SLOVENSKI STANDARD
SIST EN 16983:2017

01-januar-2017

Krožnikaste vzmeti - Specifikacije kakovosti - Mere

Disc springs - Quality specifications - Dimensions

Tellerfedern - Qualitätsanforderungen - Maße

Rondelles ressorts - Spécification de qualité - Dimensions

Ta slovenski standard je istoveten z: **EN 16983:2016**

ICS:

21.160	Vzmeti	Springs

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English Version

Disc springs - Quality specifications - Dimensions

Rondelles ressorts - Spécification de qualité - Dimensions

Tellerfedern - Qualitätsanforderungen - Maße

This European Standard was approved by CEN on 15 August 2016.

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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 16983:2016) has been prepared by Technical Committee CEN/TC 407 “Cylindrical helical springs made from round wire and bar - Calculation and design”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

This European Standard has been prepared by the initiative of the Association of the European Spring Federation ESF and is based on the German Standard DIN 2093 “Disc springs – Quality specifications – Dimensions”, which is known and used in many European countries.

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

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1 Scope

This standard specifies the set of requirements that ensure the correct functioning of disc spring. These include requirements relating to the materials and manufacturing process, tolerances on dimensions and spring forces, and also the permissible relaxation and fatigue life of such springs as a function of stress.

All requirements specified here are minimum requirements.

This standard covers three dimensional series of disc springs.

NOTE In this standard, disc springs are divided into three groups and three dimensional series. Classification into groups is based on the manufacturing process, which is a function of the material thickness. The assignment of disc springs to dimensional series is governed by the h_0 / t ratio.

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.

EN 1654, *Copper and copper alloys - Strip for springs and connectors*

EN 10083 (all parts), *Steels for quenching and tempering*

EN 10089, *Hot-rolled steels for quenched and tempered springs - Technical delivery conditions*

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

EN 10151, *Stainless steel strip for springs - Technical delivery conditions*

EN ISO 3269, *Fasteners - Acceptance inspection (ISO 3269)*

EN ISO 6507 (all parts), *Metallic materials - Vickers hardness test (ISO 6507)*

EN ISO 6508 (all parts), *Metallic materials - Rockwell hardness test (ISO 6508)*

3 Terms, definitions, symbols, units and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definition given in EN ISO 26909 apply.

NOTE Disc springs are annular coned elements that offer resistance to a compressive load applied axially. They may be designed as single disc springs or as disc springs stacked in parallel or in series, either singly or in multiples. They may be subjected to both static and fatigue loading, and may have flat bearings.

3.2 Symbols, units and abbreviated terms

For the purposes of this document, the following symbols, units and abbreviated terms apply.

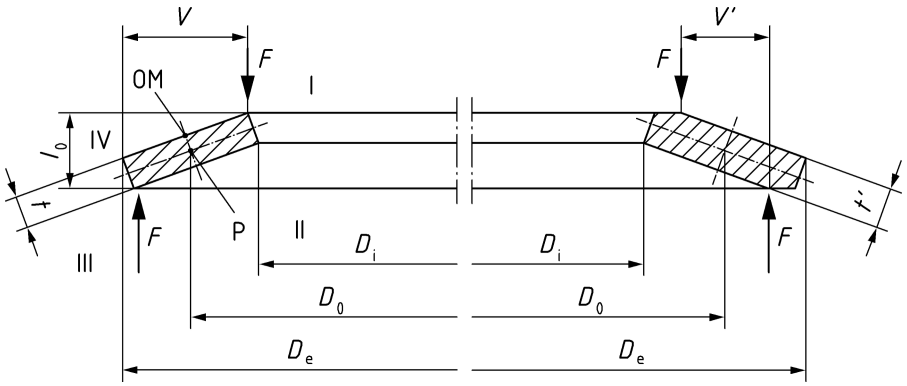
Table 1 — Symbols, units and abbreviated terms

Symbol	Unit	Description
D_e	mm	Outer diameter of spring
D_i	mm	Inner diameter of spring
D_0	mm	Diameter of centre of rotation
E	MPa	Modulus of elasticity
F	N	Spring load
F_c	N	Design spring load when spring is in the flattened position
F_t	N	Test load for length L_t or l_t
ΔF	N	Relaxation
L_0	mm	Length of springs stacked in series or in parallel, in the initial position
L_c	mm	Design length of springs stacked in series or in parallel, in the flattened position
N		Number of cycles to failure
R	N/mm	Spring rate
W	N mm	Energy capacity of spring
h_0	mm	Initial cone height of springs without flat bearings, $h_0 = l_0 - t$
h'_0	mm	Initial cone height of springs with flat bearings, $h'_0 = l_0 - t'$
i		Number of disc springs or packets stacked in series
l_0	mm	Free overall height of spring in its initial position
l_t	mm	Test length of disc spring, $l_t = l_0 - 0{,}75\ h_0$
s	mm	Deflection of single disc spring
s_1, s_2, s_3 ...	mm	Spring deflections related to spring loads F_1, F_2, F_3...
t	mm	Thickness of single disc spring
t'	mm	Reduced thickness of single disc spring with flat bearings (group 3)
μ		Poisson's ratio
σ	MPa	Design stress
$\sigma_{II}, \sigma_{III}, \sigma_{OM}$	MPa	Design stresses at the points designated II, III, OM (see Figure 1)
σ_h	MPa	Fatigue stress related to the deflection of springs subject to fatigue loading
σ_O	MPa	Maximum fatigue stress
σ_U	MPa	Minimum fatigue stress
$\sigma_H = \sigma_O - \sigma_U$	MPa	Permanent range of fatigue stress
P		Theoretical centre of rotation of disc spring cross section (see Figure 1)
V, V'		Lever arms

Symbol	Unit	Description
R_a		Mean surface roughness

4 Dimensions and designation

4.1 General



a) without flat bearings:
Group 1
Group 2

b) with flat bearings:
Group 3

Figure 1 — Single disc spring of group 1, 2 or 3 (sectional view), including the relevant points of loading

Designation of a disc spring of dimensional series A with an outer diameter, D_e of 40 mm:

Disc spring EN 16983 — A 40

4.2 Disc spring groups

Table 2 — Disc spring groups

Group	t	With flat bearings and reduced thickness
1	< 1,25	No
2	1,25 ≤ t ≤ 6	No
3	6 < t ≤ 14	Yes

4.3 Dimensional series

Table 3 — Dimensional series

series	h_0/t
A	approximately 0,40
B	approximately 0,75
C	~1,30

5 Spring material

Springs complying with this standard shall be made from steel as specified in the EN 10083 series, EN 10089 or EN 10132-4. Carbon steel shall only be used for the manufacture of Group 1 springs (see also Table 7).

The design of disc springs made from steel as above shall be based on a modulus of elasticity, *E*, of 206 000 MPa.

The modulus of elasticity and strength property of other materials (e.g. stainless steel for springs in accordance with EN 10151, copper alloys (spring bronze) in accordance with EN 1654) will likely be different. The values given for *F* and σ in Tables 4 to 6 then cease to apply. In such cases, it is recommended to consult the spring manufacturer.

6 Spring dimensions, nominal sizes, design values

6.1 Dimensional series A

Table 4 — Disc springs with $\frac{D_e}{t} \approx 18$; $\frac{h_0}{t} \approx 0,4$; E = 206 000 MPa; μ = 0,3

Group	D_e	D_i	t or $(t')^a$	h_0	l_0	F_t	l_t	$\sigma_{III}{}^b$	σ_{OM}
	h12	H12				s approximately 0,75 h_0			$s = h_0$
	8	4,2	0,4	0,2	0,6	210	0,45	1 218	−1 605
	10	5,2	0,5	0,25	0,75	325	0,56	1 218	−1 595
	12,5	6,2	0,7	0,3	1	660	0,77	1 382	−1 666
1	**14**	7,2	0,8	0,3	1,1	797	0,87	1 308	−1 551
	16	8,2	0,9	0,35	1,25	1 013	0,99	1 301	−1 555
	18	9,2	1	0,4	1,4	1 254	1,1	1 295	−1 558
	20	10,2	1,1	0,45	1,55	1 521	1,21	1 290	−1 560
	22,5	11,2	1,25	0,5	1,75	1 929	1,37	1 296	−1 534
	25	12,2	1,5	0,55	2,05	2 926	1,64	1091	−1 622
	28	14,2	1,5	0,65	2,15	2 841	1,66	1 274	−1 562
	31,5	16,3	1,75	0,7	2,45	3 871	1,92	1 296	−1 570
	35,5	18,3	2	0,8	2,8	5 187	2,2	1 332	−1 611
	40	20,4	2,25	0,9	3,15	6 500	2,47	1 328	−1 595
	45	22,4	2,5	1	3,5	7 716	2,75	1 296	−1 534
2	**50**	25,4	3	1,1	4,1	11 976	3,27	1 418	−1 659
	56	28,5	3	1,3	4,3	11 388	3,32	1 274	−1 565

Group	D_e	D_i	t or $(t')^a$	h_0	l_0	F_t	l_t	$\sigma_{III}{}^b$	σ_{OM}
	h12	H12				s approximately 0,75 h_0			$s = h_0$
	63	31	3,5	1,4	4,9	15 025	3,85	1 296	−1 524
	71	36	4	1,6	5,6	20 535	4,4	1 332	−1 594
	80	41	5	1,7	6,7	33 559	5,42	1 453	−1 679
	90	46	5	2	7	31 354	5,5	1 295	−1 558
	100	51	6	2,2	8,2	48 022	6,55	1 418	−1 663
	112	57	6	2,5	8,5	43 707	6,62	1 239	−1 505
3	**125**	64	8 (7,5)	2,6	10,6	85 926	8,65	1 326	−1 708
	140	72	8 (7,5)	3,2	11,2	85 251	8,8	1 284[c]	−1 675
	160	82	10 (9,4)	3,5	13,5	138 331	10,87	1 338	−1 753
	180	92	10 (9,4)	4	14	125 417	11	1 201[c]	−1 576
	200	102	12 (11,25)	4,2	16,2	183 020	13,05	1 227	−1 611
	225	112	12 (11,25)	5	17	171 016	13,25	1 137[c]	−1 489
	250	127	14 (13,1)	5,6	19,6	248 828	15,4	1 221[c]	−1 596

[a] The values specified for t are nominal values. In the case of springs with flat bearings (cf. Group 3 in Clause 4), the desired spring load, F (where s approximately 0,75 h_0), is to be obtained by reducing the thickness of single disc springs, t, which then gives the value t'. In the case of dimensional series A and B, t' approximately 0,94 × t, and in the case of dimensional series C, t' approximately 0,96 × t.

[b] The values specified apply for the largest calculated tensile stress on the lower edges of the spring.

[c] The values specified apply for the largest calculated tensile stress at the point designated III.

6.2 Dimensional series B

Table 5 — Disc springs with $\frac{D_e}{t} \approx 28$; $\frac{h_0}{t} \approx 0{,}75$; E = 206 000 MPa; μ = 0,3

Group	D_e	D_i	t or $(t')^a$	h_0	l_0	F_t	l_t	σ_{III}	σ_{OM}
	h12	H12				s approximately 0,75 h_0			$s = h_0$
1	**8**	4,2	0,3	0,25	0,55	118	0,36	1 312	−1 505
	10	5,2	0,4	0,3	0,7	209	0,47	1 281	−1 531
	12,5	6,2	0,5	0,35	0,85	294	0,59	1 114	−1 388
	14	7,2	0,5	0,4	0,9	279	0,6	1 101	−1 293
	16	8,2	0,6	0,45	1,05	410	0,71	1 109	−1 333
	18	9,2	0,7	0,5	1,2	566	0,82	1 114	−1 363
	20	10,2	0,8	0,55	1,35	748	0,94	1 118	−1 386
	22,5	11,2	0,8	0,65	1,45	707	0,96	1 079	−1 276
	25	12,2	0,9	0,7	1,6	862	1,07	1 023	−1 238
	28	14,2	1	0,8	1,8	1 107	1,2	1 086	−1 282
2	**31,5**	16,3	1,25	0,9	2,15	1 913	1,47	1 187	−1 442
	35,5	18,3	1,25	1	2,25	1 699	1,5	1 073	−1 258
	40	20,4	1,5	1,15	2,65	2 622	1,79	1 136	−1 359
	45	22,4	1,75	1,3	3,05	3 646	2,07	1 144	−1 396

Group	D_e	D_i	t or (t')[a]	$h0$	$l0$	F_t	l_t	σ_{III}	σ_{OM}
	h12	H12				s approximately 0,75 $h0$			$s = h0$
	50	25,4	2	1,4	3,4	4 762	2,35	1 140	−1 408
	56	28,5	2	1,6	3,6	4 438	2,4	1 092	−1 284
	63	31	2,5	1,75	4,25	7 189	2,94	1 088	−1 360
	71	36	2,5	2	4,5	6 725	3	1 055	−1 246
	80	41	3	2,3	5,3	10 518	3,57	1 142	−1 363
	90	46	3,5	2,5	6	14 161	4,12	1 114	−1 363
	100	51	3,5	2,8	6,3	13 070	4,2	1 049	−1 235
	112	57	4	3,2	7,2	17 752	4,8	1 090	−1 284
	125	64	5	3,5	8,5	29 908	5,87	1 149	−1 415
	140	72	5	4	9	27 920	6	1 101	−1 293
	160	82	6	4,5	10,5	41 008	7,12	1 109	−1 333
	180	92	6	5,1	11,1	37 502	7,27	1 035	−1 192
3	**200**	102	8 (7,5)	5,6	13,6	76 378	9,4	1 254	−1 409
	225	112	8 (7,5)	6,5	14,5	70 749	9,62	1 176	−1 267
	250	127	10 (9,4)	7	17	119 050	11,75	1 244	−1 406

[a] The values specified for t are nominal values. In the case of disc springs with flat bearings (cf. Group 3 in Clause 4), the desired spring load, F (where s approximately 0,75 h_0), is to be obtained by reducing the thickness of single disc springs, t, which then gives the value t'. In the case of dimensional series A and B, t' approximately 0,94 × t, and in the case of dimensional series C, t' approximately 0,96 × t.

6.3 Dimensional series C

Table 6 — Disc springs with $\frac{D_e}{t} \approx 40$; $\frac{h_0}{t} \approx 1{,}3$; E = 206 000 MPa; μ = 0,3

Group	D_e	D_i	t or (t')[a]	$h0$	$l0$	F_t	l_t	σ_{III}	σ_{OM}
	h12	H12				s approximately 0,75 $h0$			$s = h0$
1	**8**	4,2	0,2	0,25	0,45	39	0,26	1 034	−1 003
	10	5,2	0,25	0,3	0,55	58	0,32	965	− 957
	12,5	6,2	0,35	0,45	0,8	151	0,46	1 278	−1 250
	14	7,2	0,35	0,45	0,8	123	0,46	1 055	−1 018
	16	8,2	0,4	0,5	0,9	154	0,52	1 009	− 988
	18	9,2	0,45	0,6	1,05	214	0,6	1 106	−1 052
	20	10,2	0,5	0,65	1,15	254	0,66	1 063	−1 024
	22,5	11,2	0,6	0,8	1,4	426	0,8	1 227	−1 178
	25	12,2	0,7	0,9	1,6	600	0,92	1 259	−1 238
	28	14,2	0,8	1	1,8	801	1,05	1 304	−1 282
	31,5	16,3	0,8	1,05	1,85	687	1,06	1 130	−1 077
	35,5	18,3	0,9	1,15	2,05	832	1,19	1 078	−1 042