the pitch diameter. Slight deviation from the thread contour is permissible at the crest of the threads (see Figures 3 and 4). NOTE As the major diameter of the thread approaches maximum size, values for crest lap imperfections listed in Table 7 may be increased by half the difference between the minimum major diameter and the actual major diameter as measured on the part (see Figure 4).	See 5.5.3.		See 5.5.3
5.5.4	**Material identification**	Each finished bolt shall be subjected to a non-destructive physical test to verify the type of material. The test equipment shall be standardized by samples of known chemical composition of the same type and form and in the same heat treatment condition as the parts to be tested.	The test equipment shall be approved.	A	100 %
5.6	**Product identification**	Each finished part shall, unless package marking is stipulated, be marked at the location and by the method as specified on the product standard or definition document. Parts to be package marked shall be packed and identified in accordance with 5.7.1 and 5.7.2.	Visual examination.	A	Tables 4 and 5.

continued

Table 1 *(concluded)*

Clause	Characteristic	Requirement	Inspection and test method	Q/A [a]	Sample size
5.7	**Delivery**		Visual examination.	A	100 %
5.7.1	**Packaging**	The finished parts shall be packed in such a way as to prevent any damage or corrosion occurring in the course of handling, transportation and storage. Each primary package shall only contain parts of one part number and of the same inspection lot number.			See 5.7.
5.7.2	**Labelling**	Each primary package shall bear a label upon which is legibly recorded the designation as specified in the product standard; quantity; production batch number and manufacturers name or trade mark.			See 5.7.

[a] Q: Qualification A: Acceptance.

Table 2 — Summary of test — Acceptance

Type of test	Acceptance	
	Clause	Sample size
Dimensions	5.2	Tables 4 and 5
Cold rolling	5.3.6	Tables 4 and 5
Surfaces roughness	5.3.7	Tables 4 and 5
Surface coating	5.3.8	Tables 4 and 5
Tensile strength	5.4.1	—
Ambient temperature tensile strength	5.4.1.1	Table 6 column B or Table 8
Hardness	5.4.2	Table 6 column A
Surface hardening	5.5.1	Table 6 column B
Surface contamination	5.5.2	Table 6 column B
Discontinuities Head and shank discontinuities Thread discontinuities	5.5.3 5.5.3.1 5.5.3.2	Penetrant Tables 4 and 5 micro Table 6 column B
Material identification	5.5.4	100 %
Product identification	5.6	Tables 4 and 5
Delivery Packaging Labelling	5.7 5.7.1 5.7.2	100 %

Table 3 — Minimum tensile and stress rupture loads

Thread		Tensile		
Diameter	**Pitch**	**Stress area**	**Protruding head bolts and studs load**	**Stress area**
mm	mm	mm^2	kN	min. mm^2
3	0,5	5,44	6,9	5,5
4	0,7	9,52	12,1	9,7
5	0,8	15,3	19,5	15,6
6	1,0	21,8	27,8	22,2
7	1,0	30,9	39,4	31,5
8	1,0	41,7	53,2	36,8
10	1,25	65,1	83,0	66,4
12	1,25	97,1	124	99,2
14	1,5	132	168	134
16	1,5	176	224	179
18	1,5	226	288	230
20	1,5	283	361	289
22	1,5	345	440	352
24	2	402	513	410

Table 4 — Classification of defects

Category No.	AQL	Characteristics
Major A		
101	0,065 %	Surface discontinuities revealed by fluorescent penetrant inspection
Major B		
201		Thread size
202		Shank diameter
203		Grip length
204		Fillet radius - distortion and dimensions
205		Drilled holes missing when required
206		Surface texture (visual)
207	1,0 %	Burrs and tool marks
208		Overall length
209		Head diameter
210		Depth of lightening hole in head when required
211		Thread form
212		Incomplete threads
213		Perpendicularity - head bearing surface to shank
214		Straightness of shank
Minor A		
301		Surface coating when required
302		Product identification
303		Lightening hole diameter when required
304	2,5 %	Drilled hole location and diameter when required
305		Wrenching configuration
306		Runout - head outside diameter to shank
307		Runout - thread pitch diameter to shank
Minor B		
401		Chamfer on thread end
402	4,0 %	Head flange thickness
403		Head height
404		Other dimensional characteristics not listed

Table 5 — Sampling plans for visual inspections and dimensional characteristics

Batch size	Sample size	Acceptance number (Ac) and limiting quality (LQ_{10}) in accordance with the acceptance quality limit (AQL)							
		AQL 0,065 %		AQL 1,0 %		AQL 2,5 %		AQL 4,0 %	
		Ac	LQ_{10} %	Ac	LQ_{10} %	Ac	LQ_{10} %	Ac	LQ_{10} %
51 to 90	13	↓	↓	0	16	↓	↓	1	27
91 to 150	20	↓	↓	↑	↑	1	18	2	25
151 to 280	32	↓	↓	↓	↓	2	16	3	20
281 to 500	50	↓	↓	1	7,6	3	13	5	18
501 to 1 200	80	↓	↓	2	6,5	5	11	7	14
1 201 to 3 200	125	↓	↓	3	5,4	7	9,4	10	12
3 201 to 10 000	200	0	1,2	5	4,6	10	7,7	14	10
10 001 to 35 000	315	↑	↑	7	3,7	14	6,4	21	9
35 001 to 150 000	500	↓	↓	10	3,1	21	5,6	↑	↑
150 001 to 500 000	800	1	0,5	14	2,5	↑	↑	↑	↑

↑ Use sampling plan above.

↓ Use sampling plan below.

The data given in this table are based on single sampling plans for a standard inspection, as specified in ISO 2859-1, Tables 2-A and 6-A. A 100 % inspection should be performed when the sample size is as large as or larger than the batch size.

Other sampling plans specified in ISO 2859-1 may be used (double or multiple sampling), but these have to be chosen in such a way as to ensure an equivalent quality limit.

As regards those manufacturers who carry out an inspection during the manufacturing process (inspection on a machine and/or inspection between operations), the sampling plan for the final inspection shall be in such a way that the overall inspection plan shall guarantee an equivalent quality limit.

Table 6 — Sampling plans for the inspection of mechanical and metallurgical characteristics

Batch size	Sample size		Acceptance number
	Non-destructive tests	Destructive tests	
	A	B	(Ac)
up to 500	8	3	0
501 to 3 200	13	5	0
3 201 to 35 000	20	5	0
above 35 000	32	8	0

Table 7 — Thread discontinuities – Maximum depth or permissible faults (see 5.5.7.2)

Dimensions in millimetres

Thread pitch	Depth [a]
0,5	0,06
0,7	0,08
0,8	0,09
1,0	0,12
1,25	0,15
1,5	0,18
2,0	0,24

[a] These values correspond to 20 % of basic thread depth.

Table 8 — Variable sampling for tensile test

Batch size	Sample number	Approximately 1,0 % AQL				
		Sample size	Total	First sample		Combined sample
				K_a	K_r	K_t
under 151	First Second	4 8	4 12	2,42 —	1,35 —	— 1,72
151 to 300	First Second	5 10	5 15	2,21 —	0,89 —	— 1,74
301 to 500	First Second	6 12	6 18	2,22 —	0,94 —	— 1,70
501 to 1 300	First Second	7 14	7 21	2,32 —	1,10 —	— 1,78
1 301 to 3 200	First Second	8 16	8 24	2,48 —	0,99 —	— 1,81
above of 3 200	First Second	10 20	10 30	2,34 —	1,31 —	— 1,80

Evaluate each sample by tensile tests as follows:

First sample: accept if $\overline{X}_1 - K_a S_1 \geq M$ Reject if $\overline{X}_1 - K_r S_1 < M$.

Take second sample if batch is doubtful; evaluate as follows:

Second sample: accept if $\overline{X}_t - K_t S_t \geq M$ Reject if $\overline{X}_t - K_t S_t < M$.

Definition of terms:

$\overline{X}_1$ is the average of X_1 individual values in the first sample;

K_a, K_r and K_t are coefficients of S, which is the best estimate of standard deviation and are used to determine acceptance or rejection of the batch represented by the sample;

M is the minimum tensile value according to Table 5;

$\overline{X}_t$ is the average of X_t individual values in the combined samples;

$$S_1 = \sqrt{\frac{N_1 \sum X_1^2 - \left(\sum X_1\right)^2}{N_1 (N_1 - 1)}}$$

where

N_1 is the number of parts in the first sample;

$\sum X_1^2$ is the sum of squares of X_1 values;

$\left(\sum X_1\right)^2$ is the square of the sum of X_1 values;

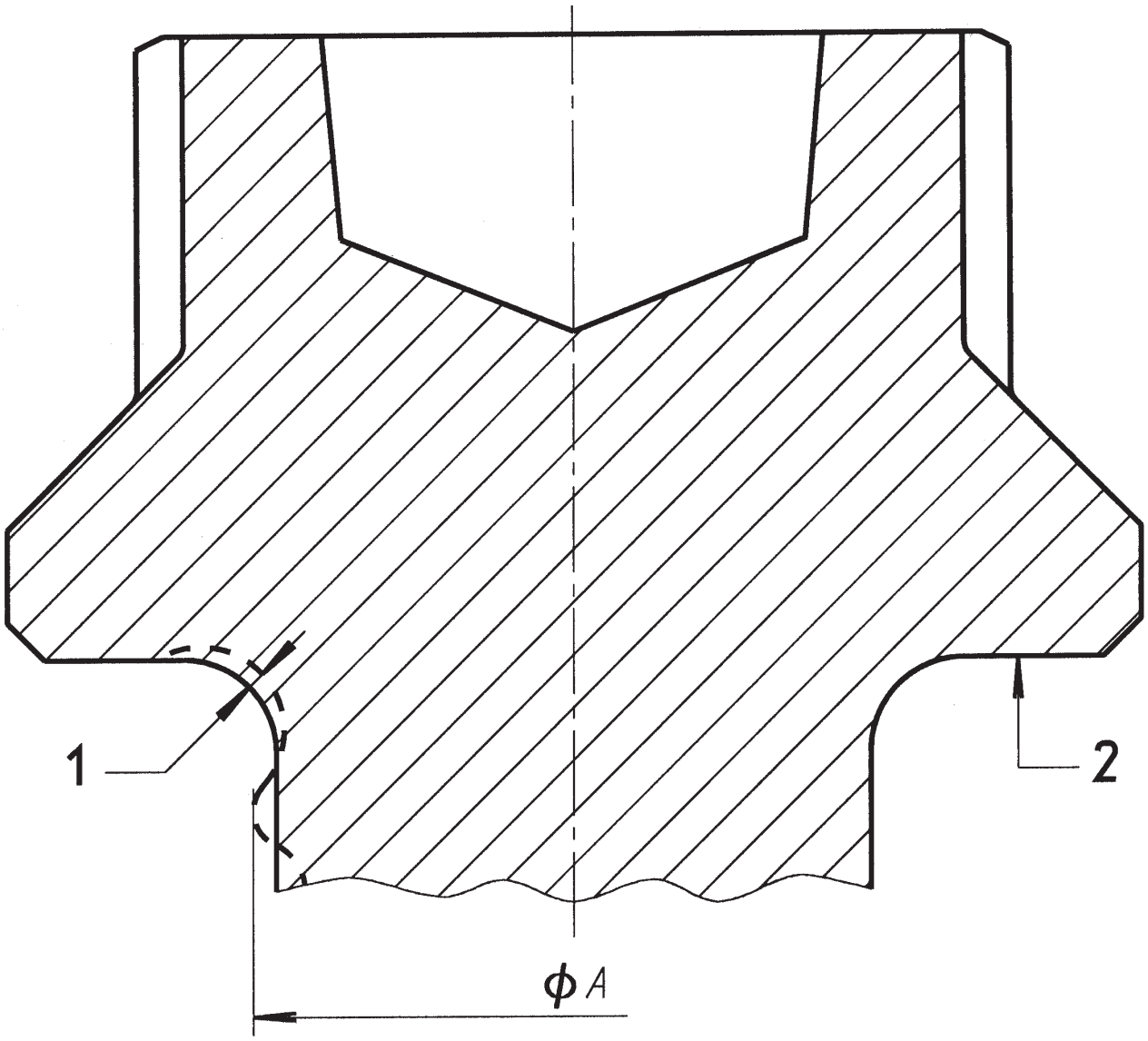
$$S_t = \sqrt{\frac{N_t \sum X_t^2 - \left(\sum X_t\right)^2}{N_t (N_t - 1)}}$$

where

N_t is the number of parts in the combined sample;

$\sum X_t^2$ is the sum of squares of X_t values;

$\left(\sum X_t\right)^2$ is the square of the sum of X_t values.



Key

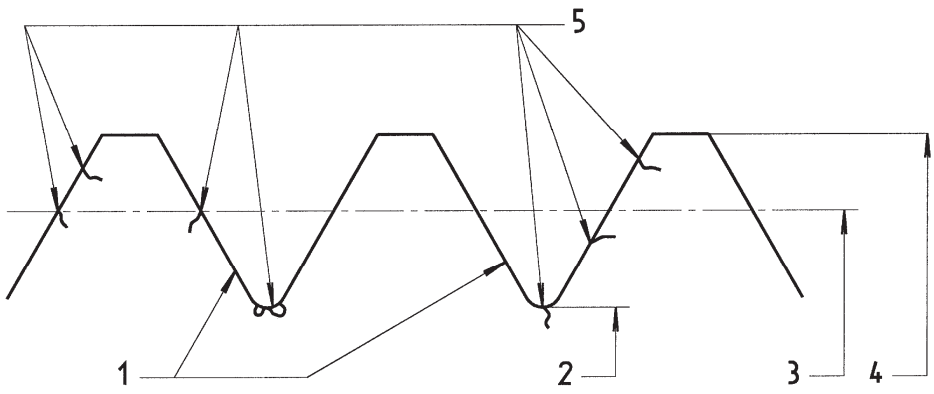
1 0,025 mm max.

2 No excrescence permissible on the head bearing face

NOTE Diameter at this position, inclusive of distortion shall *A*:

- on full shank "close" tolerance bolts, not exceed maximum shank diameter;
- on full shank "open" tolerance bolts, not exceed the actual shank diameter, prior to distortion by more than 0,06 mm;
- on pitch diameter bolts, not exceed the actual pitch diameter, prior to distortion by more than 0,06 mm.

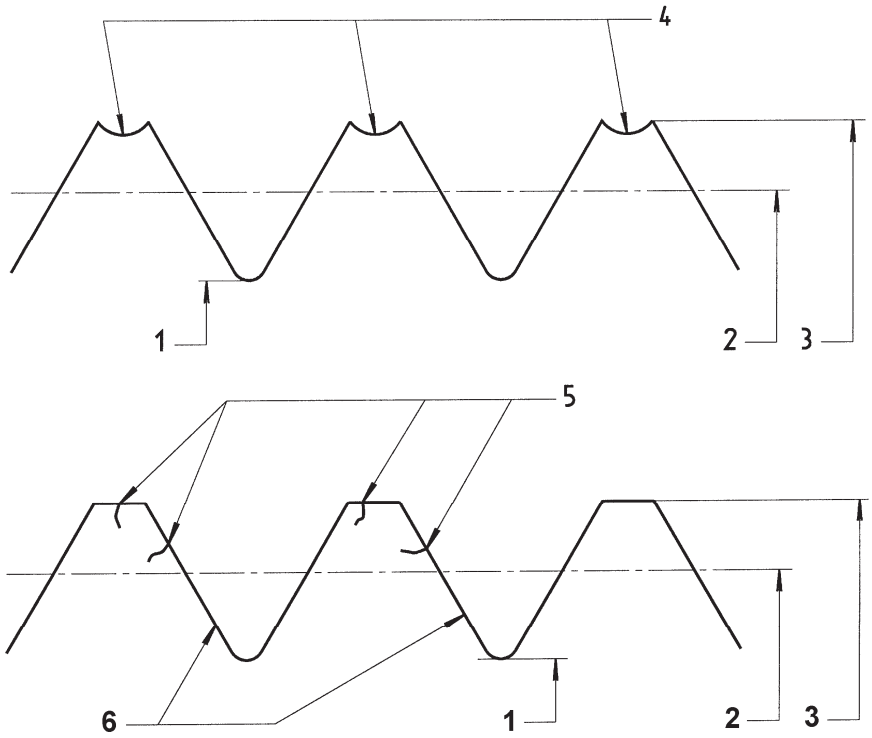
Figure 1 — Distortion in fillet area (see 5.3.6)



Key

1 Non-loaded flank
2 Minor diameter
3 Pitch diameter
4 Major diameter
5 Laps and seams not permissible

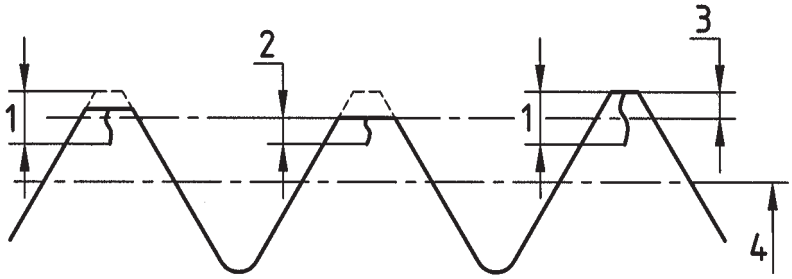
Figure 2 — Non-permissible laps, seams and surface irregularities (see 5.5.3.2)



Key

1 Minor diameter
2 Pitch diameter
3 Major diameter
4 Permissible surface irregularities
5 Permissible laps and seams
6 Non-loaded flank

Figure 3 — Permissible laps, seams and surface irregularities (see 5.5.3.2)

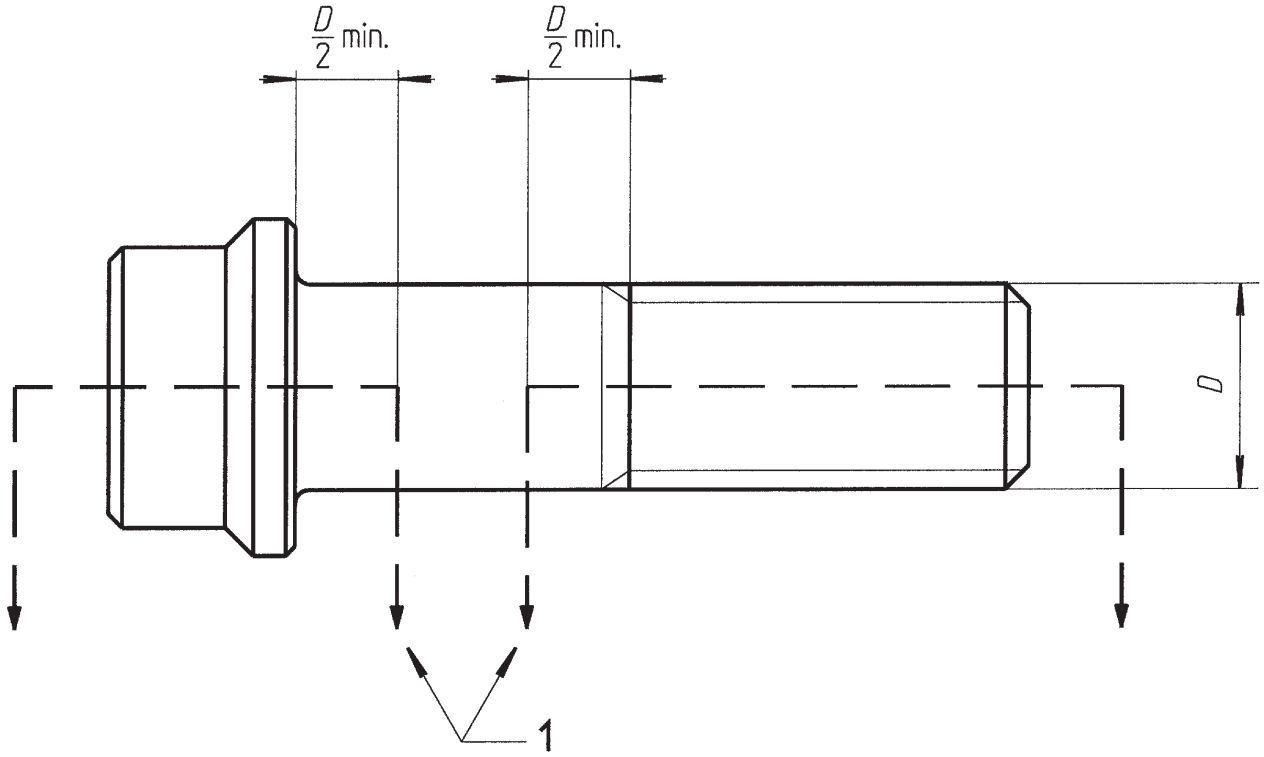


Key

1 See note
2 Maximum permissible defect 20 % of basic thread depth
3 ½ tolerance on major diameter
4 Pitch diameter

NOTE Depth of defect equals 20 % of basic thread depth plus ½ the difference or actual major diameter and minimum major diameter.

Figure 4 — Crest lap imperfections (see 5.5.3.2)



Key

1 Cut here for specimens to be micro-examined or macro-examined

Figure 5 — Metallurgical specimens (see 5.5.1)

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