

UDC 621.882.2 : 620.191

December 1991

	<p style="text-align: center;">Fasteners Surface discontinuities Bolts, screws and studs subject to special requirements (ISO 6157-3 : 1988) (English version of DIN EN 26 157 Part 3)</p>	<p style="text-align: center;">DIN EN 26 157 Part 3</p>										
<p style="text-align: center;">This standard incorporates the English version of ISO 6157-3.</p> <p>Verbindungselemente; Oberflächenfehler; Schrauben für spezielle Anforderungen (ISO 6157-3 : 1988)</p> <p style="text-align: right;">This standard, together with the December 1991 edition of DIN EN 26 157 Part 1, supersedes October 1984 edition of DIN 267 Part 19.</p> <p>European Standard EN 26 157-3 : 1991 has the status of a DIN Standard.</p> <p><i>A comma is used as the decimal marker.</i></p> <p>National foreword</p> <p>This standard has been published in accordance with a decision taken by CEN/TC 185 to adopt, without alteration, International Standards ISO 6157-1 and ISO 6157-3 as European Standards. The responsible German body involved in its publication is the <i>Normenausschuß Mechanische Verbindungselemente</i> (Fasteners Standards Committee).</p> <p>Previous to their adoption, the ISO Standards referred to were in any case applicable for all bolts, screws and studs made to the relevant DIN ISO Standards. Hence, even without the decision of CEN/TC 185, it would have been necessary to adopt them, in line with the policy of the <i>Normenausschuß Mechanische Verbindungselemente</i> providing for the gradual adoption of ISO product standards as German Standards.</p> <p>DIN EN 26 157 Parts 1 and 3 apply for all bolts, screws and studs covered in existing DIN ISO Standards and future DIN EN Standards and are also to be implemented in the case of products still manufactured to DIN Standards in which reference is made to DIN 267 Part 19.</p> <p>Unless otherwise agreed, the present standard applies for bolts, screws and studs of property classes up to 10.9. The specifications given here are less extensive than in DIN 267 Part 19; in particular, there are no specifications with regard to surface discontinuities on the thread, nor are cracks in the head of hexagon socket screws dealt with. If the scope of the specifications is deemed inadequate for a given application, then the use of DIN EN 26 157 Part 3 should be agreed.</p> <p>In most respects, DIN EN 26 157 Part 3 corresponds to the October 1984 edition of DIN 267 Part 19, except that it only covers bolts, screws and studs of property class 12.9, and applies in cases where it is used by special agreement.</p> <p>The DIN Standards corresponding to the ISO Standards referred to above and in clause 2 of the EN are as follows:</p> <table border="0"> <tr> <td>ISO Standard</td> <td>DIN Standard</td> </tr> <tr> <td>ISO 898-1</td> <td>DIN EN 20 898 Part 1</td> </tr> <tr> <td>ISO 2859</td> <td>DIN 40 080</td> </tr> <tr> <td>ISO 3269</td> <td>DIN ISO 3269</td> </tr> <tr> <td>ISO 6157-1</td> <td>DIN EN 26 157 Part 1</td> </tr> </table> <p style="text-align: right;">Continued overleaf. EN comprises 15 pages.</p>			ISO Standard	DIN Standard	ISO 898-1	DIN EN 20 898 Part 1	ISO 2859	DIN 40 080	ISO 3269	DIN ISO 3269	ISO 6157-1	DIN EN 26 157 Part 1
ISO Standard	DIN Standard											
ISO 898-1	DIN EN 20 898 Part 1											
ISO 2859	DIN 40 080											
ISO 3269	DIN ISO 3269											
ISO 6157-1	DIN EN 26 157 Part 1											

Page 2 DIN EN 26 157 Part 3

Standards referred to

(and not included in **References**)

DIN 267 Part 19 Fasteners; technical delivery conditions; surface discontinuities on bolts, screws and studs
ISO 6157-1 : 1988 Fasteners; surface discontinuities; bolts, screws and studs for general requirements

Other relevant document

Supplement 2 to DIN 918 Fasteners; synopsis of available ISO Standards and DIN Standards

Previous editions

DIN 267 Part 19: 05.81, 09.81, 10.84.

Amendments

In comparison with the October 1984 edition of DIN 267 Part 19; the following amendments have been made.

- a) The scope of the standard has been limited to bolts, screws and studs subject to special requirements.
- b) The standard now applies only for bolts, screws and studs with a nominal thread diameter of 5 mm or more.
- c) Specifications regarding forging bursts and shear bursts have been amended.

International Patent Classification

F 16 B 23/00

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**EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM**

EN 26 157-3

October 1991

UDC 621.882.2 : 620.191

Descriptors: Fasteners, bolts, screws, studs, surface defects.

English version

Fasteners

Surface discontinuities

**Part 3: Bolts, screws and studs for special requirements
(ISO 6157-3 : 1988)**

Eléments de fixation; défauts de surface.
Partie 3: Boulons, vis et goujons pour
applications particulières
(ISO 6157-3 : 1988)

Verbindungselemente; Oberflächenfehler.
Teil 3: Schrauben für besondere Anforderun-
gen (ISO 6157-3 : 1988)

This European Standard was approved by CEN on 1991-10-10 and is identical to the ISO Standard as referred to. 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

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EN 26 157-3 : 1991

Foreword

In 1990, ISO 6157-3 : 1988 was submitted to the CEN PQ procedure.

Following the positive result of the PQ, CEN/BT agreed to submit ISO 6157-3 : 1988 with the following modifications to Formal Vote.

In the French version, replace:

- 'boulon' by 'vis',
- 'boulon, vis' by 'vis'.

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.

Endorsement notice

The text of the International Standard ISO 6157-3 : 1988 was approved by CEN as a European Standard with agreed common modifications as given above.

1 Scope and field of application

1.1 This part of ISO 6157 establishes limits for various types of surface discontinuities on bolts, screws and studs for special requirements.

It applies to bolts, screws and studs with

- nominal thread diameters 5 mm and larger;
- product grades A and B;
- nominal lengths $l < 10d$ (or longer if specified);
- property class 12.9;
- property classes 8.8, 9.8 and 10.9 when specified in product standards or agreed between supplier and purchaser.

1.2 Where the permissible limits for surface discontinuities indicated in clause 3 occur, the minimum values for the mechanical and functional properties specified in ISO 898-1 should still be met.

When fatigue strength requirements are specified, the fatigue strength should not be lower than that obtained on bolts without defects taken from the same lot.

NOTES

1 The figures in clause 3 are examples only. They apply correspondingly also to other types of bolts, screws and studs.

2 The individual figures show the surface discontinuities exaggerated in some cases for clarity.

2 References

ISO 468, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 898-1, *Mechanical properties of fasteners — Part 1: Bolts, screws and studs.*

ISO 2859, *Sampling procedures and tables for inspection by attributes.*

ISO 3269, *Fasteners — Acceptance inspection.*

3 Types, causes, appearance and limits of surface discontinuities

3.1 Cracks

A crack is a clean (crystalline) fracture passing through or across the grain boundaries and may possibly follow inclusions of foreign elements. Cracks are normally caused by overstressing the metal during forging or other forming operations, or during heat treatment. Where parts are subjected to significant reheating, cracks usually are discoloured by scale.

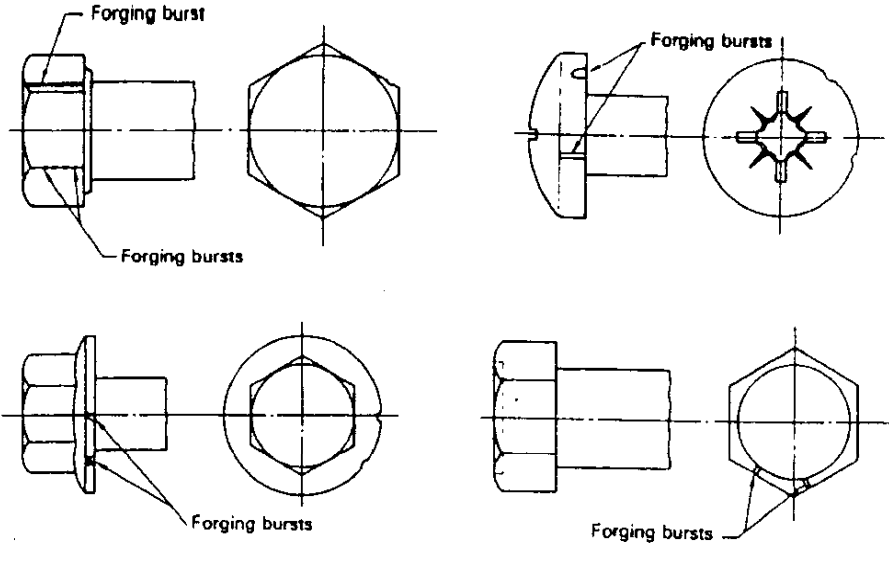
3.1.1 Quench cracks

Cause	Quench cracks may occur during hardening due to excessively high thermal and transformation stresses. Quench cracks usually follow an irregular and erratic course on the surface of the fastener.
Appearance	<p>Quench crack circumferential and adjacent to fillet</p> <p>Quench crack across washer face and to depth of washer face thickness</p> <p>Quench crack at corner of head</p> <p>Transverse quench crack</p> <p>Quench crack at root</p> <p>Quench crack, section at crest of thread missing</p> <p>Quench crack across top of head. Usually an extension of crack in shank or side of head</p> <p>Quench crack extending radially into fillet</p> <p>A-A</p> <p>Quench crack at root</p> <p>Quench crack</p>
Limits	Quench cracks of any depth, any length, or in any location are not permitted.

3.1.2 Forging cracks

Cause	Forging cracks may occur during the cut-off or forging operations and are located on the top of the head of screws and bolts.
Appearance	<p>Forging crack on top of head</p>
Limits	<p>Length, l, of forging cracks: $l < d$¹⁾</p> <p>Depth or width, b, of forging cracks: $b < 0,04d$</p> <p>NOTE - The limits for forging cracks do not apply to socket head screws (see 3.1.5)</p> <p>1) d = nominal thread diameter</p>

3.1.3 Forging bursts

Cause	Forging bursts may occur for example during forging on the flats or corners of the heads of bolts and screws, at the periphery of flanged or circular head products or on the raised periphery of indented head bolts and screws.
Appearance	
Limits	<p>Hexagon head screws</p> <p>No forging burst in the flats of hexagon bolts and screws shall extend into the crown circle on the top of the head surface (chamfer circle) or into the underhead bearing surface. Forging bursts occurring at the intersection of two wrenching flats shall not reduce the width across corners below the specified minimum.</p> <p>Forging bursts in the raised periphery of indented head bolts and screws shall not exceed a width of $0,06d^{1)}$ or have a depth extending below the indented portion.</p> <p>Circular head screws</p> <p>Flanges of bolts and screws and peripheries of circular head screws may have forging bursts, but they shall not exceed the following limits:</p> <p>Width of forging bursts:</p> <p>$0,08d_c^{2)}$ (with only one forging burst);</p> <p>$0,04d_c$ (with two or more forging bursts, one of which may extend to $0,08d_c$).</p> <p>Depth of forging bursts:</p> <p>$0,04d^{1)}$</p> <p>1) d = nominal thread diameter 2) d_c = head or flange diameter</p>

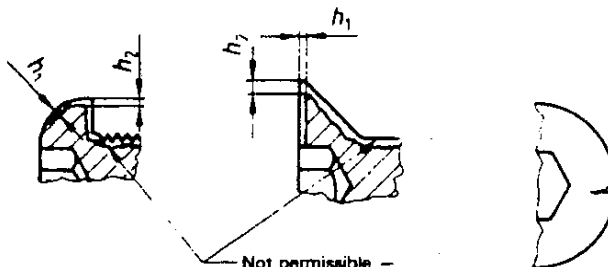
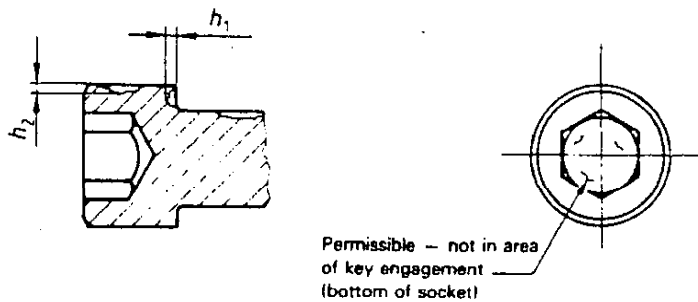
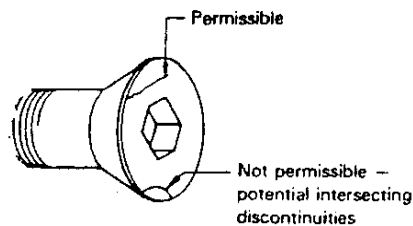
3.1.4 Shear bursts

Cause	<p>Shear bursts may occur, for example during forging, frequently at the periphery of products having circular or flanged heads, and are located at approximately 45° to the product axis.</p> <p>Shear bursts may also occur on the sides of hexagon head products.</p>
Appearance	
Limits	<p>Hexagon head screws</p> <p>Shear burst limits on the wrenching head are as follows:</p> <p>Width $< 0,25 \text{ mm} + 0,02s^{1)}$</p> <p>Depth $< 0,04d$</p> <p>No shear burst in the flats of hexagon bolts and screws shall extend into the crown circle on the top of the head surface (chamfer circle) or into the underhead bearing surface. Shear bursts, occurring at the intersection of two wrenching flats, shall not reduce the width across corners below the specified minimum.</p> <p>Shear bursts in the raised periphery of indented head bolts and screws shall not exceed a width of $0,06d^{2)}$ or have a depth extending below the indented portion.</p> <p>Circular head screws</p> <p>Flanges of bolts and screws and peripheries of circular head products may have shear bursts, but shall not exceed the following limits:</p> <p>Width of shear bursts:</p> <p>$0,08d_c^{3)}$ (for only one shear burst);</p> <p>$0,04d_c$ (with two or more forging shear bursts, one of which may extend to $0,08d_c$).</p> <p>1) s = width across flats 2) d = nominal thread diameter 3) d_c = head or flange diameter</p>

3.1.5 Forging cracks in socket head screws

Cause	Cracks in the periphery, in the top surface and on the indented portion (hexagon socket) may occur on the inner and outer faces due to cut-off of wire section, shear and compressive stress during forging operations and countersinking of head.
Appearance	<p style="text-align: center;">Permissible — does not extend more than half the distance between the periphery of the head and the socket</p> <p>Permissible — does not extend more than half the distance between the periphery of the head and the socket</p> <p>Not permissible — connects socket and edge of head</p> <p>Permissible</p> <p>Not permissible — potential intersecting discontinuities</p> <p>Permissible</p> <p>Not permissible — potential intersecting discontinuities</p> <p>Permissible</p> <p>Not permissible</p> <p>Permissible</p> <p>Permissible</p> <p>Permissible</p> <p>Not permissible — connects socket and edge of head</p>

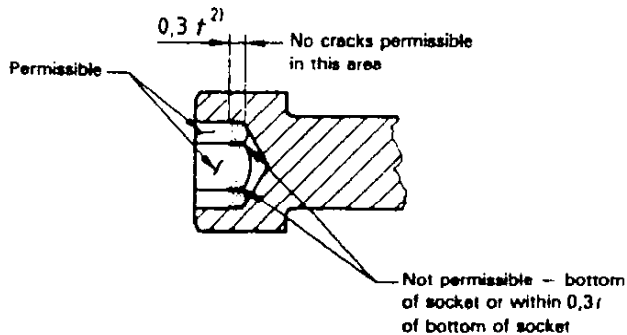
Appearance
(continued)



Permissible depths :

$h_1 < 0,03d_k^{1)}$: 0,13 mm max.

$h_2 < 0,06d_k$: 1,6 mm max.



1) d_k = head diameter

2) t = key engagement socket depth

Limits	<p>Cracks extending from the socket to the outer face and cracks with a traverse indicating a potential to intersect are not permissible. Cracks within 0,3<i>l</i> of the bottom of the socket are not permissible. Cracks located elsewhere in the socket are permissible, provided that they do not exceed a length of 0,25<i>l</i> and a depth of 0,03<i>d_t</i> (0,13 mm max.).</p> <p>One crack in the longitudinal direction with a depth not exceeding 0,03<i>d_t</i> (0,13 mm max.) at the head/shank intersection and on the top of the head is permissible. Longitudinal cracks with a depth not exceeding 0,06<i>d_t</i> (1,6 mm max.) located in the periphery are permissible.</p>
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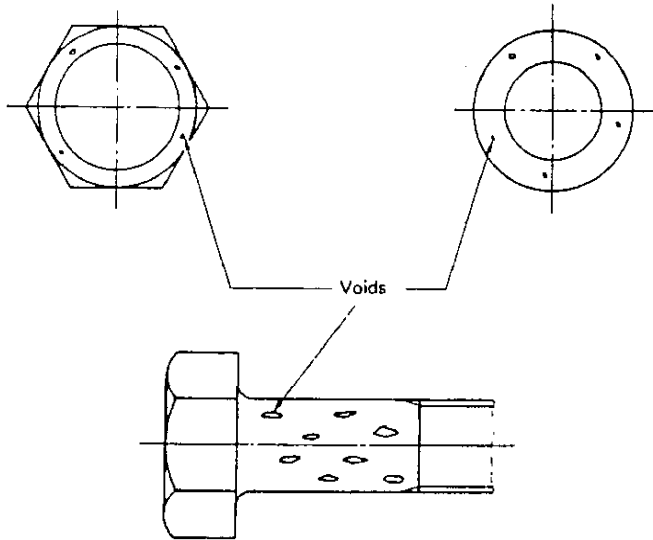
3.2 Raw material seams and laps

A seam or lap is a narrow, generally straight or smooth curved line discontinuity running longitudinally on the thread, shank or head.

Cause	Seams and laps are inherent in the raw material from which fasteners are made.
Appearance	<p>The diagram illustrates three types of defects in fasteners. The top row shows a hexagonal nut and a bolt with a longitudinal lap or seam on the threaded shank, labeled 'Lap or seam, usually straight or smooth curved line discontinuity running longitudinally'. The middle row shows a bolt with a longitudinal lap or seam on the shank, also labeled 'Lap or seam, usually straight or smooth curved line discontinuity running longitudinally'. The bottom row shows a bolt with a longitudinal seam on the shank, labeled 'Seam'. Each view includes a longitudinal section and a cross-section to show the internal structure and the location of the discontinuity.</p>
Limits	<p>Permissible depth: $0,015d^{1)}$ + 0,1 mm: 0,4 mm max.</p> <p>If laps or seams extend into the head, they shall not exceed the permissible limits for width and depth specified for bursts (see 3.1.3).</p> <p>1) <i>d</i> = nominal thread diameter</p>

3.3 Voids

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

Cause	Voids are produced by marks and impressions due to chips (shear burrs) or by rust formation on the raw material. They are not eliminated during forging or upsetting operations.
Appearance	
Limits	<p>Depth, h, of voids:</p> <p>$h < 0,02d^{1)}$: 0,25 mm max.</p> <p>Area of all voids:</p> <p>The combined surface area of all voids on the bearing face shall not exceed 5 % of the total area.</p> <p>1) d = nominal thread diameter</p>

3.4 Folds

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

Cause	Folds are produced by material displacements due to lack of congruence of forms and volumes of the single forging steps.
Appearance	
Limits	<p>Folds at interior corners at or below the bearing surface are not permissible, unless specifically permitted in this part of ISO 6157 or in the product standard.</p> <p>Folds at exterior corners are permissible.</p>

3.5 Tool marks

Tool marks are longitudinal or circumferential grooves of shallow depth.

Cause	Tool marks are produced by the movement of manufacturing tools over the surface of the bolt or screw.
Appearance	
Limits	Tool marks produced by machining in the shank, fillet or bearing surface shall not exceed a surface roughness of $R_a = 3,2 \mu\text{m}$ when tested in accordance with ISO 468.

3.6 Laps on the thread

A lap is a fold-over of metal in the thread. Laps generally show a pattern of consistency between the same product, that is laps will be identically located and with the same direction of traverse between all products.

Cause	Folds and laps on the thread occur during cold-forming of the thread by rolling.	
Appearance	<p>1) H_1 = depth of thread</p>	<p>Major diameter</p> <p>Pitch diameter</p> <p>Minor diameter</p> <p>Major diameter</p> <p>Pitch diameter</p> <p>Minor diameter</p> <p>Major diameter</p> <p>Pitch diameter</p> <p>Minor diameter</p>
Limits	<p>Laps of any depth or length are not permitted in the following places :</p> <ul style="list-style-type: none"> - at the root of the thread; - at the loaded flank of screw thread below the pitch diameter, even if they start beyond the pitch diameter. <p>The following laps are permissible :</p> <ul style="list-style-type: none"> - laps in the crest of the threads of $0,25 H_1$ max.; - crest of the threads not entirely rolled out, maximum half a turn on one thread; - laps below the pitch diameter, if they run on the non-loaded flank towards the major diameter and not deeper than $0,25 H_1$ and not longer than half a turn on one thread. 	

3.7 Damages

Damages are indentations of any surface of a bolt or screw.

Cause	Damages, for example dents, scrapes, nicks and gouges, are produced by external action during manufacture and handling of bolts and screws, for example during loading.
Appearance	No precise geometrical shape, location or direction, identifiable as external action.
Limits	<p>Damages as described above shall not cause rejection unless it can be shown that they impair function or usability.</p> <p>Dents, scrapes, nicks and gouges on the first three threads shall be such that they allow the screwing on of a go-ring gauge with torque values of $0,001 d^3$ max., in newton metres.</p> <p>A specific agreement on packaging, for example, may be necessary in order to avoid damage during transport.</p>

Table 1 -- Permissible surface discontinuities

Clause	3.1.2		3.1.3		3.1.4		3.1.5				3.2	3.3	3.6	3.7																																																					
	Forging cracks		Forging bursts		Shear bursts		Cracks on hexagon socket screws				Laps	Void	Laps in threads	Damages																																																					
Nominal thread diameter, <i>d</i>	Length max.	Depth and width max.	Circular and flange heads		Shear bursts		Socket		Head		Raw material	Depth max.	Depth max.	Torque value N.m max.																																																					
5	5	0,2	0,08 x head or flange diameter or 0,25 mm + 0,025 for wrenching surfaces	0,08 x head or flange diameter or 0,25 mm + 0,025 for wrenching surfaces	0,04 x head or flange diameter or 0,08 x head or flange diameter	0,04 x head or flange diameter or 0,08 x head or flange diameter	0,25 x depth of socket	0,03 x head diameter or 0,13 mm whichever is larger	0,06 x head diameter not more than 1,6 mm	0,17	0,1	0,11	0,125																																																						
6	6	0,24									0,2			0,13	0,13	0,12	0,24	0,27	0,27	0,31	0,25	0,34	0,34	8																																											
7	7	0,28									0,24			0,13	0,13	0,28									0,25	0,34	0,37	0,4	0,25	0,34	10,6																																				
8	8	0,32									0,28			0,13	0,13	0,31																0,4	0,25	0,4	0,25	0,41	13,8																														
10	10	0,4									0,32			0,13	0,13	0,34																						0,4	0,25	0,4	0,25	0,41	19,7																								
12	12	0,48									0,4			0,13	0,13	0,37																												0,4	0,25	0,4	0,25	0,47	27																		
14	14	0,56									0,48			0,13	0,13	0,4																																		0,4	0,25	0,4	0,25	0,47	36,9												
16	16	0,64									0,56			0,13	0,13	0,48																																								0,4	0,25	0,4	0,25	0,54	46,6						
18	18	0,72									0,64			0,13	0,13	0,56																																														0,4	0,25	0,4	0,25	0,54	56,3
20	20	0,8									0,72			0,13	0,13	0,64																																																			
22	22	0,88	0,8	0,13	0,13	0,72	0,4	0,25	0,4	0,25	0,54	56,3																																																							
24	24	0,96	0,88	0,13	0,13	0,8							0,4	0,25	0,4	0,25	0,54	56,3																																																	
27	27	1,1	0,96	0,13	0,13	0,88													0,4	0,25	0,4	0,25	0,54	56,3																																											
30	30	1,2	1,1	0,13	0,13	0,96																			0,4	0,25	0,4	0,25	0,54	56,3																																					
33	33	1,3	1,2	0,13	0,13	1,1																									0,4	0,25	0,4	0,25	0,54	56,3																															
36	36	1,4	1,3	0,13	0,13	1,2																															0,4	0,25	0,4	0,25	0,54	56,3																									
38	38	1,6	1,4	0,13	0,13	1,3																																					0,4	0,25	0,4	0,25	0,54	56,3																			
			1,6	0,13	0,13	1,4																																											0,4	0,25	0,4	0,25	0,54	56,3													
				0,13	0,13	1,6																																																	0,4	0,25	0,4	0,25	0,54	56,3							

4 Inspection and evaluation procedure

For the acceptance inspection procedure, see ISO 3269. Surface coatings shall be removed before examination if identification of the surface discontinuities is impaired.

NOTE — The 1984 edition of ISO 3269 gives no specifications on sampling plans for surface discontinuities of fasteners. Until this has been completed, the applicable sampling plan is given in the annex.

4.1 Principles

The manufacturer is entitled to use any inspection procedures but due care shall be taken to ensure that products conform to this part of ISO 6157.

The purchaser may use the inspection procedure specified in this clause at his acceptance inspection in order to decide whether a lot of fasteners may be accepted or rejected. This procedure shall also be applied when conformance to specification is disputed, unless some other acceptance procedure has been agreed between the manufacturer and the purchaser at the time of ordering the fasteners.

4.2 Non-destructive testing

A random sample shall be taken from the lot in accordance with table 2 in the annex and subjected to either visual tests or other

suitable tests, e.g. magnetic techniques or eddy current. If no defective product is found the lot shall be accepted (see also 4.4). If defective products are found these shall form the lot size for the procedures given in 4.3.

4.3 Destructive testing

If defective products are detected by the procedures given in 4.2, then a secondary sample shall be taken from the defective products, in accordance with table 3 in the annex, consisting of the products indicating the most serious defects and sectioned at 90° through the discontinuity where the greatest depth is expected.

4.4 Evaluation

If on visual inspection any product is found with quench cracks in any location, or folds at interior corners or below the bearing surface, except "clover leaf" folds in non-circular shoulder fasteners, the lot shall be subject to rejection.

If on the destructive test any product is found with forging cracks, bursts, seams and laps, voids, tool marks or damages which exceed the allowable limits as specified for the applicable type of discontinuity, the lot shall be subject to rejection.

Annex**Sampling plan for surface discontinuities**

(This annex forms an integral part of this standard.)

Sampling for surface discontinuities shall be carried out using the sample sizes given in table 2 and using the principles and procedures given in clause 4.

Table 2 — Sample sizes for visual and non-destructive testing

Lot size ¹⁾ <i>N</i>	Sample size <i>n</i>
$N < 1\ 200$	20
$1\ 201 < N < 10\ 000$	32
$10\ 001 < N < 35\ 000$	50
$35\ 001 < N < 150\ 000$	80

1) Lot size is the number of products of the same type, size and property class submitted for inspection at one time.

NOTE — The sample sizes are based on special inspection level S-4 specified in ISO 2859.

Table 3 — Secondary sample sizes for destructive testing

Number of defective products in the sample <i>N</i>	Secondary sample size <i>n</i>
$N < 8$	2
$9 < N < 15$	3
$16 < N < 25$	5
$26 < N < 50$	8
$51 < N < 80$	13

NOTE — The secondary sample sizes are based on general inspection level II specified in ISO 2859.