UDC 621.887.6 : 62-472 : 001.4 : 003.62 : 620.1   September 1981

		Circlips (retaining rings) for bores Normal type and heavy type	$\overline{\text{DIN}}$ 472

Sicherungsringe (Halteringe) für Bohrungen; Regelausführung und schwere Ausführung

Supersedes
DIN 472 Part 1/03.65 and
DIN 472 Part 2/03.65 and
partially supersedes
DIN 995/01.70

As it is current practice in standards published by the International Organization for Standardization (ISO), the comma has been used throughout as a decimal marker.

Dimensions in mm

Contents

1 Concept

Circlips within the meaning of this standard are retaining rings for holding structural components (e.g. rolling bearings) in bores. They are given an eccentric shape, are fitted with spring retention in grooves and are suitable for the transmission of axial forces (see in this respect clause 7).

2 Dimension letters, symbols

a radial width of the lug

b beam (radial width of circlip opposite the aperture)

c distance between measuring plates for testing spiral flatness

d_1 bore diameter

d_2 groove diameter

d_3 external diameter of the circlip not under tension

d_4 minimum symmetrical diameter of bore during fitting

d_5 diameter of the lug holes

E modulus of elasticity

F_N load-bearing capacity of groove at a yield point of the grooved material of 200 N/mm^2 (see subclause 7.1)

F_R load-bearing capacity of circlip with sharp-edged abutment of the pressure part (see subclause 7.2)

F_{Rg} load-bearing capacity of circlip for abutment with edge chamfering distance g (see subclause 7.2)

R_{eL} yield point

g edge chamfering distance of the surface abutting against the circlip

h distance between the plates when testing conical deformation

m groove width

n edge margin

r curvature in the groove base or test jaws

s thickness of the circlip

t groove depth with nominal sizes of d_1 and d_2

3   Dimensions, designation, design data

The circlips do not need conform to the illustration; only the dimensions specified must be adhered to.

unloaded
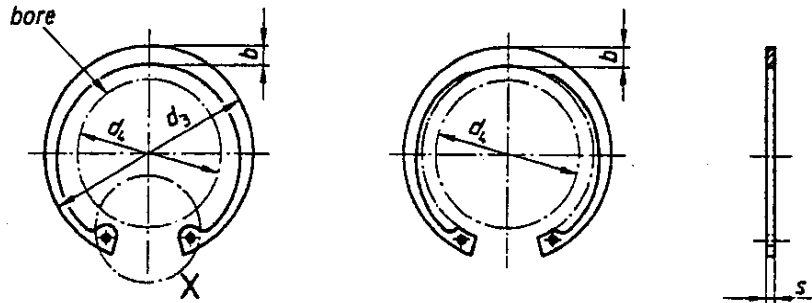shape of ring at manufacturer's discretion

Figure 1.   Figure 2.

Detail of   X

$d_1 \leq 300$ mm $d_1 \geq 170$ mm at $d_1 \geq 25$ mm at
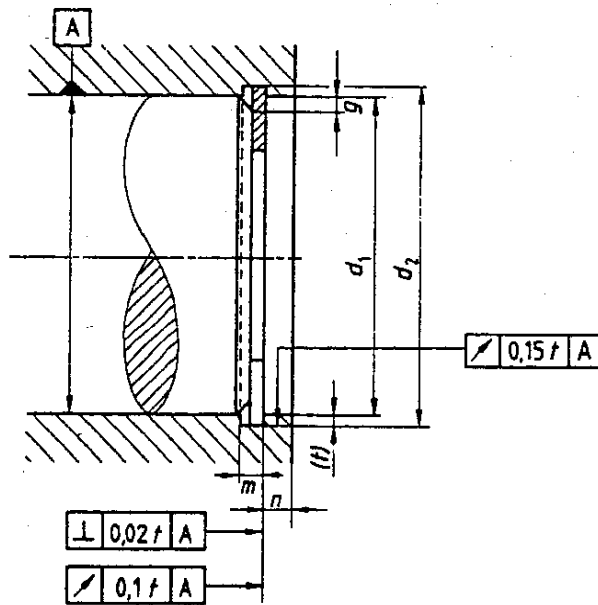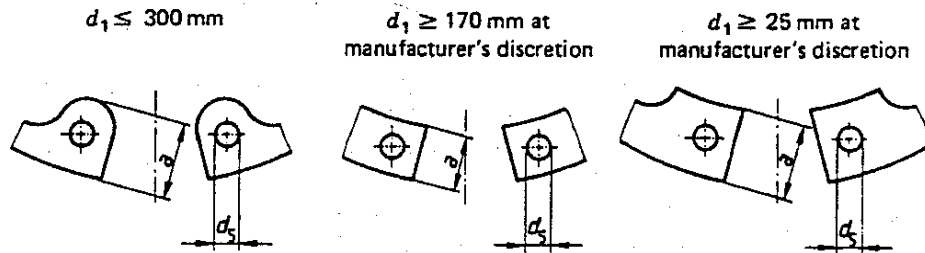   manufacturer's discretion   manufacturer's discretion

Figure 3.

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

Designation of a circlip for bore diameter (nominal dimension) d_1 = 40 mm and circlip thickness s = 1,75 mm:

Circlip DIN 472 — 40 X 1,75

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Table 1. Normal type

Bore diameter d_1 Nominal dimension	Clip							Groove					Supplementary data [4]					
	s	s per. dev.	d_3	d_3 per. dev.	a max.	b[1] ≈	d_5 min.	Weight of 1000 in kg ≈	d_2 [2]	d_2 per. dev.	m[3] H13	t	n min.	d_4	F_N kN	F_R kN	g	F_{Rg} kN	Nominal size of pliers according to DIN 5256
8	0,8	0 −0,05	8,7		2,4	1,1	1	0,14	8,4	+0,09 0 (H11)	0,9	0,2	0,6	3	0,86	2,00	0,5	1,50	
9	0,8		9,8		2,5	1,3	1	0,15	9,4		0,9	0,2	0,6	3,7	0,96	2,00	0,5	1,50	
10	1		10,8		3,2	1,4	1,2	0,18	10,4		1,1	0,2	0,6	3,3	1,08	4,00	0,5	2,20	
11	1		11,8		3,3	1,5	1,2	0,31	11,4		1,1	0,2	0,6	4,1	1,17	4,00	0,5	2,30	
12	1		13	+0,36 −0,10	3,4	1,7	1,5	0,37	12,5		1,1	0,25	0,8	4,9	1,60	4,00	0,5	2,30	
13	1		14,1		3,6	1,8	1,5	0,42	13,6	+0,11 0 (H11)	1,1	0,3	0,9	5,4	2,10	4,20	0,5	2,30	8
14	1		15,1		3,7	1,9	1,7	0,52	14,6		1,1	0,3	0,9	6,2	2,25	4,50	0,5	2,30	
15	1		16,2		3,7	2	1,7	0,56	15,7		1,1	0,35	1,1	7,2	2,80	5,00	0,5	2,30	
16	1		17,3		3,8	2	1,7	0,60	16,8		1,1	0,4	1,2	8	3,40	5,50	1	2,60	
17	1		18,3		3,9	2,1	1,7	0,65	17,8		1,1	0,4	1,2	8,8	3,60	6,00	1	2,50	
18	1		19,5		4,1	2,2	2	0,74	19		1,1	0,5	1,5	9,4	4,80	6,50	1	2,60	
19	1		20,5	+0,42 −0,13	4,1	2,2	2	0,83	20	+0,13 0 (H11)	1,1	0,5	1,5	10,4	5,10	6,80	1	2,50	
20	1		21,5		4,2	2,3	2	0,90	21		1,1	0,5	1,5	11,2	5,40	7,20	1	2,50	
21	1		22,5		4,2	2,4	2	1,00	22		1,1	0,5	1,5	12,2	5,70	7,60	1	2,60	
22	1		23,5		4,2	2,5	2	1,10	23		1,1	0,5	1,5	13,2	5,90	8,00	1	2,70	
24	1,2		25,9		4,4	2,6	2	1,42	25,2		1,3	0,6	1,8	14,8	7,70	13,9	1	4,60	
25	1,2	0 −0,06	26,9	+0,42 −0,21	4,5	2,7	2	1,50	26,2	+0,21 0 (H12)	1,3	0,6	1,8	15,5	8,00	14,6	1	4,70	
26	1,2		27,9		4,7	2,8	2	1,60	27,2		1,3	0,6	1,8	16,1	8,40	13,85	1	4,60	
28	1,2		30,1		4,8	2,9	2	1,80	29,4		1,3	0,7	2,1	17,9	10,5	13,3	1	4,50	
30	1,2		32,1		4,8	3	2	2,06	31,4		1,3	0,7	2,1	19,9	11,3	13,7	1	4,60	19
31	1,2		33,4		5,2	3,2	2,5	2,10	32,7		1,3	0,85	2,6	20	14,1	13,8	1	4,70	
32	1,2		34,4		5,4	3,2	2,5	2,21	33,7		1,3	0,85	2,6	20,6	14,6	13,8	1	4,70	
34	1,5		36,5	+0,5 −0,25	5,4	3,3	2,5	3,20	35,7		1,6	0,85	2,6	22,6	15,4	26,2	1,5	6,30	
35	1,5		37,8		5,4	3,4	2,5	3,54	37		1,6	1	3	23,6	18,8	26,9	1,5	6,40	
36	1,5		38,8		5,4	3,5	2,5	3,70	38	+0,25 0 (H12)	1,6	1	3	24,6	19,4	26,4	1,5	6,40	
37	1,5		39,8		5,5	3,6	2,5	3,74	39		1,6	1	3	25,4	19,8	27,1	1,5	6,50	
38	1,5		40,8		5,5	3,7	2,5	3,90	40		1,6	1	3	26,4	22,5	28,2	1,5	6,70	
40	1,75		43,5		5,8	3,9	2,5	4,70	42,5		1,85	1,25	3,8	27,8	27,0	44,6	2	8,30	
42	1,75		45,5	+0,9 −0,39	5,9	4,1	2,5	5,40	44,5		1,85	1,25	3,8	29,6	28,4	44,7	2	8,40	
45	1,75		48,5		6,2	4,3	2,5	6,00	47,5		1,85	1,25	3,8	32	30,2	43,1	2	8,20	
47	1,75		50,5		6,4	4,4	2,5	6,10	49,5		1,85	1,25	3,8	33,5	31,4	43,5	2	8,30	
48	1,75		51,5		6,4	4,5	2,5	6,70	50,5		1,85	1,25	3,8	34,5	32,0	43,2	2	8,40	
50	2		54,2		6,5	4,6	2,5	7,30	53		2,15	1,5	4,5	36,3	40,5	60,8	2	12,1	
52	2		56,2		6,7	4,7	2,5	8,20	55		2,15	1,5	4,5	37,9	42,0	60,25	2	12,0	
55	2		59,2		6,8	5	2,5	8,30	58		2,15	1,5	4,5	40,7	44,4	60,3	2	12,5	
56	2		60,2		6,8	5,1	2,5	8,70	59		2,15	1,5	4,5	41,7	45,2	60,3	2	12,6	
58	2		62,2		6,9	5,2	2,5	10,5	61		2,15	1,5	4,5	43,5	46,7	60,8	2	12,7	40
60	2		64,2	+1,1 −0,46	7,3	5,4	2,5	11,1	63	+0,30 0 (H12)	2,15	1,5	4,5	44,7	48,3	61,0	2	13,0	
62	2	0 −0,07	66,2		7,3	5,5	2,5	11,2	65		2,15	1,5	4,5	46,7	49,8	60,9	2	13,0	
63	2		67,2		7,3	5,6	2,5	12,4	66		2,15	1,5	4,5	47,7	50,6	60,8	2	13,0	
65	2,5		69,2		7,6	5,8	3	14,3	68		2,65	1,5	4,5	49	51,8	121	2,5	20,8	
68	2,5		72,5		7,8	6,1	3	16,0	71		2,65	1,5	4,5	51,6	54,5	121,5	2,5	21,2	
70	2,5		74,5		7,8	6,2	3	16,5	73		2,65	1,5	4,5	53,6	56,2	119	2,5	21,0	
72	2,5		76,5		7,8	6,4	3	18,1	75		2,65	1,5	4,5	55,6	58,0	119,2	2,5	21,0	
75	2,5		79,5		7,8	6,6	3	18,8	78		2,65	1,5	4,5	58,6	60,0	118	2,5	21,0	

[1] Dimension b shall not exceed dimension a max.
[2] See subclause 8.1
[3] See subclause 8.2
[4] The supplementary data apply only to circlips in spring steel in accordance with DIN 17 222.

Note: d_4 calculated from: $d_4 = d_1 − 2,1\,a$

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Table 1. (continued)

Bore diameter d_1 Nominal dimension	s	s per. dev.	d_3	d_3 per. dev.	a max.	b¹) ≈	d_5 min.	Weight of 1000 in kg ≈	$d_2$²)	d_2 per. dev. H13	m³) H13	t	n min.	d_4	F_N kN	F_R kN	g	F_{Rg} kN	Nominal size of pliers according to DIN 5256
78	2,5		82,5		8,5	6,8	3	20,4	81		2,65	1,5	4,5	60,1	62,3	122,5	2,5	21,8	
80	2,5	0 −0,07	85,5		8,5	7	3	22,0	83,5		2,65	1,75	5,3	62,1	74,6	120,9	2,5	21,8	40
82	2,5		87,5		8,5	7	3	24,0	85,5		2,65	1,75	5,3	64,1	76,6	119	2,5	21,4	
85	3		90,5		8,6	7,2	3,5	25,3	88,5		3,15	1,75	5,3	66,9	79,5	201,4	3	31,2	
88	3		93,5		8,6	7,4	3,5	28,0	91,5	+0,35 0 (H12)	3,15	1,75	5,3	69,9	82,1	209,4	3	32,7	
90	3		95,5		8,6	7,6	3,5	31,0	93,5		3,15	1,75	5,3	71,9	84,0	199	3	31,4	
92	3	0 −0,08	97,5		8,7	7,8	3,5	32,0	95,5		3,15	1,75	5,3	73,7	85,8	201	3	32,0	
95	3		100,5	+1,3 −0,54	8,8	8,1	3,5	35,0	98,5		3,15	1,75	5,3	76,5	88,6	195	3	31,4	85
98	3		103,5		9	8,3	3,5	37,0	101,5		3,15	1,75	5,3	79	91,3	191	3	31,0	
100	3		105,5		9,2	8,4	3,5	38,0	103,5		3,15	1,75	5,3	80,6	93,1	188	3	30,8	
102	4		108		9,5	8,5	3,5	55,0	106		4,15	2	6	82	108,8	439	3	72,6	
105	4		112		9,5	8,7	3,5	56,0	109		4,15	2	6	85	112	436	3	73,0	
108	4		115		9,5	8,9	3,5	60,0	112	+0,54 0 (H13)	4,15	2	6	88	115	419	3	71,0	
110	4		117		10,4	9	3,5	64,5	114		4,15	2	6	88,2	117	415	3	71,0	
112	4		119		10,5	9,1	3,5	72,0	116		4,15	2	6	90	119	418	3	72,0	
115	4		122		10,5	9,3	3,5	74,5	119		4,15	2	6	93	122	409	3	71,2	
120	4		127		11	9,7	3,5	77,0	124		4,15	2	6	96,9	127	396	3	70,0	
125	4		132		11	10	4	79,0	129		4,15	2	6	101,9	132	385	3	70,0	
130	4		137		11	10,2	4	82,0	134		4,15	2	6	106,9	138	374	3	69,0	
135	4		142		11,2	10,5	4	84,0	139		4,15	2	6	111,5	143	358	3	67,0	
140	4		147	+1,5 −0,63	11,2	10,7	4	87,5	144		4,15	2	6	116,5	148	350	3	66,5	
145	4	0 −0,1	152		11,4	10,9	4	93,0	149	+0,63 0 (H13)	4,15	2	6	121	153	336	3	65,0	
150	4		158		12	11,2	4	105	155		4,15	2,5	7,5	124,8	191	326	3	64,0	
155	4		164		12	11,4	4	107	160		4,15	2,5	7,5	129,8	206	324	3,5	55,0	
160	4		169		13	11,6	4	110	165		4,15	2,5	7,5	132,7	212	321	3,5	54,5	
165	4		174,5		13	11,8	4	125	170		4,15	2,5	7,5	137,7	219	319	3,5	54,0	
170	4		179,5		13,5	12,2	4	140	175		4,15	2,5	7,5	141,6	225	349	3,5	59,0	
175	4		184,5		13,5	12,7	4	150	180		4,15	2,5	7,5	146,6	232	351	3,5	59,0	
180	4		189,5		14,2	13,2	4	165	185		4,15	2,5	7,5	150,2	238	347	3,5	58,5	
185	4		194,5		14,2	13,7	4	170	190		4,15	2,5	7,5	155,2	245	349	3,5	59,0	125
190	4		199,5		14,2	13,8	4	175	195		4,15	2,5	7,5	160,2	251	340	3,5	57,5	
195	4		204,5	+1,70 −0,72	14,2	13,8	4	183	200		4,15	2,5	7,5	165,2	258	330	3,5	55,5	
200	4		209,5		14,2	14	4	195	205	+0,72 0 (H13)	4,15	2,5	7,5	170,2	265	325	3,5	55,0	
210	5		222		14,2	14	4	270	216		5,15	3	9	180,2	333	601	4	89,5	
220	5		232		14,2	14	4	315	226		5,15	3	9	190,2	349	574	4	85,0	
230	5		242		14,2	14	4	330	236		5,15	3	9	200,2	365	549	4	81,0	
240	5		252		14,2	14	4	345	246		5,15	3	9	210,2	380	525	4	77,5	
250	5	0 −0,12	262		14,2	14	4	360	256		5,15	3	9	220,2	396	504	4	75,0	
260	5		275		16,2	16	5	375	268		5,15	4	12	226	553	538	4	80,0	
270	5		285	+2,0 −0,81	16,2	16	5	388	278	+0,81 0 (H13)	5,15	4	12	236	573	518	4	77,0	
280	5		295		16,2	16	5	400	288		5,15	4	12	246	593	499	4	74,0	
290	5		305		16,2	16	5	415	298		5,15	4	12	256	615	482	4	71,5	
300	5		315		16,2	16	5	435	308		5,15	4	12	266	636	466	4	69,0	

For ¹), ²), ³) and ⁴) see page 3

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Table 2. Heavy type

Bore diameter d_1 Nominal dimension	Clip								Groove					Supplementary data [4]					Nominal size of pliers according to DIN 5256
	s	per. dev.	d_3	per. dev.	a max.	b [1] ≈	d_5 min.	Weight of 1000 in kg ≈	d_2 [2]	per. dev.	m [3] H13	t	n min.	d_4	F_N kN	F_R kN	g	F_{Rd} kN	
20	1,5		21,5		4,5	2,4	2	1,41	21	+0,13 -0 (H11)	1,6	0,5	1,5	10,5	5,40	16,0	1	5,60	
22	1,5		23,5		4,7	2,8	2	1,85	23		1,6	0,5	1,5	12,1	5,90	18,0	1	6,10	
24	1,5		25,9	+0,42 -0,21	4,9	3	2	1,98	25,2		1,6	0,6	1,8	13,7	7,70	21,7	1	7,20	
25	1,5		26,9		5	3,1	2	2,16	26,2	+0,21 0 (H12)	1,6	0,6	1,8	14,5	8,00	22,8	1	7,30	
26	1,5		27,9		5,1	3,1	2	2,25	27,2		1,6	0,6	1,8	15,3	8,40	21,6	1	7,20	
28	1,5	0 -0,06	30,1		5,3	3,2	2	2,48	29,4		1,6	0,7	2,1	16,9	10,5	20,8	1	7,00	19
30	1,5		32,1		5,5	3,3	2	2,84	31,4		1,6	0,7	2,1	18,4	11,3	21,4	1	7,20	
32	1,5		34,4		5,7	3,4	2	2,94	33,7		1,6	0,85	2,6	20	14,6	21,4	1	7,30	
34	1,75		36,5	+0,50 -0,25	5,9	3,7	2,5	4,20	35,7		1,85	0,85	2,6	21,6	15,4	35,6	1,5	8,60	
35	1,75		37,8		6	3,8	2,5	4,62	37		1,85	1	3	22,4	18,8	36,6	1,5	8,70	
37	1,75		39,8		6,2	3,9	2,5	4,73	39	+0,25 0 (H12)	1,85	1	3	24	19,8	36,8	1,5	8,80	
38	1,75		40,8		6,3	3,9	2,5	4,80	40		1,85	1	3	24,7	22,5	38,3	1,5	9,10	
40	2		43,5		6,5	3,9	2,5	5,38	42,5		2,15	1,25	3,8	26,3	27,0	58,4	2	10,9	
42	2		45,5	+0,90 -0,39	6,7	4,1	2,5	6,18	44,5		2,15	1,25	3,8	27,9	28,4	58,5	2	11,0	
45	2		48,5		7	4,3	2,5	6,86	47,5		2,15	1,25	3,8	30,3	30,2	56,5	2	10,7	
47	2	0 -0,07	50,5		7,2	4,4	2,5	7,00	49,5		2,15	1,25	3,8	31,9	31,4	57,0	2	10,8	
50	2,5		54,2		7,5	4,6	2,5	9,15	53		2,65	1,5	4,5	34,2	40,5	95,5	2	19,0	
52	2,5		56,2		7,7	4,7	2,5	10,2	55		2,65	1,5	4,5	35,8	42,0	94,6	2	18,8	
55	2,5		59,2		8	5	2,5	10,4	58		2,65	1,5	4,5	38,2	44,4	94,7	2	19,6	
60	3		64,2		8,5	5,4	2,5	16,6	63		3,15	1,5	4,5	42,1	48,3	137	2	29,2	40
62	3		66,2		8,6	5,5	2,5	16,8	65	+0,30 0 (H12)	3,15	1,5	4,5	43,9	49,8	137	2	29,2	
65	3	0 -0,08	69,2	+1,10 -0,46	8,7	5,8	3	17,2	68		3,15	1,5	4,5	46,7	51,8	174	2,5	30,0	
68	3		72,5		8,8	6,1	3	19,2	71		3,15	1,5	4,5	49,5	54,5	174,5	2,5	30,6	
70	3		74,5		9	6,2	3	19,8	73		3,15	1,5	4,5	51,1	56,2	171	2,5	30,3	
72	3		76,5		9,2	6,4	3	21,7	75		3,15	1,5	4,5	52,7	58,0	172	2,5	30,3	
75	3		79,5		9,3	6,6	3	22,6	78		3,15	1,5	4,5	55,5	60,0	170	2,5	30,3	
80	4		85,5		9,5	7	3	35,2	83,5		4,15	1,75	5,3	60	74,6	308	2,5	56,0	
85	4		90,5		9,7	7,2	3,5	38,8	88,5	+0,35 0 (H12)	4,15	1,75	5,3	64,6	79,5	358	3	55,0	
90	4	0 -0,1	95,5	+1,30 -0,54	10	7,6	3,5	41,5	93,5		4,15	1,75	5,3	69	84,0	354	3	56,0	85
95	4		100,5		10,3	8,1	3,5	46,7	98,5		4,15	1,75	5,3	73,4	88,6	347	3	56,0	
100	4		105,5		10,5	8,4	3,5	50,7	103,5		4,15	1,75	5,3	78	93,1	335	3	55,0	

For [1], [2], [3] and [4] see page 3

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4   Material

C 67, C 75 or Ck 75 spring steel in accordance with DIN 17 222 (at manufacturer's discretion)

Table 3 applies in respect of the hardness:

Table 3.

Nominal diameter of circlip		Hardness
over	up to	
—	48	470 to 580 Vickers hardness (corresponding to 47 to 54 Rockwell C hardness)
48	200	435 to 530 Vickers hardness (corresponding to 44 to 51 Rockwell C hardness)
200	300	390 to 470 Vickers hardness (corresponding to 40 to 47 Rockwell C hardness)
Hardness values converted in accordance with DIN 50 150		

Other materials on agreement.

5   Finish

Circlips must be without burr.

Circlips are normally supplied corrosion-proof in accordance with table 4 (at manufacturer's discretion). No special details concerning this condition on delivery must be stated in the designation of a circlip.

Table 4. Anti-corrosion treatment of circlips

Serial No.	Type of anti-corrosion treatment	Corrosion resistance
1	Phosphatized and oiled in accordance with DIN 50 942 Symbol: Znph r . . . f	No sign of corrosion permissible after 8 hours of exposure salt spray test according to DIN 50 021 – SS
2	Blackened and oiled (thermally or chemically)	
3	Burnished and oiled in accordance with DIN 50 938 Process class A Symbol: br A f	Protection factor in accordance with DIN 50 938, December 1973 edition, subclause 5.2.

If a particular anti-corrosion treatment is required which is different from that specified in table 4, the designation of the circlip must be supplemented accordingly.

For platings, the symbols according to DIN 267 Part 9 apply, e.g.:

<div align="center">Circlip DIN 472 – 40 X 1,75 – A3K</div>

In the case of mass plating of circlips in a drum or bell, it is not possible to maintain closely toleranced plating thicknesses. Attention is drawn to DIN 267 Part 9 regarding the danger of hydrogen-induced delayed brittle fractures in the case of circlips with electroplated surface protection.

The upper limit of the circlip thickness s may be exceeded according to the film thickness of the plating required in the case of circlips with electroplated surface protection. This must be taken into account when designing the groove.

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6 Testing

6.1 Testing the material

Vickers hardness test in accordance with DIN 50 133 Part 1.

Rockwell hardness test in accordance with DIN 50 103 Part 1.

In cases of doubt, the Vickers hardness test applies.

6.2 Bend and fracture test

The testing of the circlip for ductility must be carried out in accordance with figure 4.
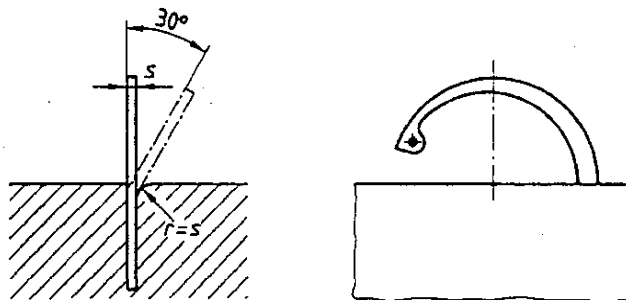
Figure 4. Bend test

One half of the circlip is clamped between two jaws, of which one has a radius equal to the thickness of the circlip. The circlip is bent through $30°$ by repeated light hammer blows or with a lever, following which there must be no fractures or cracks in the circlip. The circlip is then further bent until fracture occurs. The fracture surface must reveal a fine-grained structure.

6.3 Testing the deformation

6.3.1 Testing the conical deformation

The circlip is placed between two parallel plates and loaded in accordance with figure 5. The distance $h - s$ measured under force F must not exceed the maximum value stated in table 5.
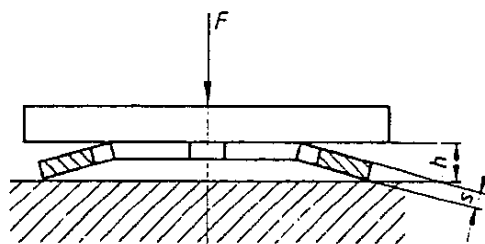
Figure 5. Testing the conical deformation

Table 5.

Nominal diameter of circlip		Force F in N $\pm$ 5 %		$h - s$
over	up to	Normal type	Heavy type	max.
—	22	30	60	$b \times 0{,}03$
22	38	40	80	
38	82	60	120	
82	150	80	160	$b \times 0{,}02$
150	300	150	300	

6.3.2   Testing the spiral flatness

The circlip must fall through two parallel, perpendicular plates with a clearance of c in accordance with table 6.

Figure 6.   Testing the spiral flatness
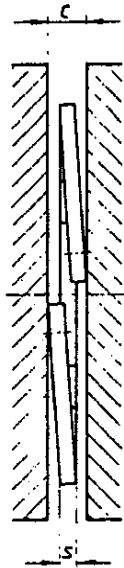
Table 6.

Nominal diameter of circlip		c
over	up to	
—	100	$1{,}5 \times s$
100	—	$1{,}8 \times s$

6.4   Testing the function (permanent set and grip test)

The circlip must be inserted five times into a cone with a diameter of $0{,}99\, d_1$ in accordance with figure 14 and must then be fitted into a bore with maximum groove diameter d_2 where it must be held under its own weight.

6.5   Acceptance testing

For the acceptance testing the principles for testing and acceptance in accordance with DIN 267 Part 5 apply.

Table 7 applies to the features, while for the acceptable quality level table 8 applies.

Table 7.

Features
Circlip thickness s Circlip external diameter d_3 Conical deformation   Spiral flatness   Function (set and grip)

Table 8.

Acceptable quality level AQL [1]	
for testing of features	for testing for faulty parts
1	1,5
[1] See DIN 40 080	

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

For hardness testing DIN 267 Part 5, April 1968 edition, clause 5 applies.

In case of circlips, the hardness test shall be regarded as a destructive test.

7   Load-bearing capacity

A circlip connection requires separate calculations for the load-bearing capacity of the groove F_N and for the load-bearing capacity of the circlip F_R. In each case the weaker part is that which applies. The load-bearing capacities (F_N, F_R, F_{Rg}) listed in clause 3 contain no safety neither against yielding under static load nor against fatigue fracture under fluctuating load. There is at least twice the level of safety against fracture under static load.

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7.1   Load-bearing capacity of groove F_N

The load-bearing capacity of the groove F_N in clause 3 applies for a yield point of the material in the region of the bore groove of R_{eL} = 200 N/mm^2 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' (resulting from deviating bore diameters d_1 and/or deviating groove diameters d_2) and yield points R_{eL}' (previously σ_s') is directly proportional to the groove depth and the yield point:

$$F_N' = F_N \cdot \frac{t'}{t} \cdot \frac{R_{eL}'}{200}$$

7.2   Load-bearing capacity of circlip F_R

The load-bearing capacity of the circlip F_R in accordance with clause 3 applies to a sharp-edged abutment of the pressing machine part (see figure 7).
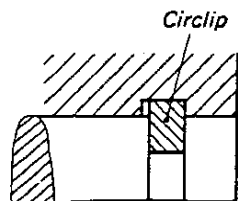
Figure 7.   Sharp-edged abutment
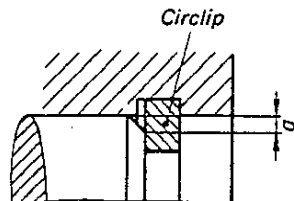
Figure 8.   Abutment with edge chamfering distance (chamfering or rounding)

The values F_{R_g} apply to an abutment with an edge chamfering distance g (see figure 8).

The two values F_R and F_{R_g} apply to circlip materials with a modulus of elasticity (E-Modulus) of 210 000 N/mm^2. If circlips of a different material with a different E-modulus E', are used, then, for conversion, the load-bearing capacity of the circlip is directly proportional to the modulus of elasticity:

$$F_R' = F_R \cdot \frac{E'}{210\ 000}$$

$$F_{R_g}' = F_{R_g} \cdot \frac{E'}{210\ 000}$$

If the existing edge chamfering distance g' deviates from the values in clause 3, then, for conversion, the load-bearing capacity of the circlip is indirectly proportional to the edge chamfering distance:

$$F_{R_g}' = F_{R_g} \cdot \frac{g}{g'}$$

Note: If F_{R_g}' with small values of g' is greater than F_R, then F_R applies.

If the existing forces, because of too great an edge chamfering distance, cannot be accommodated, then a sharp-edged abutment must be created by means of a supporting ring in accordance with DIN 988 (see figure 9).
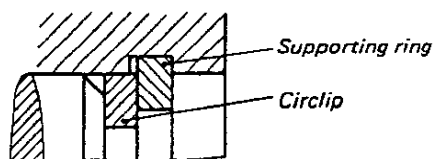

Figure 9.   Sharp-edged abutment at the circlip using a supporting ring

8   Shape of groove

8.1   Groove diameter d_2

The groove diameters d_2 specified in clause 3 are selected so that the circlips are seated in the groove with pretension.

Note: Larger groove diameters are possible if pretension can be dispensed with. The upper limit is: d_2 max. = d_3 min.

8.2 Groove width m

As a rule, for the groove widths specified in table 1 and table 2, the tolerance zone H13 applies. With unilateral power transmission, the grooves can be widened and/or chamfered towards the unloaded side. The groove width has no influence on the load-bearing capacity of the circlip connection. Groove shapes and groove widths specified in-house are therefore possible.

If the circlip is to be subjected to alternate power transmission on both groove edges, the groove width m must as far as possible, e.g. also by reducing the tolerance, be matched to the circlip thickness s. (For groove shapes, see figure 10 to figure 13).
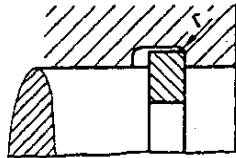
Figure 10.
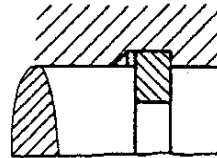
Figure 11.
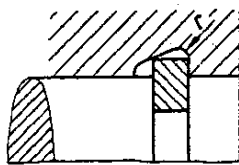
Figure 12.
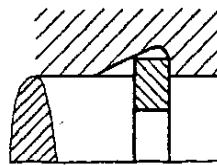
Figure 13.

8.3 Shape of groove base

A square shape is the normal type of groove base (see figure 10). The radius r on the load side must not exceed 0,1 s. Other successful shapes of groove are shown in figure 11 to figure 13. In the case of a sharp-edged square groove, the notch sensitivity of the material used produces a corresponding fatigue notch factor.

9 Fitting the circlip

Pliers in accordance with DIN 5256 shall be preferred for fitting the circlips.

When fitting, make absolutely sure that the circlips are not overstrained i.e. are not squeezed further together than is necessary for insertion into the bore. If necessary, pliers with closing restriction (set screw) shall be used. The safest protection against overstretching is fitting with the aid of cones (see figure 14).
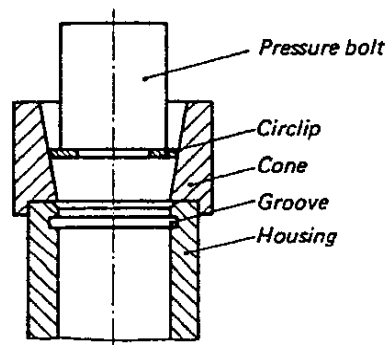
Pressure bolt
Circlip
Cone
Groove
Housing

Figure 14. Fitting with cones

Standards referred to

DIN	267 Part 5	Bolts, screws, nuts and similar threaded and formed parts; technical delivery conditions; testing and acceptance
DIN	267 Part 9	Fasteners; technical delivery conditions; components with electroplated coatings
DIN	988	Shim rings and supporting rings
DIN	5256	Pliers for circlips for bores
DIN 17 222		Cold rolled steel strip for springs; technical delivery conditions
DIN 40 080		Procedures and tables for random sampling using qualitative features (sampling by attributes)
DIN 50 021		Corrosion tests; spray tests with different sodium chloride solutions
DIN 50 103 Part 1		Testing of metallic materials; Rockwell hardness testing, C, A, B, F methods
DIN 50 133 Part 1		Testing of metallic materials; Vickers hardness testing, test load range: 49 N to 980 N (5 kp to 100 kp)
DIN 50 150		Testing of steel and cast steel; conversion table for Vickers hardness, Brinell hardness, Rockwell hardness and tensile strength
DIN 50 938		Burnishing of iron material; procedural principles, symbols and test methods
DIN 50 942		Phosphatizing of metals; procedural principles, symbols and test methods

Further standards

DIN	471	Circlips (retaining rings) for shafts; normal type and heavy type
DIN	983	Circlips with lugs (retaining rings) for shafts
DIN	984	Circlips with lugs (retaining rings) for bores
DIN	5254	Pliers for circlips for shafts
DIN	6799	Lock washers for shafts

Previous editions

DIN 472: 12.41, 11.42, 01.52, 01.54x; DIN 471 and 472 Supplement 1: 01.45, 03.54x; DIN 472 Part 1: 03.65; DIN 472 Part 2: 03.65; DIN 995: 01.70.

Amendments

The following amendments have been made as compared with DIN 472 Part 1, March 1965 edition, DIN 472 Part 2, March 1965 edition and DIN 995, January 1970 edition:

a) standards combined

b) contents revised and extended (see Explanations).

Explanations

The present revised edition of DIN 472 supersedes DIN 472 Part 1 and Part 2 and parts of DIN 995 where these concern circlips for bores. This inclusion of several standards within one standard and supplemented by technical delivery conditions and guidelines for fitting has produced a whole and complete standard which can be applied without the inclusion of additional standards. The following explanations are given with respect to this standard.

Re Title

The term "(retaining rings)" has been added to the title of the standard. The old designation "circlips" has been retained, although these components are used only for the axial retention of components in bores and have no locking action. The organizational problems associated with a general change in designation desirable for the sake of clarity were, because of the wide distribution of these standards, also rated as more important than the danger of misunderstood information on the part of the standards user due to an inappropriate title.

Re Clause 1 Concept

This clause was included in order to prevent possible errors in the application and function of the parts resulting from the designation.

Re Clause 2 Dimension letters, symbols

Clause 2 lists and describes the dimension letters and symbols used in the standard.

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Re Clause 3 Dimensions, designation, design data

This clause contains the dimensions of the circlips of normal type and heavy type. Required design data have been added. The dimensions of the circlips or their tolerances have been corrected slightly in a few cases without any danger thereby of replacement difficulties.

Two types of circlip have been shown. The second type of circlip shape (included as an additional option has been used for some years. In certain fields it has had manufacturing advantages. The application and function of the circlips do not differ from the type previously represented in this standard (lefthand illustration).

Toleranced dimensions for the shape and position of the bore groove have been included at the request of the users. These specifications apply to the general application of circlips. Other internal specifications may be used for individual cases. In the main, this applies also to the groove surfaces for which no generally valid regulations were able to be given in this standard.

The possibility of reducing the number of types of circlips, also possibly by means of main and subsidiary series for the bore diameters, has been thoroughly examined. But no technically feasible solution was able to be found, since practically all sizes with varying datum points are in use as a result of the already mentioned wide range of application. It was also not possible to offer a selection according to rolling bearing diameters.

Re Clause 4 Material

Details of the material have been modified. Three materials have been selected as the most usual from DIN 17 222. Other materials must be agreed by the parties concerned.

Re Clause 5 Finish

Details of the finish have been extended and adapted to present conditions. With electroplated circlips, the danger of hydrogen embrittlement is relatively great and requires special attention within the meaning of DIN 267 Part 9. Particular reference has therefore been made to DIN 267 Part 9. According to this standard, the situation is approximately as follows:

In order to avoid hydrogen-induced delayed brittle fractures in the electroplated surface protection of circlips, the galvanic treatment and heat treatment before and after electroplating must be selected so that only a small amount of hydrogen is taken up in the pickling and galvanic treatment and this hydrogen is furthermore driven off again to a large extent.

Normally, delayed brittle fractures can be avoided by these measures. If brittle fractures must be avoided with specific, statistical certainty, the taking of appropriate quantities of random samples is recommended followed by fatigue testing of these samples over 48 hours at room temperature; the circlips must thereby be loaded up to the bore diameter d_1.

Re Clause 6 Testing

Clause 6 covering the testing of circlips is new to the standard. It specifies tests which are required for the assessment of the mechanical and functional properties of circlips. The contents of this clause results from the experience of manufacturers and users and correspond to the general applications for circlips.

This also applies to the details of acceptance testing given in subclause 6.5. These details are based on DIN 267 Part 5. Special agreements are not thereby excluded.

Re Clause 7 Load-bearing capacity

Clause 7 contains details of the calculation of the load-bearing capacities of circlips and indicates how the extended data given in tables 1 and 2 have arisen. These data refer only to normal applications but clause 7 gives the principles for calculating the load-bearing capacities also for other applications.

Re Clause 8 Shape of groove

Various possibilities are presented in clause 8 for the shape of the grooves for circlips and these are also applicable from an economic standpoint. Decisions on appropriate shapes must be made on an individual basis.

Re Clause 9 Fitting the circlip

Clause 9 recommends the use of cones for fitting circlips. This type of fitting is of particular advantage in bulk manufacturing.