BS EN ISO 4759-3:2016

BSI Standards Publication

Tolerances for fasteners

Part 3: Washers for bolts, screws and nuts — Product grades A, C and F (ISO 4759-3:2016)

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National foreword

This British Standard is the UK implementation of EN ISO 4759-3:2016. It supersedes BS EN ISO 4759-3:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee FME/9, Fasteners.

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

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Published by BSI Standards Limited 2016

ISBN 978 0 580 82558 3

ICS 21.060.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2016.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 4759-3

June 2016

ICS 21.060.30

Supersedes EN ISO 4759-3:2000

English Version

Tolerances for fasteners - Part 3: Washers for bolts, screws and nuts - Product grades A, C and F (ISO 4759-3:2016)

Tolérances pour fixations - Partie 3: Rondelles pour vis et écrous - Grades A, C et F (ISO 4759-3:2016)

Toleranzen für Verbindungselemente - Teil 3: Scheiben für Schrauben und Muttern - Produktklassen A, C und F (ISO 4759-3:2016)

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European foreword

This document (EN ISO 4759-3:2016) has been prepared by Technical Committee ISO/TC 2 "Fasteners" in collaboration with Technical Committee CEN/TC 185 “Fasteners” the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by December 2016, and conflicting national standards shall be withdrawn at the latest by December 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 4759-3:2016 has been approved by CEN as EN ISO 4759-3:2016 without any modification.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 2, *Fasteners*.

This fourth edition cancels and replaces the third edition (ISO 4759-3:2000), which has been technically revised.

In comparison to ISO 4759-3:2000, the following changes have been made.

a) the scope has been amended;

b) the normative references have been updated;

c) a new Clause 3 "Symbols and abbreviated terms" has been added;

d) new product grade F has been included (F for Fine tolerances);

e) tolerances for chamfers have been included;

f) in Table A.1 tolerances for standard tolerance grades IT11 and IT14 have been included and IT16 has been deleted;

g) in Tables A.2 and A.3 limit deviations for tolerance classes h13 and H12 respectively have been included;

h) the bibliography has been updated;

i) this part of ISO 4759 has been editorially revised.

ISO 4759 consists of the following parts, under the general title *Tolerances for fasteners*:

— *Part 1: Bolts, screws, studs and nuts — Product grades A, B and C*

— *Part 3: Washers for bolts, screws and nuts — Product grades A, C and F*

INTERNATIONAL STANDARD ISO 4759-3:2016(E)

Tolerances for fasteners —

Part 3: Washers for bolts, screws and nuts — Product grades A, C and F

1 Scope

This part of ISO 4759 specifies tolerances for flat washers of product grades A, C and F with nominal diameters of 1 mm to 150 mm inclusive, designed to be used in bolted joints in combination with bolts, screws, studs and nuts.

This part of ISO 4759 may be applied to non-flat washers however it does not include all the tolerances related to these washers.

It applies to non-captive and captive washers, and to standard and non-standard washers.

It does not apply to dynamic disc springs.

Washers of product grades F and A are intended to be used with bolts, screws, studs and nuts of product grades A and B; washers of product grade C are intended to be used with bolts, screws, studs and nuts of product grade C.

NOTE The product grade refers to a specific tolerance range related to dimensional and geometrical characteristics (product grade F for fine tolerances, product grade A for precise tolerances, product grade C for large tolerances).

Annex A presents tolerances taken from ISO 286-1 and ISO 286-2.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 2692, *Geometrical product specifications (GPS) — Geometrical tolerancing — Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR)*

3 Symbols

c_1 height of the internal chamfer, mm

c_2 height of the external chamfer, mm

d_1 clearance hole, mm

d_2 outside diameter, mm

e_1 radial difference between the clearance hole (area subject to shearing) and the end of the brittle fracture on the bearing side of the washer

e_2 radial difference between the outside diameter (area subject to shearing) and the end of the brittle fracture on the bearing side of the washer

h_{eff} effective height of the washer, mm

t nominal thickness of the washer, mm

t_{eff} effective thickness of the washer, mm

t_1 part of the clearance hole within the tolerance specified for d_1

t_2 part of the outside diameter within the tolerance specified for d_2

y coaxiality, mm

z flatness (deflection), mm

4 Tolerances

The tolerances for washers of product grades A, C and F are specified in Table 1.

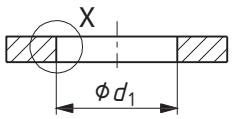
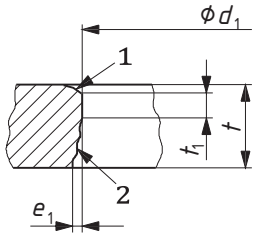
Unless otherwise specified, the tolerances specified in this part of ISO 4759 apply to washers prior to coating.

Deviations from the tolerances specified in this part of ISO 4759 are permitted in product standards only for valid technical reasons. In cases where there is a difference between the tolerance requirements in this part of ISO 4759 and the product standard, the latter takes precedence.

The tolerances of form and position are specified and indicated according to the definitions of ISO 1101 and ISO 2692.

Table 1 — Tolerances for washers

Dimensions in millimetres

Feature	Thickness t	Tolerances						
		Product grade						
		F			A			C
4.1 Clearance hole  Detail X for punched hole  **Key** 1 rollover 2 fracture	$t < 2$ $2 \le t < 4$ $t \ge 4$	d_1 tol. H12 H12 H13	t_1 min. 0,5 t 0,3 t 0,2 t	e_1 max. 0,10 t 0,15 t 0,20 t	d_1 tol. H13 H13 H14	t_1 min. 0,3 t 0,25 t 0,2 t	e_1 max. 0,15 t 0,20 t 0,25 t	d_1 tol. H14 H14 H15
		Rollover is undefined but allowed.						Fracture (e_1), t_1, and rollover are undefined but allowed.
		t_1 is the part of the hole within the tolerance specified for d_1.						

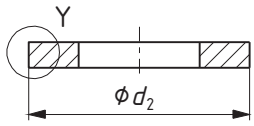
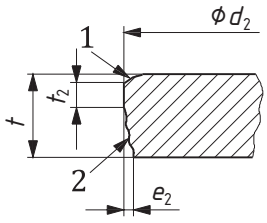
Feature	Thickness t	Tolerances				
		Product grade				
		F		A		C
4.2 Outside diameter  Detail Y for outside diameter  **Key** 1 rollover 2 fracture	$t < 2$ $2 \le t < 4$ $t \ge 4$	d_2 tol. h13 h13 h14	e_2 max. 0,13 t 0,15 t 0,18 t	d_2 tol. h14 h14 h15	e_2 max. 0,18 t 0,20 t 0,25 t	d_2 tol. h16 h16 h16
		Rollover and t_2 are undefined but allowed.				Fracture (e_2), t_2 and rollover are undefined but allowed.
		t_2 is the part of the outside diameter within the tolerance specified for d_2.				

Table 1 — *(continued)*

Dimensions in millimetres

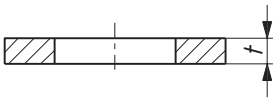
Feature	Thickness t	Tolerances		
		Product grade		
		F	A	C
4.3 Thickness  Tolerance on thickness shall be measured after removal of burrs.	$t \leq 0,5$	±0,04	±0,05	±0,10
	$0,5 < t \leq 1$	±0,06	±0,10	±0,20
	$1 < t \leq 2,5$	±0,12	±0,20	±0,30
	$2,5 < t \leq 4$	±0,16	±0,30	±0,60
	$4 < t \leq 6$	±0,20	±0,60	±1,00
	$6 < t \leq 10$	±0,24	±1,00	±1,20
	$10 < t \leq 20$	±0,28	±1,20	±1,60

Table 1 — *(continued)*

Dimensions in millimetres

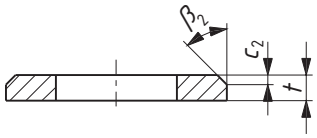
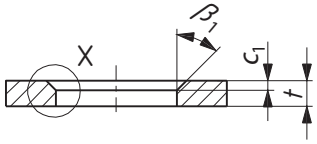
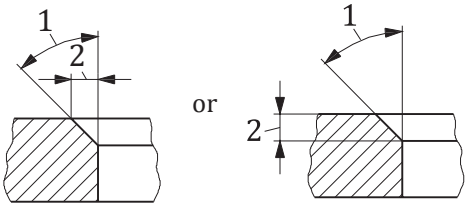
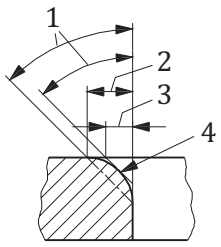
Feature	Thickness t	Tolerances					
		Product grade					
		F		A		C	
4.4 Chamfers	nom.	c_1 min.	c_2 min.	c_1 min.	c_2 min.	c_1 min.	c_2 min.
	$1 \le t < 2$	0,20 t	0,25 t	0,20 t	0,25 t	0,20 t	0,25 t
	$2 \le t < 4$	0,18 t	0,22 t	0,18 t	0,22 t	0,18 t	0,22 t
	$t \ge 4$	0,15 t	0,20 t	0,15 t	0,20 t	0,15 t	0,20 t
4.4.1 Outer chamfer  							
4.4.2 Inner chamfer Dimension t_1 in accordance with 4.1 shall be achieved irrespective to the height of the inner chamfer.  The chamfer dimensioning shall be considered as follows:  **Key – dimensioning** 1 angle 2 dimension ± tolerance  **Key – shape** 1 angle 2 dimension + tolerance 3 dimension - tolerance 4 undefined shape		β_1 = 35° to 45° β_2 = 35° to 45°					

Table 1 — *(continued)*

Dimensions in millimetres

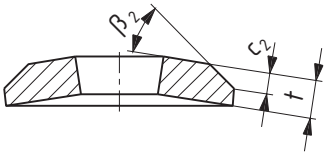
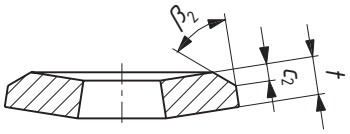
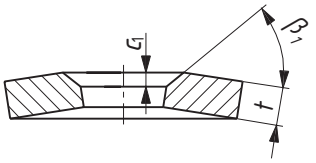
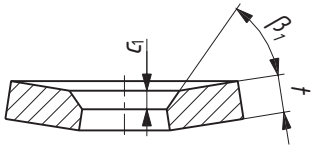
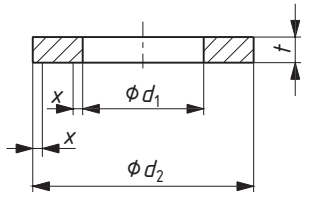
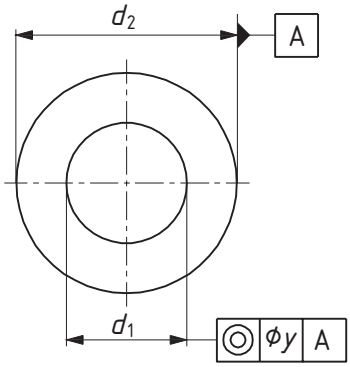
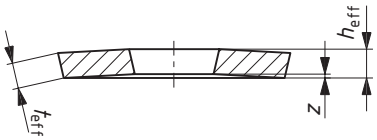
Feature	Thickness *t*	Tolerances		
		Product grade		
		F	A	C
4.4.3 Supplementary optional requirements for captive washers				
When required by the purchaser, the position of the chamfer(s) relative to the deflection resulting from punching process shall be specified at the time of the order.				
 **a) Outer chamfer opposite to concave side**				
 **b) Outer chamfer opposite to convex side**				
 **c) Inner chamfer opposite to concave side**				
 **d) Inner chamfer opposite to convex side**				

Table 1 — *(continued)*

Dimensions in millimetres

Feature	Thickness t	Tolerances		
		Product grade		
		F	A	C
4.5 Tolerances of form and position		Δt max.	Δt max.	
4.5.1 Thickness variation Δt on the same part				
 Requirements for Δt apply at a distance of $x = 0{,}1\ (d_2 - d_1)$ from the edge of the hole and outer edge, i.e. only the 60 % of the ring width.	$t \le 0{,}5$	0,020	0,025	No requirements
	$0{,}5 < t \le 1$	0,030	0,050	
	$1 < t \le 2{,}5$	0,060	0,100	
	$2{,}5 < t \le 4$	0,080	0,150	
	$4 < t \le 6$	0,100	0,200	
	$6 < t \le 10$	0,120	0,300	
	$10 < t \le 20$	0,140	0,400	
4.5.2 Coaxiality		y max.	y max.	y max.
	$t < 2$	2IT11	2IT12	2IT13
	$2 \le t < 4$	2IT12	2IT13	2IT14
	$t \ge 4$	2IT13	2IT14	2IT15
		Tolerance y is based on dimension d_2 (see Table A.1).		
4.5.3 Flatness (deflection)		z max.	z max.	z max.
 Flatness (deflection), z, is the difference between the effective height, h_{eff}, of the washer and the effective thickness, t_{eff}, of the material. NOTE 1 Tolerance z is always independent of the tolerance on the thickness. NOTE 2 Additional processes (e.g. grinding or calibrating) may be required to minimize deflection. Tolerance on flatness shall be measured after removal of burrs.	$t \le 0{,}5$	0,07	0,10	0,13
	$0{,}5 < t \le 1$	0,10	0,15	0,20
	$1 < t \le 2{,}5$	0,20	0,20	0,25
	$2{,}5 < t \le 4$	0,30	0,30	0,30
	$4 < t \le 6$	0,40	0,40	0,40
	$6 < t \le 10$	0,60	0,60	0,60
	$10 < t \le 20$	1,00	1,00	1,00

Annex A
(informative)

Tolerances

Standard tolerance grades for IT values are given in Table A.1 and the limit deviations for shafts and holes in Tables A.2 and A.3, respectively. These tolerances are taken from ISO 286-1 and ISO 286-2.

Table A.1 — IT values of standard tolerance grades

Dimensions in millimetres

Nominal dimensions		**Standard tolerance grades**				
		IT11	IT12	IT13	IT14	IT15
over	to	**Tolerances**				
	3	0,06	0,10	0,14	0,25	0,40
3	6	0,08	0,12	0,18	0,30	0,48
6	10	0,09	0,15	0,22	0,36	0,58
10	18	0,11	0,18	0,27	0,43	0,70
18	30	0,13	0,21	0,33	0,52	0,84
30	50	0,16	0,25	0,39	0,62	1,00
50	80	0,19	0,30	0,46	0,74	1,20
80	120	0,22	0,35	0,54	0,87	1,40
120	180	0,25	0,40	0,63	1,00	1,60
180	250	0,29	0,46	0,72	1,15	1,85

Table A.2 — Limit deviations for shafts

Dimensions in millimetres

Nominal dimensions		**Limit deviations**			
over	to	h13	h14	h15	h16
	3	0 −0,14	0 −0,25	0 −0,40	0 −0,60
3	6	0 −0,18	0 −0,30	0 −0,48	0 −0,75
6	10	0 −0,22	0 −0,36	0 −0,58	0 −0,90
10	18	0 −0,27	0 −0,43	0 −0,70	0 −1,10
18	30	0 −0,33	0 −0,52	0 −0,84	0 −1,30
30	50	0 −0,39	0 −0,62	0 −1,00	0 −1,60
50	80	0 −0,46	0 −0,74	0 −1,20	0 −1,90
80	120	0 −0,54	0 −0,87	0 −1,40	0 −2,20
120	180	0 −0,63	0 −1,00	0 −1,60	0 −2,50
180	250	0 −0,72	0 −1,15	0 −1,85	0 −2,90

Table A.3 — Limit deviations for holes

Dimensions in millimetres

Nominal dimensions		Limit deviations			
over	to	H12	H13	H14	H15
	3	+0,10 0	+0,14 0	+0,25 0	+0,40 0
3	6	+0,12 0	+0,18 0	+0,30 0	+0,48 0
6	10	+0,15 0	+0,22 0	+0,36 0	+0,58 0
10	18	+0,18 0	+0,27 0	+0,43 0	+0,70 0
18	30	+0,21 0	+0,33 0	+0,52 0	+0,84 0
30	50	+0,25 0	+0,39 0	+0,62 0	+1,00 0
50	80	+0,30 0	+0,46 0	+0,74 0	+1,20 0
80	120	+0,35 0	+0,54 0	+0,87 0	+1,40 0
120	180	+0,40 0	+0,63 0	+1,00 0	+1,60 0
180	250	+0,46 0	+0,72 0	+1,15 0	+1,85 0

Bibliography

[1] ISO 286-1, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 1: Basis of tolerances, deviations and fits*

[2] ISO 286-2, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

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