April 2011

DIN 471

DIN

ICS 21.060.60; 21.120.10

Supersedes
DIN 471:1981-09

Retaining rings for shafts – Normal type and heavy type English translation of DIN 471:2011-04

Sicherungsringe (Halteringe) für Wellen –
Regelausführung und schwere Ausführung
Englische Übersetzung von DIN 471:2011-04

Anneaux d'arrêt pour arbres –
Type standard et type robuste
Traduction anglaise de DIN 471:2011-04

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A comma is used as the decimal marker.

Contents

Page

Foreword

This standard has been prepared by Working Committee NA 067-00-09 AA *Verbindungselemente ohne Gewinde* of the *Normenausschuss Mechanische Verbindungselemente* (Fasteners Standards Committee).

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

Amendments

This standard differs from DIN 471:1981-09 as follows:

a) normative references have been updated;

b) the specifications for load bearing capacity, detaching speed and assembly have been revised;

c) the tolerances on radial run-out have been deleted from Figure 2 (formerly Figure 3);

d) in Clause 10, Figure 11 (formerly Figure 14) “Taper assembly” has been revised;

e) Figure 10 “Design of groove base” has been included in 10.3;

f) examples of designation for retaining rings with corrosion protection have been included;

g) the standard has been editorially revised.

Previous editions

DIN 471: 1941-12, 1942-11, 1952-01, 1954-01, 1981-09
DIN 471 and DIN 472 Supplement 1: 1945-01, 1954x-03
DIN 471-1: 1965-03
DIN 471-2: 1965-03
DIN 995: 1970-01

1 Scope

This standard specifies requirements for retaining rings for shafts and lays down design details for the grooves into which such rings are fitted.

NOTE Retaining rings are used to hold components or assemblies (e.g. rolling bearings) on shafts and are suitable for the transmission of axial forces.

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.

DIN 988, *Shim rings and supporting rings*

DIN 5254, *Pliers for retaining rings for shafts*

DIN 50938, *Black oxide coatings on iron or steel — Requirements and test methods*

DIN EN 10132-4, *Cold-rolled narrow steel strip for heat-treatment — Technical delivery conditions — Part 4: Spring steels and other applications*

DIN EN 12476, *Phosphate conversion coatings of metals — Method of specifying requirements*

DIN EN ISO 3269, *Fasteners — Acceptance inspection*

DIN EN ISO 4042, *Fasteners — Electroplated coatings*

DIN EN ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

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

DIN EN ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

DIN EN ISO 18265, *Metallic materials — Conversion of hardness values*

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

3 Symbols

a radial width of the lug

b radial width of retaining ring opposite the aperture

c distance between measuring plates for testing spiral flatness

d_1 shaft diameter

d_2 groove diameter

d_3 internal diameter of retaining ring in the unstressed state

d_4 maximum centre line diameter of external clearance during assembly, to be calculated from:
$d_4 = d_1 + 2{,}1\ a$

d_5 diameter of the assembly holes

E modulus of elasticity

F force acting on the retaining ring when testing conical deformation

F_N load bearing capacity of groove at a yield point of the grooved material of 200 MPa (see 8.2)

F_R load bearing capacity of retaining ring with sharp-edged abutment of a machine component (see 8.3)

F_{Rg} load bearing capacity of retaining ring for abutment with edge distance g (see 8.3)

g edge distance of the machine component abutting the retaining ring

h distance between the plates when testing conical deformation

m groove width

n edge margin

n_{abl} detaching speed of the retaining ring (see Clause 9)

R_{eL} yield point

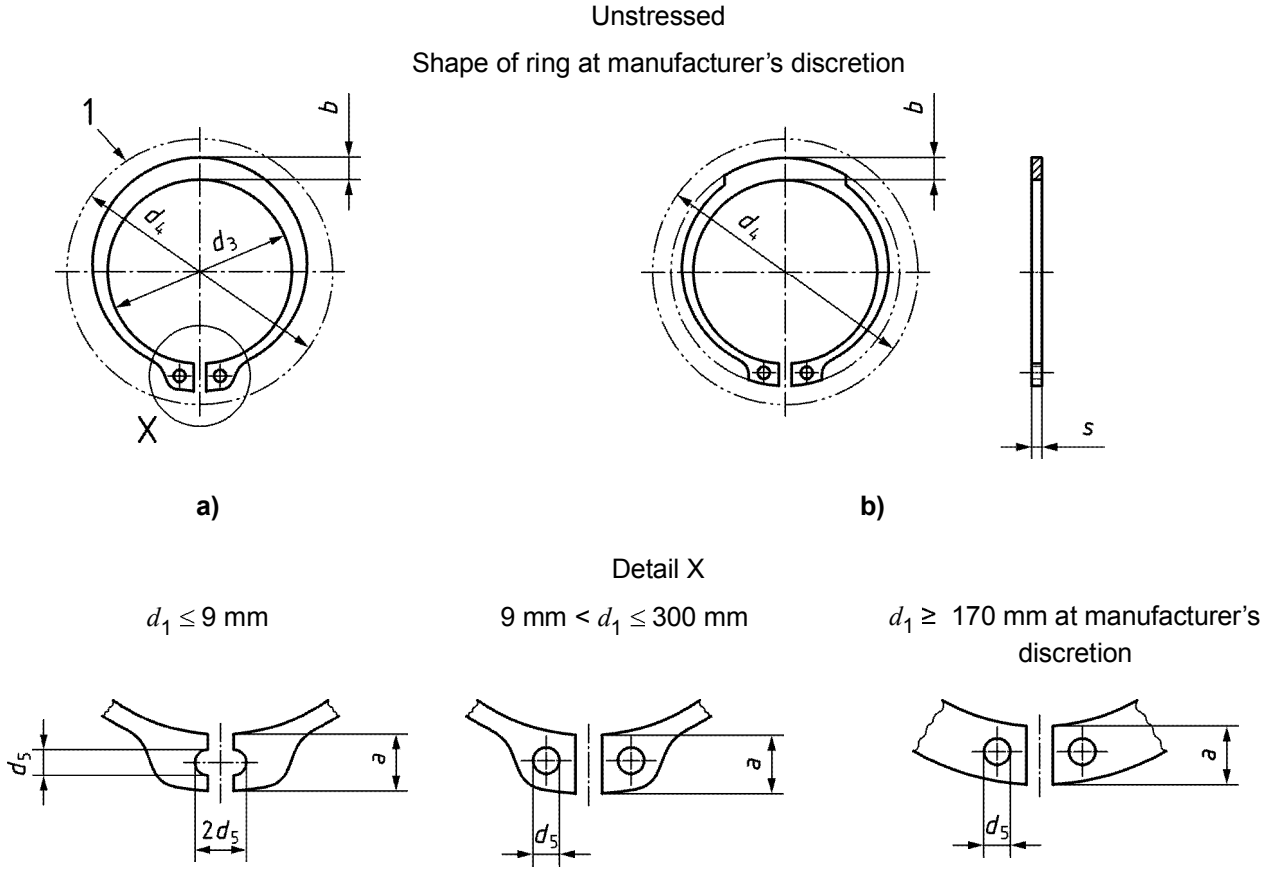
r curvature in the groove base or test jaws

s thickness of retaining ring

t groove depth with nominal sizes of d_1 and d_2

4 Dimensions and design details

The designs shown in Figure 1 are for illustrative purposes only; however, the dimensions of retaining rings and grooves shall be as specified in Tables 1 and 2. The tolerances specified relate to retaining rings in their uncoated condition.



Key

1 External clearance

Figure 1 — Dimensions of retaining ring (notation)

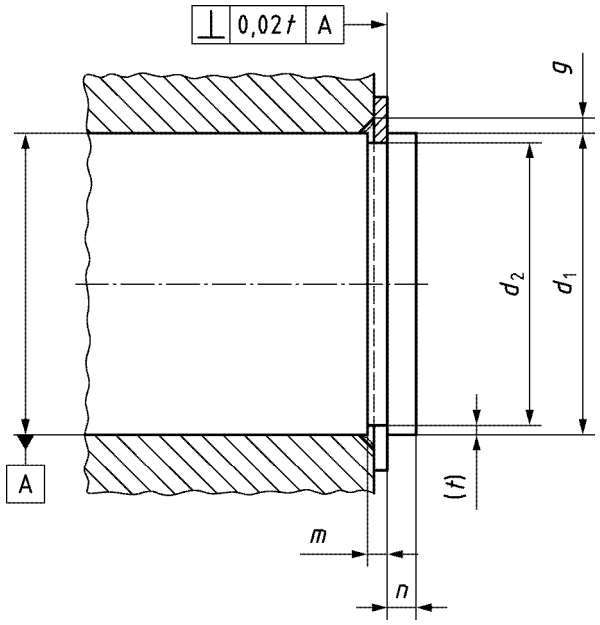


Figure 2 — Example of installation

Values for peak-to-valley height for groove base and loaded edge shall be specified in each case.

The design of the groove base shall be as specified in 10.3.

Table 1 — Normal type

Dimensions in millimetres

Shaft diameter	Ring								Groove					Supplementary data[d]						
d_1	s		d_3		a	b[a]	d_5	Mass per 1 000 units in kg	d_2[b]		m[c]	t	n_4	d_4	F_N	F_R	g	F_{Rg}	n_{abl}	Nominal size of pliers as in DIN 5254
Nominal size		perm. dev.		perm. dev.	max.	≈	min.	≈		perm. dev.	H13		min.		kN	kN		kN	min^{-1}	
3	0,4	0 –0,05	2,7	+0,04 –0,15	1,9	0,8	1,0	0,017	2,8	0 –0,04	0,5	0,10	0,3	7,0	0,15	0,47	0,5	0,27	360 000	3
4	0,4		3,7		2,2	0,9	1,0	0,022	3,8	0 –0,05	0,5	0,10	0,3	8,6	0,20	0,50	0,5	0,30	211 000	
5	0,6		4,7		2,5	1,1	1,0	0,066	4,8		0,7	0,10	0,3	10,3	0,26	1,00	0,5	0,80	154 000	
6	0,7		5,6		2,7	1,3	1,2	0,084	5,7		0,8	0,15	0,5	11,7	0,46	1,45	0,5	0,90	114 000	
7	0,8		6,5	+0,06 –0,18	3,1	1,4	1,2	0,121	6,7	0 –0,06	0,9	0,15	0,5	13,5	0,54	2,60	0,5	1,40	121 000	
8	0,8		7,4		3,2	1,5	1,2	0,158	7,6		0,9	0,20	0,6	14,7	0,81	3,00	0,5	2,00	96 000	
9	1,0	0 –0,06	8,4		3,3	1,7	1,2	0,300	8,6	0 –0,11	1,1	0,20	0,6	16,0	0,92	3,50	0,5	2,40	85 000	
10	1,0		9,3	+0,10 –0,36	3,3	1,8	1,5	0,340	9,6		1,1	0,20	0,6	17,0	1,01	4,00	1,0	2,40	84 000	3; 10
11	1,0		10,2		3,3	1,8	1,5	0,410	10,5		1,1	0,25	0,8	18,0	1,40	4,50	1,0	2,40	70 000	10
12	1,0		11,0		3,3	1,8	1,7	0,500	11,5		1,1	0,25	0,8	19,0	1,53	5,00	1,0	2,40	75 000	
13	1,0		11,9		3,4	2,0	1,7	0,530	12,4		1,1	0,30	0,9	20,2	2,00	5,80	1,0	2,40	66 000	
14	1,0		12,9		3,5	2,1	1,7	0,640	13,4		1,1	0,30	0,9	21,4	2,15	6,35	1,0	2,40	58 000	
15	1,0		13,8		3,6	2,2	1,7	0,670	14,3		1,1	0,35	1,1	22,6	2,66	6,90	1,0	2,40	50 000	
16	1,0		14,7		3,7	2,2	1,7	0,700	15,2		1,1	0,40	1,2	23,8	3,26	7,40	1,0	2,40	45 000	
17	1,0		15,7		3,8	2,3	1,7	0,820	16,2		1,1	0,40	1,2	25,0	3,46	8,00	1,0	2,40	41 000	

See page 13 for [a, b, c] and [d].

Table 1 *(continued)*

Dimensions in millimetres

Shaft diameter	Ring								Groove					Supplementary data[d]						
d_1	s		d_3		a	b[a]	d_5	Mass per 1 000 units in kg	d_2[b]		m[c]	t	n_4	d_4	F_N	F_R	g	F_{Rg}	n_{abl}	Nominal size of pliers as in DIN 5254
Nominal size		perm. dev.		perm. dev.	max.	≈	min.	≈		perm. dev.	H13		min.		kN	kN		kN	min^{-1}	
18	1,20	0 −0,06	16,5	+0,10 −0,36	3,9	2,4	2,0	1,11	17,0	0 −0,11	1,30	0,50	1,5	26,2	4,58	17,0	1,5	3,75	39 000	10
19	1,20		17,5		3,9	2,5	2,0	1,22	18,0		1,30	0,50	1,5	27,2	4,48	17,0	1,5	3,80	35 000	10; 19
20	1,20		18,5	+0,13 −0,42	4,0	2,6	2,0	1,30	19,0	0 −0,13	1,30	0,50	1,5	28,4	5,06	17,1	1,5	3,85	32 000	
21	1,20		19,5		4,1	2,7	2,0	1,42	20,0		1,30	0,50	1,5	29,6	5,36	16,8	1,5	3,75	29 000	
22	1,20		20,5		4,2	2,8	2,0	1,50	21,0		1,30	0,50	1,5	30,8	5,65	16,9	1,5	3,80	27 000	
24	1,20		22,2	+0,21 −0,42	4,4	3,0	2,0	1,77	22,9	0 −0,21	1,30	0,55	1,7	33,2	6,75	16,1	1,5	3,65	27 000	
25	1,20		23,2		4,4	3,0	2,0	1,90	23,9		1,30	0,55	1,7	34,2	7,05	16,2	1,5	3,70	25 000	
26	1,20		24,2		4,5	3,1	2,0	1,96	24,9		1,30	0,55	1,7	35,5	7,34	16,1	1,5	3,70	24 000	19
28	1,50		25,9		4,7	3,2	2,0	2,92	26,6		1,60	0,70	2,1	37,9	10,00	32,1	1,5	7,50	21 200	
29	1,50		26,9		4,8	3,4	2,0	3,20	27,6		1,60	0,70	2,1	39,1	10,37	31,8	1,5	7,45	20 000	
30	1,50		27,9		5,0	3,5	2,0	3,31	28,6		1,60	0,70	2,1	40,5	10,73	32,1	1,5	7,65	18 900	
32	1,50		29,6		5,2	3,6	2,5	3,54	30,3	0 −0,25	1,60	0,85	2,6	43,0	13,85	31,2	2,0	5,55	16 900	
34	1,50		31,5	+0,25 −0,5	5,4	3,8	2,5	3,80	32,3		1,60	0,85	2,6	45,4	14,72	31,3	2,0	5,60	16 100	
35	1,50		32,2		5,6	3,9	2,5	4,00	33,0		1,60	1,00	3,0	46,8	17,80	30,8	2,0	5,55	15 500	
36	1,75		33,2		5,6	4,0	2,5	5,00	34,0		1,85	1,00	3,0	47,8	18,33	49,4	2,0	9,00	14 500	
38	1,75		35,2		5,8	4,2	2,5	5,62	36,0		1,85	1,00	3,0	50,2	19,30	49,5	2,0	9,10	13 600	
40	1,75		36,5	+0,39 −0,9	6,0	4,4	2,5	6,03	37,5		1,85	1,25	3,8	52,6	25,30	51,0	2,0	9,50	14 300	19; 40

See page 13 for [a, b, c] and [d].

Table 1 *(continued)*

Dimensions in millimetres

Shaft diameter d_1	Ring								Groove					Supplementary data[d]						
	s		d_3		a	b[a]	d_5	Mass per 1 000 units in kg	d_2[b]		m[c]	t	n	d_4	F_N	F_R	g	F_{Rg}	n_{abl}	Nominal size of pliers as in DIN 5254
Nominal size		perm. dev.		perm. dev.	max.	≈	min.	≈		perm. dev.	H13		min.		kN	kN		kN	min^{-1}	
42	1,75	0 −0,06	38,5	+0,39 −0,9	6,5	4,5	2,5	6,5	39,5	0 −0,25	1,85	1,25	3,8	55,7	26,70	50,0	2,0	9,45	13 000	40
45	1,75		41,5		6,7	4,7	2,5	7,5	42,5		1,85	1,25	3,8	59,1	28,60	49,0	2,0	9,35	11 400	
48	1,75		44,5		6,9	5	2,5	7,9	45,5		1,85	1,25	3,8	62,5	30,70	49,4	2,0	9,55	10 300	
50	2,0	0 −0,07	45,8		6,9	5,1	2,5	10,2	47,0		2,15	1,50	4,5	64,5	38,00	73,3	2,0	14,40	10 500	
52	2,0		47,8		7,0	5,2	2,5	11,1	49,0		2,15	1,50	4,5	66,7	39,70	73,1	2,5	11,50	9 850	
55	2,0		50,8	+0,46 −1,1	7,2	5,4	2,5	11,4	52,0	0 −0,30	2,15	1,50	4,5	70,2	42,00	71,4	2,5	11,40	8 960	
56	2,0		51,8		7,3	5,5	2,5	11,8	53,0		2,15	1,50	4,5	71,6	42,80	70,8	2,5	11,35	8 670	
58	2,0		53,8		7,3	5,6	2,5	12,6	55,0		2,15	1,50	4,5	73,6	44,30	71,1	2,5	11,50	8 200	
60	2,0		55,8		7,4	5,8	2,5	12,9	57,0		2,15	1,50	4,5	75,6	46,00	69,2	2,5	11,30	7 620	
62	2,0		57,8		7,5	6,0	2,5	14,3	59,0		2,15	1,50	4,5	77,8	47,50	69,3	2,5	11,45	7 240	
63	2,0		58,8		7,6	6,2	2,5	15,9	60,0		2,15	1,50	4,5	79,0	48,30	70,2	2,5	11,60	7 050	
65	2,5		60,8		7,8	6,3	3,0	18,2	62,0		2,65	1,50	4,5	81,4	49,80	135,6	2,5	22,70	6 640	
68	2,5		63,5		8,0	6,5	3,0	21,8	65,0		2,65	1,50	4,5	84,8	52,20	135,9	2,5	23,10	6 910	
70	2,5		65,5		8,1	6,6	3,0	22,0	67,0		2,65	1,50	4,5	87,0	53,80	134,2	2,5	23,00	6 530	
72	2,5		67,5		8,2	6,8	3,0	22,5	69,0		2,65	1,50	4,5	89,2	55,30	131,8	2,5	22,80	6 190	

See page 13 for [a, b, c] and [d].

Table 1 *(continued)*

Dimensions in millimetres

Shaft diameter d_1	Ring								Groove					Supplementary data[d]						
	s		d_3		a	b[a]	d_5	Mass per 1 000 units in kg	d_2[b]		m[c]	t	n	d_4	F_N	F_R	g	F_{Rg}	n_{abl}	Nominal size of pliers as in DIN 5254
Nominal size		perm. dev.		perm. dev.	max.	≈	min.	≈		perm. dev.	H13		min.		kN	kN		kN	min^{-1}	
75	2,5	0 –0,07	70,5	+0,46 –1,1	8,4	7,0	3,0	24,6	72,0	0 –0,3	2,65	1,50	4,5	92,7	57,60	130,0	2,5	22,80	5 740	40
78	2,5		73,5		8,6	7,3	3,0	26,2	75,0		2,65	1,50	4,5	96,1	60,00	131,3	3,0	19,75	5 450	
80	2,5		74,5		8,6	7,4	3,0	27,3	76,5		2,65	1,75	5,3	98,1	71,60	128,4	3,0	19,50	6 100	
82	2,5		76,5		8,7	7,6	3,0	31,2	78,5		2,65	1,75	5,3	100,3	73,50	128,0	3,0	19,60	5 860	
85	3,0	0 –0,08	79,5		8,7	7,8	3,5	36,4	81,5	0 –0,54	3,15	1,75	5,3	103,3	76,20	215,4	3,0	33,40	5 710	40; 85
88	3,0		82,5	+0,54 –1,3	8,8	8,0	3,5	41,2	84,5		3,15	1,75	5,3	106,5	79,00	221,8	3,0	34,85	5 200	
90	3,0		84,5		8,8	8,2	3,5	44,5	86,5		3,15	1,75	5,3	108,5	80,80	217,2	3,0	34,40	4 980	
95	3,0		89,5		9,4	8,6	3,5	49,0	91,5		3,15	1,75	5,3	114,8	85,50	212,2	3,5	29,25	4 550	
100	3,0		94,5		9,6	9,0	3,5	53,7	96,5		3,15	1,75	5,3	120,2	90,00	206,4	3,5	29,00	4 180	85
105	4,0	0 –0,1	98,0		9,9	9,3	3,5	80,0	101,0	0 –0,54	4,15	2,00	6,0	125,8	107,60	471,8	3,5	67,70	4 740	
110	4,0		103,0		10,1	9,6	3,5	82,0	106,0		4,15	2,00	6,0	131,2	113,00	457,0	3,5	66,90	4 340	
115	4,0		108,0		10,6	9,8	3,5	84,0	111,0		4,15	2,00	6,0	137,3	118,20	438,6	3,5	65,50	3 970	
120	4,0		113,0		11,0	10,2	3,5	86,0	116,0		4,15	2,00	6,0	143,1	123,50	424,6	3,5	64,50	3 685	
125	4,0		118,0		11,4	10,4	4,0	90,0	121,0	0 –0,63	4,15	2,00	6,0	149,0	128,70	411,5	4,0	56,50	3 420	e
130	4,0		123,0	+0,63 –1,5	11,6	10,7	4,0	100,0	126,0		4,15	2,00	6,0	154,4	134,00	395,5	4,0	55,20	3 180	
135	4,0		128,0		11,8	11,0	4,0	104,0	131,0		4,15	2,00	6,0	159,8	139,20	389,5	4,0	55,40	2 950	

See page 13 for [a, b, c, d] and [e].

Table 1 *(continued)*

Dimensions in millimetres

Shaft diameter d_1	Ring								Groove					Supplementary data[d]						
	s		d_3		a	b[a]	d_5	Mass per 1 000 units in kg	d_2[b]		m[c]	t	n	d_4	F_N	F_R	g	F_{Rg}	n_{abl}	Nominal size of pliers as in DIN 5254
Nominal size		perm. dev.		perm. dev.	max.	≈	min.	≈		perm. dev.	H13		min.		kN	kN		kN	min^{-1}	
140	4,0	0 −0,1	133,0	+0,63 −1,5	12,0	11,2	4,0	110,0	136,0	0 −0,63	4,15	2,0	6,0	165,2	144,5	376,5	4,0	54,4	2 760	e
145	4,0		138,0		12,2	11,5	4,0	115,0	141,0		4,15	2,0	6,0	170,6	149,6	367,0	4,0	53,8	2 600	
150	4,0		142,0		13,0	11,8	4,0	120,0	145,0		4,15	2,5	7,5	177,3	193,0	357,5	4,0	53,4	2 480	
155	4,0		146,0		13,0	12,0	4,0	135,0	150,0		4,15	2,5	7,5	182,3	199,6	352,9	4,0	52,6	2 710	
160	4,0		151,0		13,3	12,2	4,0	150,0	155,0		4,15	2,5	7,5	188,0	206,1	349,2	4,0	52,2	2 540	
165	4,0		155,5		13,5	12,5	4,0	160,0	160,0		4,15	2,5	7,5	193,4	212,5	345,3	5,0	41,4	2 520	
170	4,0		160,5		13,5	12,9	4,0	170,0	165,0		4,15	2,5	7,5	198,4	219,1	349,2	5,0	41,9	2 440	
175	4,0		165,5		13,5	12,9	4,0	180,0	170,0		4,15	2,5	7,5	203,4	225,5	340,1	5,0	40,7	2 300	
180	4,0		170,4		14,2	13,5	4,0	190,0	175,0		4,15	2,5	7,5	210,0	232,2	345,3	5,0	41,4	2 180	
185	4,0		175,5		14,2	13,5	4,0	200,0	180,0		4,15	2,5	7,5	215,0	238,6	336,7	5,0	40,4	2 070	
190	4,0		180,5	+0,72 −1,7	14,2	14,0	4,0	210,0	185,0	0 −0,72	4,15	2,5	7,5	220,0	245,1	333,8	5,0	40,0	1 970	
195	4,0		185,5		14,2	14,0	4,0	220,0	190,0		4,15	2,5	7,5	225,0	251,8	325,4	5,0	39,0	1 835	
200	4,0		190,5		14,2	14,0	4,0	230,0	195,0		4,15	2,5	7,5	230,0	258,3	319,2	5,0	38,3	1 770	
210	5,0	0 −0,12	198,0		14,2	14,0	4,0	248,0	204,0		5,15	3,0	9,0	240,0	325,1	598,2	6,0	59,9	1 835	
220	5,0		208,0		14,2	14,0	4,0	265,0	214,0		5,15	3,0	9,0	250,0	340,8	572,4	6,0	57,3	1 620	
230	5,0		218,0		14,2	14,0	4,0	290,0	224,0		5,15	3,0	9,0	260,0	356,6	548,9	6,0	55,0	1 445	
240	5,0		228,0		14,2	14,0	4,0	310,0	234,0		5,15	3,0	9,0	270,0	372,6	530,3	6,0	53,0	1 305	

See page 13 for [a, b, c, d] and [e].

Table 1 *(continued)*

Dimensions in millimetres

Shaft diameter	Ring								Groove					Supplementary data[d]							
d_1	s		d_3		a	b[a]	d_5	Mass per 1 000 units in kg	d_2[b]		m[c]	t	n	d_4	F_N	F_R	g	F_{Rg}	n_{abl}	Nominal size of pliers as in DIN 5254
Nominal size		perm. dev.		perm. dev.	max.	≈	min.	≈		perm. dev.	H13		min.		kN	kN		kN	min^{-1}	
250	5,0	0 −0,12	238,0	+0,72 −1,7	14,2	14,0	4,0	335,0	244,0	0 −0,72	5,15	3,0	9,0	280	388,3	504,3	6,0	50,5	1 180	e
260	5,0		245,0		16,2	16,0	5,0	355,0	252,0	0 −0,81	5,15	4,0	12,0	294	535,8	540,6	6,0	54,6	1 320	
270	5,0		255,0	+0,81 −2	16,2	16,0	5,0	375,0	262,0		5,15	4,0	12,0	304	556,6	525,3	6,0	52,5	1 215	
280	5,0		265,0		16,2	16,0	5,0	398,0	272,0		5,15	4,0	12,0	314	576,6	508,2	6,0	50,9	1 100	
290	5,0		275,0		16,2	16,0	5,0	418,0	282,0		5,15	4,0	12,0	324	599,1	490,8	6,0	49,2	1 005	
300	5,0		285,0		16,2	16,0	5,0	440,0	292,0		5,15	4,0	12,0	334	619,1	475,0	6,0	47,5	930	

a Dimension b shall not exceed dimension a max.

b See 10.1.

c See 10.2.

d The supplementary data apply only to retaining rings made of spring steel as in DIN EN 10132-4.

e Pliers are available in special designs.

Table 2 — Heavy type

Dimensions in millimetres

Shaft diameter	Ring								Groove				Supplementary data[d]						
d_1	s		d_3		a	b[a]	d_5	Mass per 1 000 units in kg	d_2[b]		m[c]	t	n	d_4	F_N	F_R	g	F_{Rg}	n_{abl}	Nominal size of pliers as in DIN 5254
Nominal size		perm. dev.		perm. dev.	max.	≈	min.	≈		perm. dev.	H13		min.		kN	kN		kN	min^{-1}	
15	1,50	0 −0,06	13,8	+0,10 −0,36	4,8	2,4	2,0	1,10	14,3	0 −0,11	1,60	0,35	1,1	25,1	2,66	15,5	1,0	6,40	57 000	10
16	1,50		14,7		5,0	2,5	2,0	1,19	15,2		1,60	0,40	1,2	26,5	3,26	16,6	1,0	6,35	44 000	
17	1,50		15,7		5,0	2,6	2,0	1,39	16,2		1,60	0,40	1,2	27,5	3,46	18,0	1,0	6,70	46 000	
18	1,50		16,5		5,1	2,7	2,0	1,56	17,0		1,60	0,50	1,5	28,7	4,58	26,6	1,5	5,85	42 750	
20	1,75		18,5	+0,13 −0,42	5,5	3,0	2,0	2,19	19,0	0 −0,13	1,85	0,50	1,5	31,6	5,06	36,3	1,5	8,20	36 000	10; 19
22	1,75		20,5		6,0	3,1	2,0	2,42	21,0		1,85	0,50	1,5	34,6	5,65	36,0	1,5	8,10	29 000	
24	1,75		22,2	+0,21 −0,42	6,3	3,2	2,0	2,76	22,9	0 −0,21	1,85	0,55	1,7	37,3	6,75	34,2	1,5	7,60	29 200	
25	2,00	0 −0,07	23,2		6,4	3,4	2,0	3,59	23,9		2,15	0,55	1,7	38,5	7,05	45,0	1,5	10,30	25 000	
28	2,00		25,9		6,5	3,5	2,0	4,25	26,6		2,15	0,70	2,1	41,7	10,00	57,0	1,5	13,40	22 200	19
30	2,00		27,9		6,5	4,1	2,0	5,35	28,6		2,15	0,70	2,1	43,7	10,70	57,0	1,5	13,60	21 100	
32	2,00		29,6		6,5	4,1	2,5	5,85	30,3	0 −0,25	2,15	0,85	2,6	45,7	13,80	55,5	2,0	10,00	18 400	
34	2,50		31,5	+0,25 −0,5	6,6	4,2	2,5	7,05	32,3		2,65	0,85	2,6	47,9	14,70	87,0	2,0	15,60	17 800	
35	2,50		32,2		6,7	4,2	2,5	7,20	33,0		2,65	1,00	3,0	49,1	17,80	86,0	2,0	15,40	16 500	
38	2,50		35,2		6,8	4,3	2,5	8,30	36,0		2,65	1,00	3,0	52,3	19,30	101,0	2,0	18,60	14 500	
40	2,50		36,5	+0,39 −0,9	7,0	4,4	2,5	8,60	37,5		2,65	1,25	3,8	54,7	25,30	104,0	2,0	19,30	14 300	19; 40
42	2,50		38,5		7,2	4,5	2,5	9,30	39,5		2,65	1,25	3,8	57,2	26,70	102,0	2,0	19,20	13 000	

See page 15 for [a, b, c] and [d].

Table 2 *(continued)*

Dimensions in millimetres

Shaft diameter d_1	Ring								Groove					Supplementary data[d]						
	s		d_3		a	b[a]	d_5	Mass per 1 000 units in kg	d_2[b]		m[c]	t	n	d_4	F_N	F_R	g	F_{Rg}	n_{abl}	Nominal size of pliers as in DIN 5254
Nominal size		perm. dev.		perm. dev.	max.	≈	min.	≈		perm. dev.	H13		min.		kN	kN		kN	min^{-1}	
45	2,5	0 −0,07	41,5	+0,39 −0,9	7,5	4,7	2,5	10,7	42,5	0 −0,25	2,65	1,25	3,8	60,8	28,6	100,0	2,0	19,1	11 400	19; 40
48	2,5		44,5		7,8	5,0	2,5	11,3	45,5		2,65	1,25	3,8	64,4	30,7	101,0	2,0	19,5	10 300	
50	3,0	0 −0,08	45,8		8,0	5,1	2,5	15,3	47,0		3,15	1,50	4,5	66,8	38,0	165,0	2,0	32,4	10 500	
52	3,0		47,8		8,2	5,2	2,5	16,6	49,0		3,15	1,50	4,5	69,3	39,7	165,0	2,5	26,0	9 850	
55	3,0		50,8	+0,46 −1,1	8,5	5,4	2,5	17,1	52,0	0 −0,30	3,15	1,50	4,5	72,9	42,0	161,0	2,5	25,6	8 960	
58	3,0		53,8		8,8	5,6	2,5	18,9	55,0		3,15	1,50	4,5	76,5	44,3	160,0	2,5	26,0	8 200	
60	3,0		55,8		9,0	5,8	2,5	19,4	57,0		3,15	1,50	4,5	78,9	46,0	156,0	2,5	25,4	7 620	
65	4,0	0 −0,1	60,8		9,3	6,3	3,0	29,1	62,0		4,15	1,50	4,5	84,6	49,8	346,0	2,5	58,0	6 640	40
70	4,0		65,5		9,5	6,6	3,0	35,3	67,0		4,15	1,50	4,5	90,0	53,8	343,0	2,5	59,0	6 530	
75	4,0		70,5		9,7	7,0	3,0	39,3	72,0		4,15	1,50	4,5	95,4	57,6	333,0	2,5	58,0	5 740	
80	4,0		74,5		9,8	7,4	3,0	43,7	76,5		4,15	1,75	5,3	100,6	71,6	328,0	3,0	50,0	6 100	
85	4,0		79,5		10,0	7,8	3,5	48,5	81,5	0 −0,35	4,15	1,75	5,3	106,0	76,2	383,0	3,0	59,4	5 710	40; 85
90	4,0		84,5	+0,54 −1,3	10,2	8,2	3,5	59,4	86,5		4,15	1,75	5,3	111,5	80,8	386,0	3,0	61,0	4 980	
100	4,0		94,5		10,5	9,0	3,5	71,6	96,5		4,15	1,75	5,3	122,1	90,0	368,0	3,5	51,6	4 180	

a Dimension b shall not exceed dimension a max.

b See 10.1.

c See 10.2.

d The supplementary data apply only to retaining rings made of spring steel as in DIN EN 10132-4.

5 Material

C67S or C75S spring steel as in DIN EN 10132-4 (at the manufacturer's discretion).

The hardness shall be as specified in Table 3.

Table 3 — Hardness of retaining rings

Retaining ring for shaft diameter d_1	Hardness
$d_1 \leq 48$ mm	470 HV to 580 HV or 47 HRC to 54 HRC
48 mm < $d_1 \leq 200$ mm	435 HV to 530 HV or 44 HRC to 51 HRC
200 mm < $d_1 \leq 300$ mm	390 HV to 470 HV or 40 HRC to 47 HRC
Hardness values converted in accordance with DIN EN ISO 18265.	

6 Finish

Retaining rings shall be free from burr.

Retaining rings are normally supplied provided with corrosion protection in accordance with Table 4 (at the manufacturer's discretion). No special details concerning this condition on delivery are to be stated in the designation of a retaining ring.

Table 4 — Anti-corrosion treatment of retaining rings

No.	Type of anti-corrosion treatment	Corrosion resistance
1	Phosphated and oiled in accordance with DIN EN 12476 Symbol: Znph/r/…/T4	No sign of corrosion permitted after 8 hours exposure to salt spray test DIN EN ISO 9227 — NSS.
2	Blackened and oiled in accordance with DIN 50938 Process class A Symbol: br A f	Degree of protection as in DIN 50938

If a particular anti-corrosion treatment is required, either of the type specified in Table 4 or of a different type, the designation of the retaining ring shall be supplemented accordingly.

In the case of retaining rings provided with a coating other than those specified in Table 4, the upper limit of the ring thickness s may be exceeded by the thickness of the coating required. This shall be taken into account when dimensioning the groove.

NOTE 1 When applying surface coatings to retaining rings, it is not possible to maintain closely toleranced coating thicknesses.

NOTE 2 As regards the risk of hydrogen-induced delayed brittle fracture in the case of retaining rings with electroplated coating, DIN EN ISO 4042 shall be observed.

NOTE 3 An example of designation is given in Clause 12.

7 Testing

7.1 Testing the material

Vickers hardness test in accordance with DIN EN ISO 6507-1

Rockwell hardness test in accordance with DIN EN ISO 6508-1

In cases of doubt, the Vickers hardness test is decisive.

7.2 Bend and fracture test

Testing of the retaining ring for ductility shall be carried out in accordance with Figure 3.

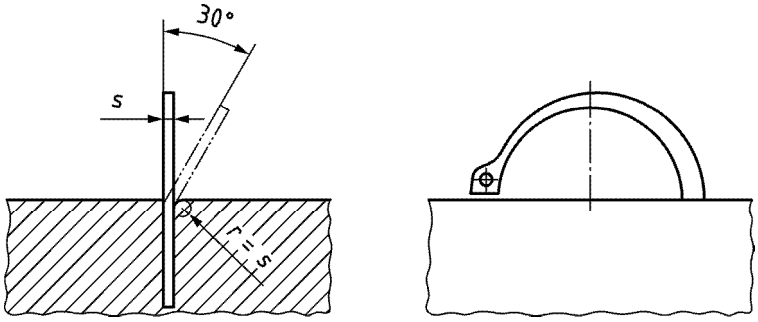


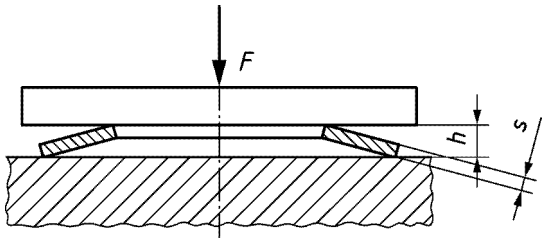
Figure 3 — Bend test

One half of the retaining ring is clamped between two jaws, one of which has a radius equal to the thickness of the ring ($r = s$) (see Figure 3). The ring is then bent through 30° by repeated light hammer blows or using a lever, following which there shall be no fractures or cracks in the ring.

7.3 Testing the deformation

7.3.1 Testing the conical deformation

The retaining ring is placed between two parallel plates and loaded as shown in Figure 4. The distance $h - s$ measured under force F shall not exceed the maximum value given in Table 5.



Key

F Force

Figure 4 — Testing the conical deformation

Table 5 — Conical deformation

Retaining ring for shaft diameter d_1	Force F N ± 5 %		$h - s$
	Normal type	Heavy type	max.
$d_1 \leq 22$ mm	30	60	$b \times 0{,}03$
22 mm < $d_1 \leq 38$ mm	40	80	
38 mm < $d_1 \leq 82$ mm	60	120	
82 mm < $d_1 \leq 150$ mm	80	160	$b \times 0{,}02$
150 mm < $d_1 \leq 300$ mm	150	300	

7.3.2 Testing the spiral flatness

The retaining ring shall fall through two parallel, perpendicular plates with a clearance c (see Figure 5) as given in Table 6.

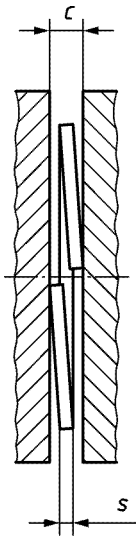


Figure 5 — Testing the spiral flatness

Table 6 — Spiral flatness

Retaining ring for shaft diameter d_1	c
$d_1 \leq 100$ mm	$1{,}5 \times s$
100 mm < $d_1 \leq 300$ mm	$1{,}8 \times s$

7.4 Testing the function (permanent set and grip test)

The retaining ring shall be passed three times over a taper with a diameter of $1{,}01 \times d_1$ as shown in Figure 11, which may cause a permanent deformation. The ring shall then be fitted onto a bolt of minimum groove diameter d_2, where it shall be held under its own weight.

7.5 Acceptance inspection

For acceptance inspection, the principles for testing and acceptance specified in DIN EN ISO 3269 shall apply.

See Table 7 for characteristics and Table 8 for the acceptance quality level.

Table 7 — Characteristics

Characteristics
Thickness of retaining ring s
Internal diameter of retaining ring in the unstressed state d_3
Conical deformation
Spiral flatness
Function (set and grip)

Table 8 — Acceptable quality level AQL

Acceptable quality level AQL[a]	
for testing characteristics	for testing faulty parts
1	1,5

[a] See DIN ISO 2859-1.

If other sampling plans are to be applied, this shall be agreed at the time of ordering.

For hardness testing, DIN EN ISO 3269 shall apply.

The hardness test of retaining rings shall be regarded as a destructive test.

8 Load bearing capacity

8.1 General

Dimensioning of a retaining ring assembly requires separate calculations for the load bearing capacity of the groove F_N and for the load bearing capacity of the retaining ring F_R. In each case the resulting lower value is decisive. The load bearing capacities listed in Tables 1 and 2 (F_N, F_R, F_{Rg}) contain no safety factor against yield under static stress or against fatigue fracture under swelling stress. There is at least twice the level of safety against fracture under static stress.

8.2 Load bearing capacity of groove F_N

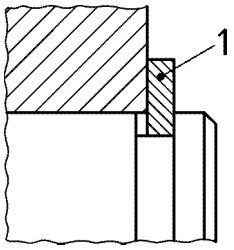
The values of F_N given in Tables 1 and 2 apply for a yield point of the material in the region of the shaft groove of R_{eL} = 200 MPa as well as for the given nominal groove depths t and edge margins n.

The load bearing capacity F'_N for deviating groove depths t' and yield points R'_{eL} shall be calculated using Equation (1):

$$F'_N = F_N \cdot \frac{t'}{t} \cdot \frac{R'_{eL}}{200} \quad (1)$$

8.3 Load bearing capacity of retaining ring F_R

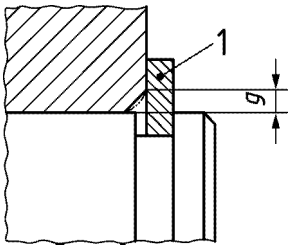
The values of F_R given in Tables 1 and 2 apply for an assembly over the maximum diameter 1,01 $\times$ d_1 (see Clause 11) and up to the given detaching speed n_{abl} (see Clause 9) as well as for a sharp-edged abutment of the machine component (see Figure 6).



Key

1 Retaining ring

Figure 6 — Sharp-edged abutment



Key

1 Retaining ring

Figure 7 — Abutment with edge chamfering distance (chamfering or rounding)

The values of F_{Rg} apply to an abutment with an edge chamfering distance g (see Figure 7).

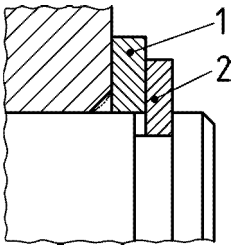
The values of F_R and F_{Rg} apply to ring materials with a modulus of elasticity of 210 000 MPa.

If the existing edge chamfering distance g' deviates from the values specified in Tables 1 and 2, then, for conversion, the load bearing capacity of the retaining ring is indirectly proportional to the edge chamfering distance:

$$F'_{Rg} = F_{Rg} \cdot \frac{g}{g'} \tag{2}$$

NOTE If F'_{Rg} with small values of g' is greater than F_R, then F_R applies.

If the existing forces cannot be accommodated because the edge chamfering distance is too great, then a sharp-edged abutment is to be made by means of a supporting ring complying with DIN 988 (see Figure 8).



Key

1 Supporting ring
2 Retaining ring

Figure 8 — Sharp-edged abutment at the retaining ring using a supporting ring

9 Detaching speed

The application of retaining rings is limited by those speeds at which the prestress is relieved by centrifugal forces and at which the retaining ring starts to lift from its seating in the groove base.

Tables 1 and 2 give detaching speeds n_{abl} at which, assuming there has been correct assembly (see Clause 11), the retaining rings start to become detached from their seating in the groove (groove diameter = nominal diameter). Actual release of the retaining ring is to be expected only after a further increase of the speeds by 50 %. The values apply to retaining rings made of spring steels as specified in Clause 5.

10 Design of the groove

10.1 Groove diameter d_2

The groove diameters d_2 specified in Tables 1 and 2 are selected so that the retaining rings are seated in the groove with prestress.

NOTE Smaller groove diameters are possible if prestress can be dispensed with. The lower limit is: $d_{2\,min} = d_{3\,max}$.

10.2 Groove width m

As a rule, tolerance zone H13 applies for the groove widths specified in Tables 1 and 2. With unilateral force transmission, the grooves can be widened and/or chamfered towards the relieving side. The groove width has no influence on the load bearing capacity of the retaining ring joint. Companies can therefore specify their own groove shapes and widths.

If the retaining ring is to alternately transmit the forces onto the groove walls in both directions, the groove width m shall as far as possible be matched to the ring thickness s, e.g. by also reducing the tolerance. See Figure 9 for groove shapes.

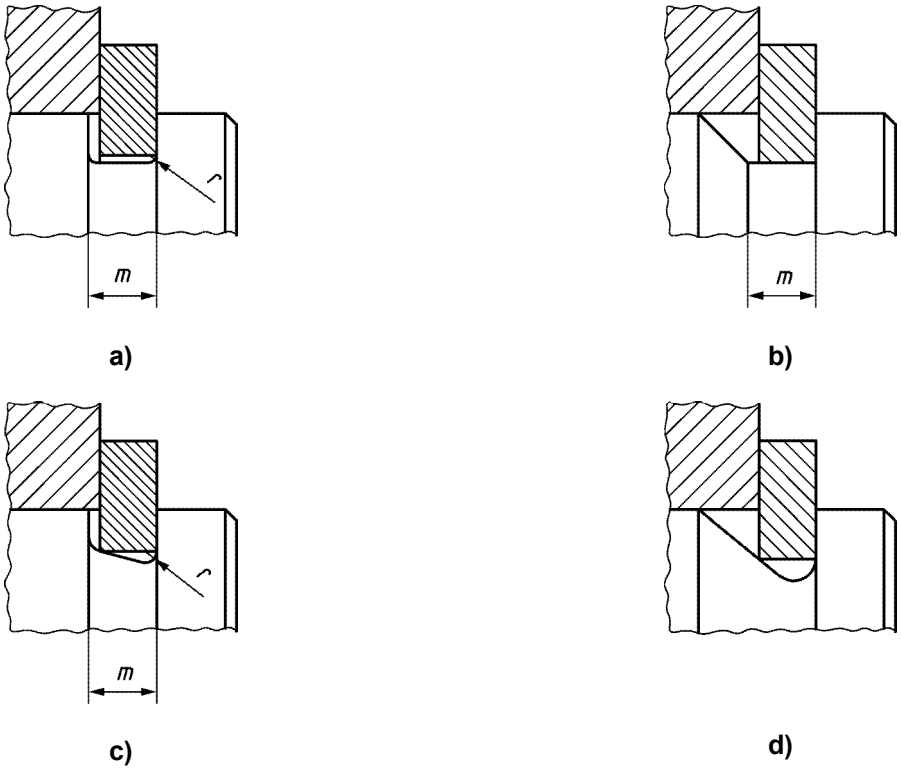
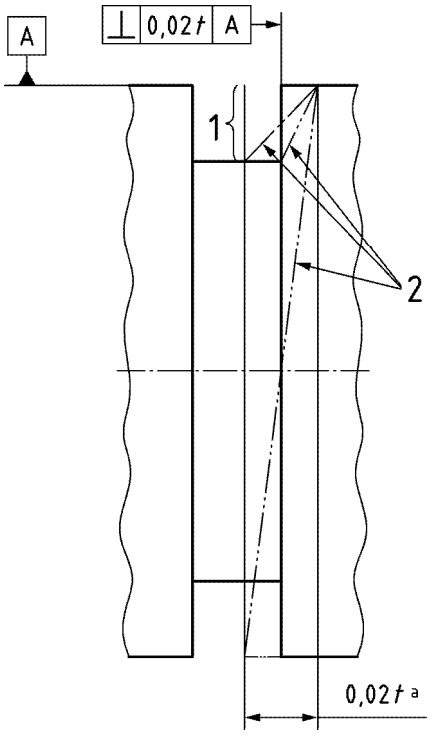


Figure 9 — Groove shapes

10.3 Design of the groove base

The rectangular groove is the standard form (see Figure 9a). The radius r on the loaded side shall not exceed $0{,}1 \times s$. Other suitable groove shapes are shown in Figures 9b to 9d. In the case of a sharp-edged rectangular groove, the notch sensitivity of the material used produces a corresponding notch effect factor. Details of the groove base design are shown in Figure 10.



Key

1 Point for measuring perpendicularity
2 Possible contours

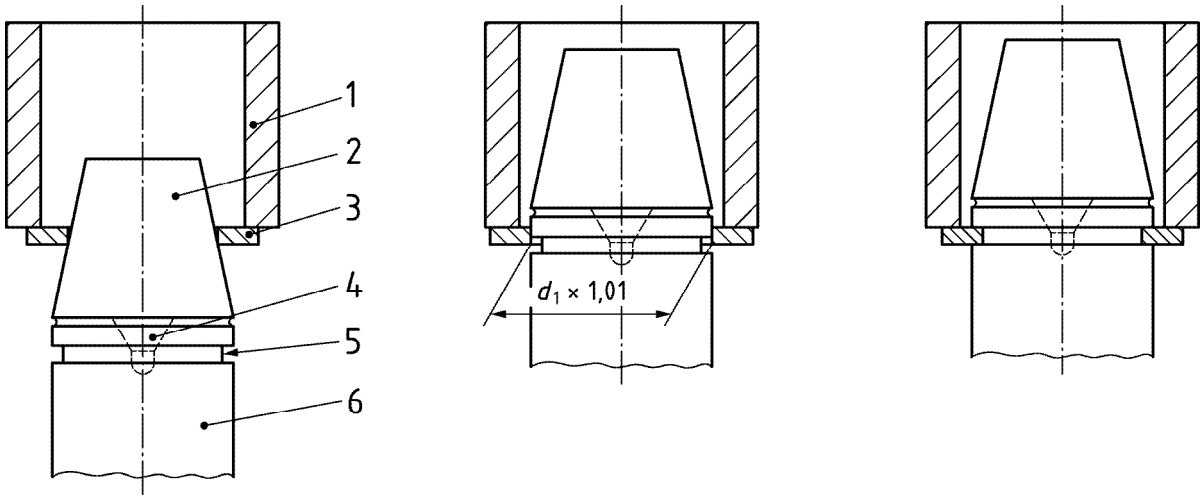
[a] Tolerance zone

Figure 10 — Design of groove base

11 Assembly

Retaining rings shall be assembled by means of pliers conforming to DIN 5254 or using tapers.

During assembly care shall be taken to ensure that the ring is expanded only to the extent necessary to pass over the shaft, i.e. to a maximum diameter of $1{,}01 \times d_1$. If necessary, pliers equipped with limiting screws (set screw) shall be used. The most reliable protection against overexpansion is assembly using a taper (see Figure 11). Where an additional sleeve is to be provided, e.g. to install rings with a larger edge margin n or to protect the shaft surface during assembly, it is recommended that the manufacturer be consulted.



Key

1 Pressure sleeve
2 Taper
3 Retaining ring
4 Centering
5 Groove
6 Shaft

Figure 11 — Taper assembly

12 Designation

EXAMPLE 1 Designation of a retaining ring for a shaft diameter (nominal size) d_1 = 40 mm and with a thickness s = 1,75 mm:

Retaining ring DIN 471 — 40 × 1,75

EXAMPLE 2 If, by way of departure from Table 4, rings with a specific corrosion protection are required, this shall be indicated in the designation by adding the relevant symbol. For electroplated coatings, the symbols specified in DIN EN ISO 4042 shall apply:

Retaining ring DIN 471 — 40 × 1,75 — A3K

EXAMPLE 3 For phosphate coatings according to Table 4, serial number 1 shall apply:

Retaining ring DIN 471 — 40 × 1,75 — 1