SCHNORR® Product range

Disc springs
Bolt locking systems

SCHNORR®
DISC SPRING ENGINEERING

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Certified acc. to ISO/TS 16949-2002

Grown competence for highest precision.

Adolf Schnorr, who founded our business in 1908, showed true pioneering spirit and his inventiveness laid the foundation for our success. Today, SCHNORR® has grown to become an internationally leading company in the field of disc springs and bolt locking systems.

The constructive and economic solutions offered by SCHNORR® accrue from long-term experience, reliability and high demands on perfection and quality.

SCHNORR® is a proven partner for renowned industrial companies, whether it be the automotive industry, machine construction and plant engineering, or for the aerospace industry.

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Material types and surface protection

We put things in motion – or hold them securely.

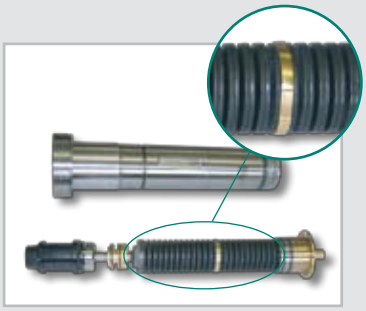
For example, pressure-relief valve in pipelines.

References

Hilti

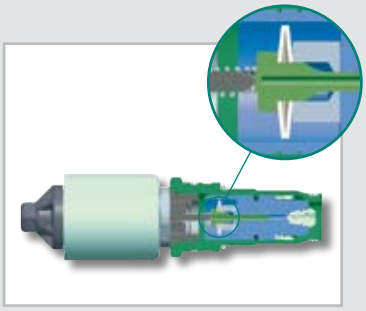
Overload limitation

Machine tool



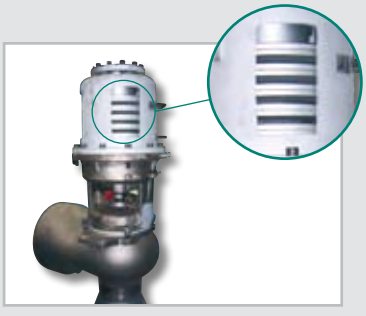
Spindle

Actuator



Control valve

Pipelines subject to pressure



Pressure-relief valve

Managing maximum force using minimum space.

SCHNORR® disc springs support a lot of dynamic processes in a skilful, safe and efficient way – often under extreme force and load conditions.

With the demand to develop and manufacture perfectly fitting solutions for various applications, SCHNORR®, offer an extensive standard range of disc springs, together with a multitude of special sizes as well as customer-oriented solutions and special developments.

SCHNORR® disc springs excel by:

- An optionally linear, degressive or progressive course of the load deflection curve
- Long service life with dynamic load
- Use of high quality materials
- Precise adherence to force and dimension requirements

Original SCHNORR® disc springs

The characteristic benefits of original SCHNORR® disc springs include:

① Load deflection curves of straight, progressive or degressive character according to the selection of spring arrangement and dimension.

② Simple adjustment of the spring stack length by the addition or removal of individual springs, thus altering the spring stack characteristic.

③ Efficient use of space with high spring forces obtainable with small deflections.

④ Largely self damping, particularly with parallel stacking.

⑤ No setting or fatigue under normal loads load.

⑥ Long service life

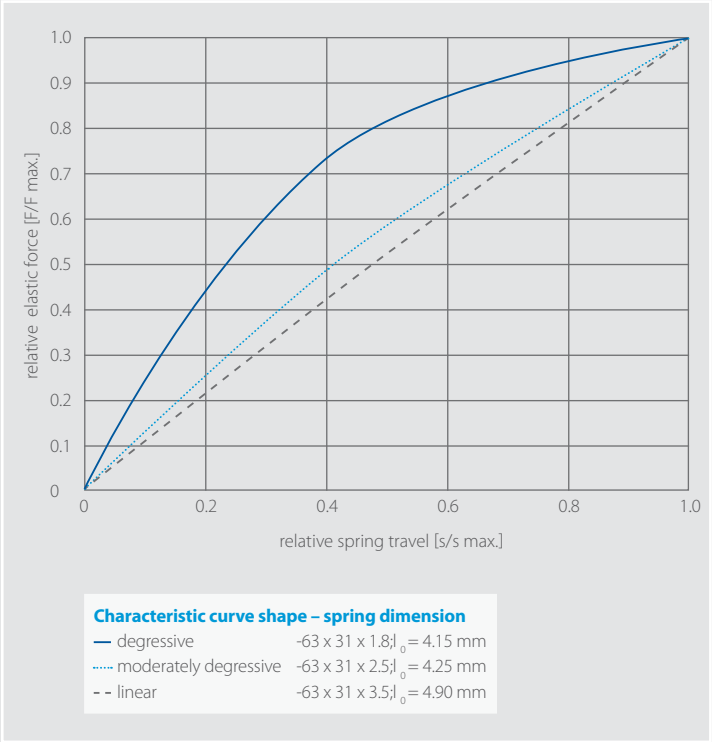
⑦ Flexibility in application of the disc springs can lead to a reduction in stock levels.

By means of these characteristics, the original SCHNORR® disc spring has developed such a wealth of application areas that nowadays there is scarcely an engineering area where it is not used.

Effect of spring forces

The importance of disc springs on machines and control systems is very often underestimated. At the same time, each impact on the behaviour of these components may give rise to a malfunction or even failure of entire facilities.

Classification of the various spring type is often carried out according to the kind of load. The disc spring has a special place in the range of springs commonly available. By changing its geometric parameters it is possible to provide individual springs with characteristic curves from linear to strongly degressive accrording to the application needs.



Characteristic curve shape – spring dimension

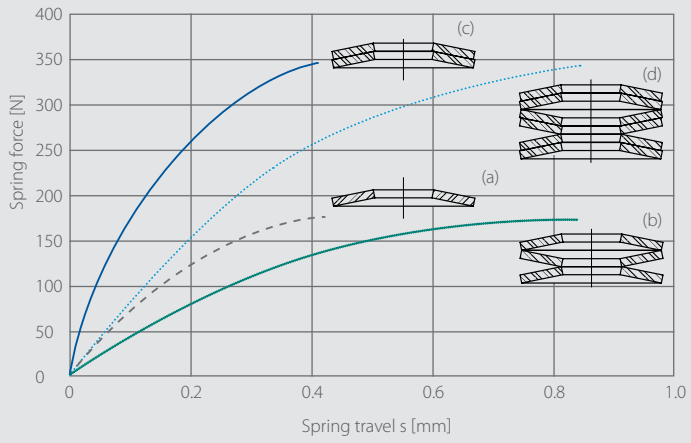
— degressive	-63 x 31 x 1.8; l_0 = 4.15 mm
····· moderately degressive	-63 x 31 x 2.5; l_0 = 4.25 mm
- - linear	-63 x 31 x 3.5; l_0 = 4.90 mm

A key advantage of the disc spring is that it can raise a high elastic force with a small spring travel. That is why it is used very often to store potential energy. Apart from this virtual static use, it is also often used in dynamic applications.

When using disc springs under sinusoidal oscillating loads, fatigue strength and time yield diagrams are available in order to enable a safe design. Wherever possible the spring arrangement applied should achieve a fatigue live in excess of 2 million cycles. Fundamental to the successful application of a disc spring under these conditions is observing the minimum preload requirements and that the springs are correctly guided.

SCHNORR® fatigue life estimates are based on a sinusoidal load input. For applications where step input (i.e. impact) is seen SCHNORR® can advise on fatigue life according to application.

The conical shape of the disc spring allows single springs to be combined in different ways. As a result, the characteristic of a spring combination can be varied in almost any way desired. In principle the following possibilities exist. In spring columns with single springs stacked in series, the spring deflections add up with constant load (b). In spring columns with springs stacked in parallel, the forces add up at the same deflection (c). In spring columns with combinations of serial and parallel stacking, various characteristic curves can be realized (d).



Spring dimensions: 15 x 5.2 x 0.4; l_0 = 0.95

- - (a) single disc spring
— (b) stacked in series; example 3 x 1 = triple deflection
— (c) stacked in parallel; example 1 x 2 = double force
····· (d) parallel pairs arranged in series; example 3 x 2 = double force and triple deflection

If disc springs of different thickness are stacked in a suitable way, then even progressive characteristic curves can be realized. For this, either several disc springs of different material thickness or identical disc springs with intermediate rings of different thickness or different layering types are used.

Due to this flexibility in the characteristic curve design, the disc spring can be used in a very wide spectrum.

Do you require assistance in specifying the correct disc spring either standard or special to your exact requirements?

Our engineering team will be pleased to help you in designing the most suitable disc spring solution according to your specifications.

The earlier we are involved in the development process, the better we can support you with our expertise.

What should one look for when selecting disc springs?

The price of incorrect selection with warranty claims and loss of reputation is very often more than the initial cost of a quality disc spring in the first place. In order to help you, we think the following are the most important criteria:

① Does the manufactured version comply with the quality requirements? On pages 8 and 9 you will find various manufacturing processes. One should pay attention to using a quality which complies with the requirements. We would be glad to advise you on the correct selection.

② Is the disc spring preset? Some suppliers in the low-price segment try to save this step. As a result, the disc spring will take a set after the first load.

③ Was a suitable material selected? In case of high temperatures or hostile environment, special materials need to be specified (see page 37).

④ Was a suitable surface treatment selected for corrosion protection (see page 40)?

Should individual consulting and design be carried out? We would be glad to support you with our experience and know-how.

The original SCHNORR® disc springs

Today DIN 2093 divides three manufacturing methods depending on the relevant thickness:

The large dimensional range in which disc springs are made requires very different production methods.

Group 1: t <1.25, punching, cold forming, rounding-off edges

Group 2: 1.25 ≤ t ≤ 6 mm, punching, cold forming, turning and rounding off edges or fine-blanking, cold forming and rounding off edges

Group 3: 6>t ≤14 mm, cold or hot forming, turning all sides, rounding off edges or punching, cold forming, turning and rounding off edges or fine-blanking, cold forming, rounding off edges.

Disc springs of group 2 acc. to DIN 2093 can be manufactured acc. to the following alternative processes:

- First the blank is stamped and subsequently the inner and outer diameter are turned to finished size.
- The disc spring is fine-blanked* and the punching grooves and the burr at the cutting edges are subsequently removed by tumbling/ vibrofinishing.

SCHNORR® regard the group 2 turned version as the best for most applications; due to a high level of automation they can be continuously and competetively manufactured. Alternatively, we will offer group 2 disc springs in a fine-blanked version if it is more sensible to use them from a technical or efficient point of view.

Simply stamped and ground disc springs of group 2 do not correspond to DIN 2093 and generally do not comply with the quality requirements for a disc spring. Such products should only be used after a close technical examination and for simplest static applications.

Spring load and various shape-forming processes

During the stamping process to form the disc spring, small grooves may form on the machined surface running in the stamping direction. Under load a series of tangential tensile stresses will occur particularly on the external edge of the spring.

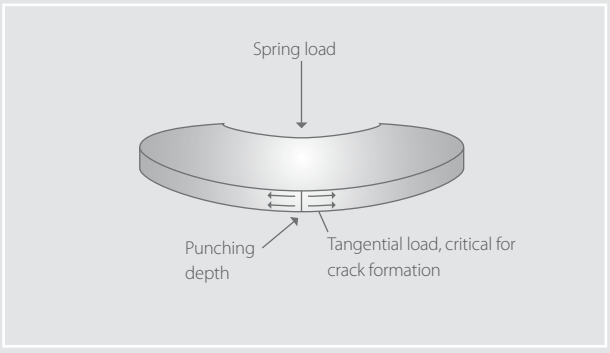


Figure 1

The inner and outer diameters of SCHNORR® disc springs are finished by lathe turning to counteract these critical conditions. That way, this critical condition is avoided. The turning pattern that inevitably occurs during the turning process runs in an uncritical tangential direction and thus into the direction of the acting tensile strength so that the danger of breakage is reduced to a minimum with SCHNORR® disc springs.

Turned variant:

During the turning procedure the stamping grooves are completely eliminated. The radial machining grooves occuring during the turning process run in the direction of the main tension of the spring and are thus not critical.

Fine-blank variant:

During fine-blanking the stamping grooves occur across the tangential tension which leads to an increased notch sensitivity (see figure 1) if these are not completely removed.

Prior to grinding

The stamping grooves are smoothed during the tumbling or vibratory grinding process.

After grinding

Stamped only variant:

During simple stamping accentuated stamping grooves occur across the main direction of tension resulting in a much higher notch sensitivity. We do not recommend this variant for dynamic requirements. Due to the punching cracks, a higher service life cannot be guaranteed.

* according to VDI directive 2906 page 5

Benefits of turned disc springs

- By turning the key surfaces of the spring, stamping cracks across the main direction of tension have been completely removed. This eliminates the risk of the notch effect.
- As the bearing surfaces are fully turned then friction between components is significantly reduced. This benefit can only be achieved by individually turning the disc springs (see figure 1b).
- Zones of work hardening which may occur on the cutting edges during fine-blanking are removed as far as possible during turning. The hardening process is clearly more uniform than with punched or fine-blanked surfaces which are then tumbling or vibratory ground only (see figure 1a and 1b).
- To achieve particularly high precision, the disc springs can be fine-turned to final dimension once again after the hardening process.
- With normal stamping and subsequent turning, material grades with a higher tensile strength than 600 N/mm² which do not have sufficient shaping capability for fine-blanking and are thus subject to the danger of crack formation can also be processed.

Formation of the edge area of a disc spring with the dimensions: 63 x 41 x 1.8, material grade: 1.4310, hardness data in HV0.1

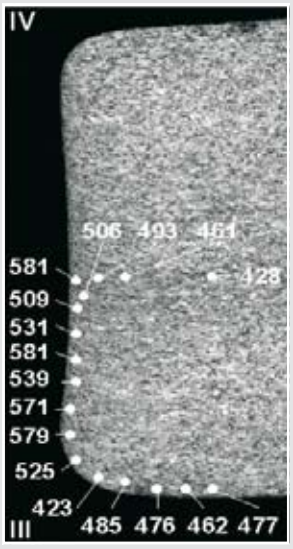


Figure 1a: punched
Minimum 423
Maximum 581

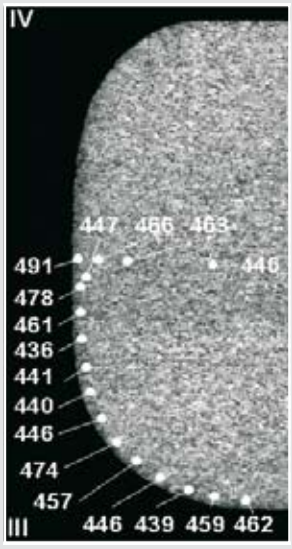
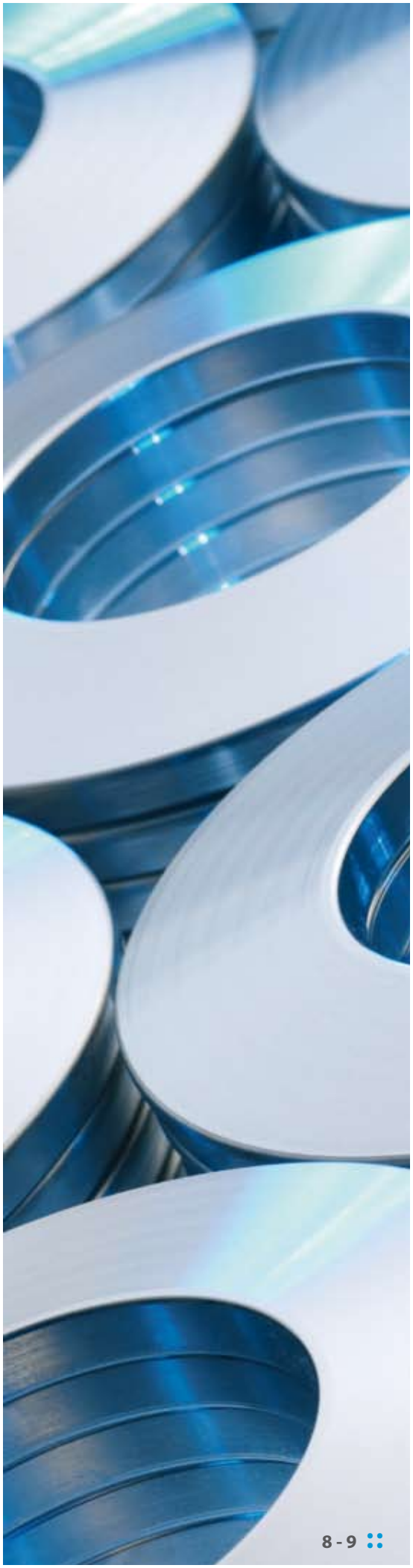


Figure 1b: punched and turned
Minimum 435
Maximum 491



The following tolerances apply to springs made of standard materials:

Diameter tolerances

Nominal dimension		Admissible tolerances				
D_e or D_i [mm]		D_e [mm]		D_i [mm]		concentricity [mm]
greater	up to	max.	min.	max.	min.	max.
3	6	0	-0.12	+0.12	0	0.15
6	10	0	-0.15	+0.15	0	0.18
10	18	0	-0.18	+0.18	0	0.22
18	30	0	-0.21	+0.21	0	0.26
30	50	0	-0.25	+0.25	0	0.32
50	80	0	-0.30	+0.30	0	0.60
80	120	0	-0.35	+0.35	0	0.70
120	180	0	-0.40	+0.40	0	0.80
180	250	0	-0.46	+0.46	0	0.92

Allowances for external and internal diameters and concentricity with springs according to DIN 2093

Thickness tolerances

Nominal spring thickness		Admissible tolerances	
t or t' [mm]		t or t' [mm]	
greater than	up to	max.	min.
0.20	0.60	+0.02	-0.06
0.60	1.25	+0.03	-0.09
1.25	3.80	+0.04	-0.12
3.80	6.00	+0.05	-0.15
6.00	16.00	+0.10	-0.10

Allowances for spring thickness with springs according to DIN 2093

Overall height tolerances

Nominal spring thickness		Admissible tolerances	
t or t' [mm]		l_0 [mm]	
greater than	up to	max.	min.
0.20	1.25	+0.10	-0.05
1.25	2.00	+0.15	-0.08
2.00	3.00	+0.20	-0.10
3.00	6.00	+0.30	-0.15
6.00	16.00	+0.30	-0.30

Allowances for the overall height with springs according to DIN 2093

Load tolerances

Nominal spring thickness		Admissible tolerances	
t or t' [mm]		F* [%]	
greater than	up to	max.	min.
0.20	1.25	+25	-7.5
1.25	3.00	+15	-7.5
3.00	6.00	+10	-5.0
6.00	16.00	+5	-5.0

Allowances for the spring load with springs according to DIN 2093

* F with test length $l_P = l_0 - 0.75*h_0$

Notes on the disc spring table

The following tables, list the springs according to DIN 2093 as well as those to SCHNORR® Internal standards. Sizes according to DIN 2093 are shown in heavy type. The prefix A, B or C shows the corresponding series. All sizes listed are in production and normally available from stock. The Article number quoted is the normal manufacture from spring steel with phosphate finish.

The load and the corresponding stresses are given for the three points $s = 0.25\ h_o$, $s = 0.5\ h_o$, $s = 0.75\ h_o$. From $s > 0.75\ h_o$, the actual characteristic curve increases progressively, contrary to the calculation (the table contains calculated values).

Disc springs according to group 3 are provided with turned bearing surfaces and reduced disc thickness. The disc's force increased by the bearing surfaces is compensated by means of the reduced disc thickness t'.

Disc thickness t' corresponds to the effective thickness of the spring and must be accounted for with parallel stacking for determining the column length. The elastic force applies to disc springs made of spring steel.

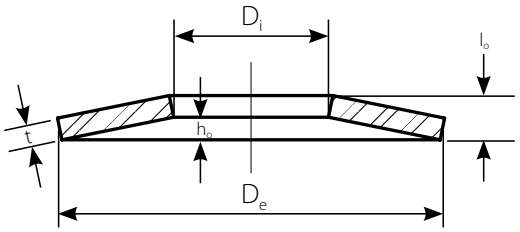
Original SCHNORR® disc springs

The following dimension tables describe:

Further versions:

Furthermore, we also manufacture from special materials, such as:
> Steel grades for higher temperatures (X22 CrMoV 12-1, X39 CrMo 17-1)
> Copper alloys (CuSn 8, CuBe 2)
> Nickel and cobalt alloys (Nimonic 90, Inconel X750, Inconel 718)
> and other material grades

For this, please see our material grade overview table on pages 38 and 39



Reference for a disc spring

D_e = 40 mm, D_i = 20.4 mm, t = 1.5 mm:
Disc spring 40 x 20.4 x 1.5
according to DIN 2093: DIN 2093-B 40
or Article no. 012 800

Original SCHNORR® disc springs standard material — dia. 6 - 15 mm

Article number/ Order reference	Ordering dimensions						Weight	Spring travel s and force F					
							per 1000 pieces	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e [mm]	D_i [mm]	t [mm]	t' [mm]	l_o [mm]	h_o [mm]	[kg]	s [mm]	F [N]	s [mm]	F [N]	s [mm]	F [N]
000 100	6.00	3.20	0.30		0.45	0.15	0.044	0.038	45	0.075	84	0.113	119
000 200	8.00	3.20	0.20		0.40	0.20	0.064	0.050	12	0.100	21	0.150	26
000 300	8.00	3.20	0.30		0.55	0.25	0.093	0.063	46	0.125	79	0.188	104
000 400	8.00	3.20	0.40		0.60	0.20	0.126	0.050	69	0.100	130	0.150	186
000 550 **C**	**8.00**	**4.20**	**0.20**		0.45	0.25	0.055	0.063	21	0.125	33	0.188	39
000 600 **B**	**8.00**	**4.20**	**0.30**		0.55	0.25	0.080	0.063	52	0.125	89	0.188	118
000 700 **A**	**8.00**	**4.20**	**0.40**		0.60	0.20	0.107	0.050	78	0.100	147	0.150	210
000 800	10.00	3.20	0.30		0.65	0.35	0.157	0.088	51	0.175	82	0.263	98
000 900	10.00	3.20	0.40		0.70	0.30	0.211	0.075	75	0.150	133	0.225	179
001 000	10.00	3.20	0.50		0.75	0.25	0.266	0.063	104	0.125	196	0.188	279
001 100	10.00	4.20	0.40		0.70	0.30	0.193	0.075	79	0.150	140	0.225	189
001 200	10.00	4.20	0.50		0.75	0.25	0.243	0.063	110	0.125	206	0.188	294
001 300 **C**	**10.00**	**5.20**	**0.25**		0.55	0.30	0.109	0.075	31	0.150	48	0.225	58
001 400 **B**	**10.00**	**5.20**	**0.40**		0.70	0.30	0.170	0.075	88	0.150	155	0.225	209
001 500 **A**	**10.00**	**5.20**	**0.50**		0.75	0.25	0.214	0.063	122	0.125	228	0.188	325
001 600	12.00	4.20	0.40		0.80	0.40	0.297	0.100	85	0.200	141	0.300	178
001 700	12.00	4.20	0.50		0.85	0.35	0.374	0.088	116	0.175	208	0.263	284
001 800	12.00	4.20	0.60		1.00	0.40	0.450	0.100	224	0.200	405	0.300	557
001 900	12.00	5.20	0.50		0.90	0.40	0.345	0.100	151	0.200	263	0.300	350
002 000	12.00	5.20	0.60		0.95	0.35	0.415	0.088	196	0.175	361	0.263	506
002 100	12.00	6.20	0.50		0.85	0.35	0.310	0.088	134	0.175	239	0.263	326
002 200	12.00	6.20	0.60		0.95	0.35	0.373	0.088	214	0.175	394	0.263	552
002 300	12.50	5.20	0.50		0.85	0.35	0.382	0.088	111	0.175	200	0.263	272
002 050 **C**	**12.50**	**6.20**	**0.35**		0.80	0.45	0.251	0.113	84	0.225	130	0.338	151
002 500 **B**	**12.50**	**6.20**	**0.50**		0.85	0.35	0.346	0.088	120	0.175	215	0.263	294
002 700 **A**	**12.50**	**6.20**	**0.70**		1.00	0.30	0.488	0.075	240	0.150	457	0.225	660
002 750 **C**	**14.00**	**7.20**	**0.35**		0.80	0.45	0.308	0.113	68	0.225	106	0.338	123
002 800 **B**	**14.00**	**7.20**	**0.50**		0.90	0.40	0.425	0.100	120	0.200	210	0.300	279
002 900 **A**	**14.00**	**7.20**	**0.80**		1.10	0.30	0.676	0.075	284	0.150	547	0.225	797
003 000	15.00	5.20	0.40		0.95	0.55	0.468	0.138	101	0.275	154	0.413	176
003 100	15.00	5.20	0.50		1.00	0.50	0.588	0.125	133	0.250	221	0.375	278
003 200	15.00	5.20	0.60		1.05	0.45	0.708	0.113	171	0.225	302	0.338	407
003 300	15.00	5.20	0.70		1.10	0.40	0.828	0.100	214	0.200	395	0.300	555
003 500	15.00	6.20	0.50		1.00	0.50	0.553	0.125	138	0.250	230	0.375	289
003 600	15.00	6.20	0.60		1.05	0.45	0.665	0.113	178	0.225	314	0.338	424
003 700	15.00	6.20	0.70		1.10	0.40	0.778	0.100	222	0.200	411	0.300	578
003 800	15.00	8.20	0.70		1.10	0.40	0.654	0.100	256	0.200	474	0.300	666
003 900	15.00	8.20	0.80		1.20	0.40	0.740	0.100	367	0.200	689	0.300	982

Original SCHNORR® disc springs standard material — dia. 16 - 23 mm

Article number/ Order reference	Ordering dimensions						Weight	Spring travel s and force F					
							per 1000 pieces	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e [mm]	D_i [mm]	t [mm]	t' [mm]	l_o [mm]	h_o [mm]	[kg]	s [mm]	F [N]	s [mm]	F [N]	s [mm]	F [N]
004 100 **C**	**16.00**	**8.20**	**0.40**		0.90	0.50	0.444	0.125	84	0.250	131	0.375	154
004 300 **B**	**16.00**	**8.20**	**0.60**		1.05	0.45	0.672	0.113	172	0.225	304	0.338	410
004 400	16.00	8.20	0.70		1.15	0.45	0.786	0.113	254	0.225	461	0.338	637
004 500	16.00	8.20	0.80		1.20	0.40	0.888	0.100	308	0.200	579	0.300	825
004 600 **A**	**16.00**	**8.20**	**0.90**		1.25	0.35	1.002	0.088	363	0.175	697	0.263	1013
004 700	18.00	6.20	0.40		1.00	0.60	0.677	0.150	85	0.300	126	0.450	139
004 800	18.00	6.20	0.50		1.10	0.60	0.850	0.150	130	0.300	206	0.450	246
004 900	18.00	6.20	0.60		1.20	0.60	1.024	0.150	191	0.300	317	0.450	400
005 000	18.00	6.20	0.70		1.25	0.55	1.197	0.138	236	0.275	414	0.413	553
005 100	18.00	6.20	0.80		1.30	0.50	1.353	0.125	286	0.250	523	0.375	726
005 200	18.00	8.20	0.50		1.10	0.60	0.762	0.150	140	0.300	222	0.450	265
005 300	18.00	8.20	0.70		1.25	0.55	1.073	0.138	255	0.275	446	0.413	596
005 400	18.00	8.20	0.80		1.30	0.50	1.213	0.125	309	0.250	564	0.375	783
005 500	18.00	8.20	1.00		1.40	0.40	1.524	0.100	425	0.200	815	0.300	1181
005 550 **C**	**18.00**	**9.20**	**0.45**		1.05	0.60	0.651	0.150	121	0.300	186	0.450	214
005 600 **B**	**18.00**	**9.20**	**0.70**		1.20	0.50	0.999	0.125	233	0.250	417	0.375	566
005 700 **A**	**18.00**	**9.20**	**1.00**		1.40	0.40	1.418	0.100	451	0.200	865	0.300	1254
005 800	20.00	8.20	0.60		1.30	0.70	1.191	0.175	214	0.350	342	0.525	412
005 900	20.00	8.20	0.70		1.35	0.65	1.393	0.163	262	0.325	442	0.488	569
006 000	20.00	8.20	0.80		1.40	0.60	1.574	0.150	315	0.300	557	0.450	751
006 100	20.00	8.20	0.90		1.45	0.55	1.776	0.138	374	0.275	685	0.413	954
006 200	20.00	8.20	1.00		1.55	0.55	1.978	0.138	494	0.275	918	0.413	1295
006 300 **C**	**20.00**	**10.20**	**0.50**		1.15	0.65	0.876	0.163	141	0.325	219	0.488	254
006 400 **B**	**20.00**	**10.20**	**0.80**		1.35	0.55	1.394	0.138	304	0.275	547	0.413	748
006 500	20.00	10.20	0.90		1.45	0.55	1.573	0.138	412	0.275	754	0.413	1050
006 600	20.00	10.20	1.00		1.55	0.55	1.752	0.138	544	0.275	1010	0.413	1425
006 700 **A**	**20.00**	**10.20**	**1.10**		1.55	0.45	1.913	0.113	548	0.225	1050	0.338	1521
006 800	20.00	10.20	1.25		1.75	0.50	2.181	0.125	890	0.250	1708	0.375	2477
006 900	20.00	10.20	1.50		1.80	0.30	2.610	0.075	857	0.150	1695	0.225	2521
007 000 **C**	**22.50**	**11.20**	**0.60**		1.40	0.80	1.361	0.200	241	0.400	370	0.600	426
007 100 **B**	**22.50**	**11.20**	**0.80**		1.45	0.65	1.799	0.163	306	0.325	533	0.488	708
007 200 **A**	**22.50**	**11.20**	**1.25**		1.75	0.50	2.814	0.125	693	0.250	1330	0.375	1929
007 400	23.00	8.20	0.70		1.50	0.80	1.939	0.200	280	0.400	448	0.600	544
007 500	23.00	8.20	0.80		1.55	0.75	2.192	0.188	332	0.375	560	0.563	719
007 600	23.00	8.20	0.90		1.60	0.70	2.472	0.175	391	0.350	687	0.525	919
007 700	23.00	8.20	1.00		1.70	0.70	2.753	0.175	507	0.350	909	0.525	1240
007 800	23.00	10.20	0.90		1.65	0.75	2.270	0.188	463	0.375	802	0.563	1058
007 900	23.00	10.20	1.00		1.70	0.70	2.527	0.175	538	0.350	964	0.525	1315
008 000	23.00	10.20	1.25		1.90	0.65	3.172	0.163	870	0.325	1627	0.488	2310
008 100	23.00	12.20	1.00		1.60	0.60	2.255	0.150	475	0.300	872	0.450	1217
008 200	23.00	12.20	1.25		1.85	0.60	2.807	0.150	864	0.300	1630	0.450	2331
008 350	23.00	12.20	1.50		2.00	0.50	3.359	0.125	1159	0.250	2250	0.375	3297

Original SCHNORR® disc springs standard material — dia. 25 - 50 mm

Article number/ Order reference	Ordering dimensions						Weight	Spring travel s and force F					
							per 1000	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e	D_i	t	t'	l_o	h_o	pieces	s	F	s	F	s	F
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]	[mm]	[N]	[mm]	[N]	[mm]	[N]
008 600	25.00	10.20	1.00		1.75	0.75	3.105	0.188	492	0.375	870	0.563	1172
008 700 **C**	**25.00**	**12.20**	**0.70**		1.60	0.90	1.994	0.225	331	0.450	515	0.675	600
008 800 **B**	**25.00**	**12.20**	**0.90**		1.60	0.70	2.543	0.175	367	0.350	644	0.525	862
008 900	25.00	12.20	1.00		1.80	0.80	2.832	0.200	585	0.400	1021	0.600	1359
009 000	25.00	12.20	1.25		1.95	0.70	3.526	0.175	848	0.350	1573	0.525	2214
009 100 **A**	**25.00**	**12.20**	**1.50**		2.05	0.55	4.219	0.138	1040	0.275	2007	0.413	2926
009 200	28.00	10.20	0.80		1.75	0.95	3.233	0.238	348	0.475	553	0.713	662
009 300	28.00	10.20	1.00		1.90	0.90	4.062	0.225	512	0.450	872	0.675	1130
009 400	28.00	10.20	1.25		2.05	0.80	5.057	0.200	737	0.400	1339	0.600	1853
009 500	28.00	10.20	1.50		2.20	0.70	6.051	0.175	1003	0.350	1899	0.525	2723
009 600	28.00	12.20	1.00		1.95	0.95	3.789	0.238	590	0.475	992	0.713	1268
009 700	28.00	12.20	1.25		2.10	0.85	4.717	0.213	844	0.425	1519	0.638	2083
009 800	28.00	12.20	1.50		2.25	0.75	5.645	0.188	1149	0.375	2159	0.563	3077
009 900 **C**	**28.00**	**14.20**	**0.80**		1.80	1.00	2.760	0.250	435	0.500	681	0.750	801
010 000 **B**	**28.00**	**14.20**	**1.00**		1.80	0.80	3.468	0.200	476	0.400	832	0.600	1107
010 100	28.00	14.20	1.25		2.10	0.85	4.317	0.213	908	0.425	1634	0.638	2240
010 200 **A**	**28.00**	**14.20**	**1.50**		2.15	0.65	5.166	0.163	1033	0.325	1970	0.488	2841
010 300	31.50	12.20	1.00		2.10	1.10	5.035	0.275	587	0.550	951	0.825	1167
010 400	31.50	12.20	1.25		2.20	0.95	6.268	0.238	761	0.475	1343	0.713	1805
010 500	31.50	12.20	1.50		2.35	0.85	7.501	0.213	1033	0.425	1912	0.638	2688
010 650 **C**	**31.50**	**16.30**	**0.80**		1.85	1.05	3.442	0.263	384	0.525	594	0.788	687
010 700 **B**	**31.50**	**16.30**	**1.25**		2.15	0.90	5.384	0.225	791	0.450	1409	0.675	1913
010 800	31.50	16.30	1.50		2.40	0.90	6.443	0.225	1260	0.450	2314	0.675	3230
010 900 **A**	**31.50**	**16.30**	**1.75**		2.45	0.70	7.546	0.175	1391	0.350	2669	0.525	3871
011 000	31.50	16.30	2.00		2.75	0.75	8.605	0.188	2199	0.375	4239	0.563	6173
011 100	34.00	12.30	1.00		2.25	1.25	6.006	0.313	637	0.625	998	0.938	1174
011 200	34.00	12.30	1.25		2.35	1.10	7.477	0.275	815	0.550	1395	0.825	1818
011 300	34.00	12.30	1.50		2.50	1.00	8.948	0.250	1097	0.500	1982	0.750	2725
011 400	34.00	14.30	1.25		2.40	1.15	7.074	0.288	913	0.575	1546	0.863	1993
011 500	34.00	14.30	1.50		2.55	1.05	8.465	0.263	1224	0.525	2192	0.788	2990
011 600	34.00	16.30	1.50		2.55	1.05	7.911	0.263	1291	0.525	2313	0.788	3155
011 700	34.00	16.30	2.00		2.85	0.85	10.570	0.213	2097	0.425	4003	0.638	5783
011 850 **C**	**35.50**	**18.30**	**0.90**		2.05	1.15	4.952	0.288	458	0.575	713	0.863	832
011 900 **B**	**35.50**	**18.30**	**1.25**		2.25	1.00	6.865	0.250	731	0.500	1277	0.750	1699
012 000 **A**	**35.50**	**18.30**	**2.00**		2.80	0.80	10.970	0.200	1864	0.400	3576	0.600	5187
012 100	40.00	14.30	1.25		2.65	1.40	10.400	0.350	904	0.700	1459	1.050	1780
012 200	40.00	14.30	1.50		2.75	1.25	12.450	0.313	1114	0.625	1929	0.938	2545
012 300	40.00	14.30	2.00		3.05	1.05	16.630	0.263	1800	0.525	3363	0.788	4769
012 400	40.00	16.30	1.50		2.80	1.30	11.890	0.325	1225	0.650	2103	0.975	2749
012 500	40.00	16.30	2.00		3.10	1.10	15.890	0.275	1972	0.550	3663	0.825	5169
012 600	40.00	18.30	2.00		3.15	1.15	15.040	0.288	2182	0.575	4030	0.863	5656
012 700 **C**	**40.00**	**20.40**	**1.00**		2.30	1.30	7.067	0.325	565	0.650	876	0.975	1017
012 800 **B**	**40.00**	**20.40**	**1.50**		2.65	1.15	10.530	0.288	1109	0.575	1953	0.863	2622
012 900	40.00	20.40	2.00		3.10	1.10	14.060	0.275	2175	0.550	4041	0.825	5701
013 000 **A**	**40.00**	**20.40**	**2.25**		3.15	0.90	15.720	0.225	2336	0.450	4481	0.675	6500
013 100	40.00	20.40	2.50		3.45	0.95	17.520	0.238	3351	0.475	6453	0.713	9390
013 250 **C**	**45.00**	**22.40**	**1.25**		2.85	1.60	11.340	0.400	1041	0.800	1620	1.200	1891
013 300 **B**	**45.00**	**22.40**	**1.75**		3.05	1.30	15.890	0.325	1524	0.650	2701	0.975	3646
013 400 **A**	**45.00**	**22.40**	**2.50**		3.50	1.00	22.770	0.250	2773	0.500	5320	0.750	7716
013 500	50.00	18.40	1.25		2.85	1.60	16.130	0.400	757	0.800	1178	1.200	1375
013 600	50.00	18.40	1.50		3.30	1.80	19.310	0.450	1379	0.900	2184	1.350	2606

Original SCHNORR® disc springs standard material — dia. 50 - 100 mm

Article number/ Order reference	Ordering dimensions						Weight	Spring travel s and force F					
							per 1000 pieces	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e	D_i	t	t'	l_o	h_o		s	F	s	F	s	F
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]	[mm]	[N]	[mm]	[N]	[mm]	[N]
013 700	50.00	18.40	2.00		3.50	1.50	25.790	0.375	1918	0.750	3393	1.125	4572
013 800	50.00	18.40	2.50		4.10	1.60	32.140	0.400	3703	0.800	6733	1.200	9315
013 900	50.00	18.40	3.00		4.40	1.40	38.350	0.350	5043	0.700	9546	1.050	13688
014 000	50.00	20.40	2.00		3.50	1.50	24.850	0.375	1966	0.750	3478	1.125	4687
014 100	50.00	20.40	2.50		3.85	1.35	30.970	0.338	3008	0.675	5601	1.013	7919
014 200	50.00	22.,40	2.00		3.60	1.60	23.820	0.400	2247	0.800	3924	1.200	5222
014 300	50.00	22.40	2.50		3.90	1.40	29.680	0.350	3261	0.700	6044	1.050	8510
014 400 **C**	**50.00**	**25.40**	**1.25**		2.85	1.60	13.820	0.400	854	0.800	1328	1.200	1550
014 500	50.00	25.40	1.50		3.10	1.60	16.540	0.400	1242	0.800	2029	1.200	2512
014 600 **B**	**50.00**	**25.40**	**2.00**		3.40	1.40	22.090	0.350	1949	0.700	3491	1.050	4762
014 700	50.00	25.40	2.50		3.90	1.40	27.520	0.350	3473	0.700	6437	1.050	9063
014 800 **A**	**50.00**	**25.40**	**3.00**		4.10	1.10	32.850	0.275	4255	0.550	8214	0.825	11977
014 950 **C**	**56.00**	**28.50**	**1.50**		3.45	1.95	20.850	0.488	1458	0.975	2259	1.463	2622
015 000 **B**	**56.00**	**28.50**	**2.00**		3.60	1.60	27.810	0.400	1910	0.800	3335	1.200	4438
015 100 **A**	**56.00**	**28.50**	**3.00**		4.30	1.30	41.570	0.325	4142	0.650	7895	0.975	11388
015 200	60.00	20.50	2.00		4.10	2.10	38.160	0.525	2318	1.050	3802	1.575	4730
015 300	60.00	20.50	2.50		4.30	1.80	47.690	0.450	3018	0.900	5379	1.350	7302
015 400	60.00	20.50	3.00		4.70	1.70	57.040	0.425	4449	0.850	8234	1.275	11577
015 500	60.00	25.50	2.50		4.40	1.90	44.200	0.475	3447	0.950	6081	1.425	8175
015 600	60.00	25.50	3.00		4.65	1.65	52.860	0.413	4495	0.825	8352	1.238	11784
015 700	60.00	30.50	2.50		4.30	1.80	39.940	0.450	3447	0.900	6145	1.350	8342
015 800	60.00	30.50	3.00		4.70	1.70	47.770	0.425	5083	0.850	9407	1.275	13226
015 900	60.00	30.50	3.50		5.00	1.50	55.100	0.375	6591	0.750	12574	1.125	18153
016 050 **C**	**63.00**	**31.00**	**1.80**		4.15	2.35	32.530	0.588	2364	1.175	3658	1.763	4238
016 100 **B**	**63.00**	**31.00**	**2.50**		4.25	1.75	44.850	0.438	2942	0.875	5270	1.313	7189
016 200	63.00	31.00	3.00		4.80	1.80	53.860	0.450	4891	0.900	8981	1.350	12536
016 300 **A**	**63.00**	**31.00**	**3.50**		4.90	1.40	62.130	0.350	5399	0.700	10359	1.050	15025
016 400	70.00	25.50	2.00		4.50	2.50	50.780	0.625	2408	1.250	3771	1.875	4437
016 500	70.00	30.50	2.50		4.90	2.40	59.530	0.600	3755	1.200	6297	1.800	8031
016 600	70.00	30.50	3.00		5.10	2.10	71.190	0.525	4676	1.050	8376	1.575	11426
016 700	70.00	35.50	3.00		5.10	2.10	65.210	0.525	5028	1.050	9007	1.575	12288
016 800	70.00	35.50	4.00		5.80	1.80	86.130	0.450	8757	0.900	16634	1.350	23923
016 900	70.00	40.50	4.00		5.60	1.60	77.040	0.400	8391	0.800	16099	1.200	23351
017 000	70.00	40.50	5.00		6.20	1.20	95.150	0.300	11544	0.600	22728	0.900	33672
017 100 **C**	**71.00**	**36.00**	**2.00**		4.60	2.60	44.660	0.650	2861	1.300	4432	1.950	5144
017 200 **B**	**71.00**	**36.00**	**2.50**		4.50	2.00	56.110	0.500	2894	1.000	5054	1.500	6725
017 300 **A**	**71.00**	**36.00**	**4.00**		5.60	1.60	88.630	0.400	7379	0.800	14157	1.200	20535
017 400	80.00	31.00	2.50		5.30	2.80	82.010	0.700	3678	1.400	5933	2.100	7239
017 500	80.00	31.00	3.00		5.50	2.50	98.010	0.625	4531	1.250	7847	1.875	10352
017 600	80.00	31.00	4.00		6.10	2.10	130.000	0.525	7319	1.050	13677	1.575	19394
017 700	80.00	36.00	3.00		5.70	2.70	91.920	0.675	5401	1.350	9196	2.025	11919
017 800	80.00	36.00	4.00		6.20	2.20	121.900	0.550	8164	1.100	15168	1.650	21400
017 850 **C**	**80.00**	**41.00**	**2.25**		5.20	2.95	63.540	0.738	3698	1.475	5715	2.213	6613
017 900 **B**	**80.00**	**41.00**	**3.00**		5.30	2.30	84.920	0.575	4450	1.150	7838	1.725	10518
018 000	80.00	41.00	4.00		6.20	2.20	112.600	0.550	8726	1.100	16213	1.650	22874
018 100 **A**	**80.00**	**41.00**	**5.00**		6.70	1.70	139.500	0.425	11821	0.850	22928	1.275	33559
018 200 **C**	**90.00**	**46.00**	**2.50**		5.70	3.20	89.740	0.800	4232	1.600	6585	2.400	7684
018 300 **B**	**90.00**	**46.00**	**3.,50**		6.00	2.50	125.300	0.625	5836	1.250	10416	1.875	14161
018 400 **A**	**90.00**	**46.00**	**5.00**		7.00	2.00	177.600	0.500	11267	1.000	21617	1.500	31354
018 500	100.00	41.00	4.00		7.20	3.20	200.000	0.800	8714	1.600	15219	2.400	20251
018 600	100.00	41.00	5.00		7.75	2.75	248.900	0.688	12345	1.375	22937	2.063	32361

Original SCHNORR® disc springs standard material — dia. 100 - 200 mm

Article number/ Order reference	Ordering dimensions						Weight	Spring travel s and force F					
							per 1000	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e	D_i	t	t'	l_o	h_o	pieces	s	F	s	F	s	F
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]	[mm]	[N]	[mm]	[N]	[mm]	[N]
018 750 **C**	**100.00**	**51.00**	**2.70**		6.20	3.50	120.100	0.875	4779	1.750	7410	2.625	8609
018 800 **B**	**100.00**	**51.00**	**3.50**		6.30	2.80	155.400	0.700	5624	1.400	9823	2.100	13070
018 900	100.00	51.00	4.00		7.00	3.00	177.600	0.750	8673	1.500	15341	2.250	20674
019 000	100.00	51.00	5.00		7.80	2.80	221.100	0.700	13924	1.400	25810	2.100	36339
019 150 **A**	**100.00**	**51.00**	**6.00**		8.20	2.20	262.800	0.550	17061	1.100	32937	1.650	48022
019 250 **C**	**112.00**	**57.00**	**3.00**		6.90	3.90	168.000	0.975	5834	1.950	9038	2.925	10489
019 300 **B**	**112.00**	**57.00**	**4.00**		7.20	3.20	222.700	0.800	7639	1.600	13341	2.400	17752
019 450 **A**	**112.00**	**57.00**	**6.00**		8.50	2.50	332.100	0.625	15800	1.250	30215	1.875	43707
019 500	125.00	41.00	4.00		8.20	4.20	338.100	1.050	8501	2.100	13943	3.150	17346
019 600	125.00	51.00	4.00		8.50	4.50	315.600	1.125	10096	2.250	16265	3.375	19817
019 700	125.00	51.00	5.00		8.90	3.90	391.500	0.975	13063	1.950	22931	2.925	30669
019 850	125.00	51.00	6.00		9.40	3.40	465.800	0.850	17027	1.700	31514	2.550	44307
019 900	125.00	61.00	5.00		9.00	4.00	357.600	1.000	14615	2.000	25526	3.000	33966
020 050	125.00	61.00	6.00		9.60	3.60	425.400	0.900	19789	1.800	36336	2.700	50722
020 100	125.00	61.00	8.00	7.50	10.90	2.90	547.300	0.725	34434	1.450	65305	2.175	93577
020 200 **C**	**125.00**	**64.00**	**3.50**		8.00	4.50	242.300	1.125	8514	2.250	13231	3.375	15416
020 300 **B**	**125.00**	**64.00**	**5.00**		8.50	3.50	346.200	0.875	12238	1.750	21924	2.625	29908
020 400 **A**	**125.00**	**64.00**	**8.00**	7.50	10.60	2.60	529.900	0.650	31119	1.300	59520	1.950	85926
020 550	125.00	71.00	6.00		9.30	3.30	377.900	0.825	19538	1.650	36302	2.475	51304
020 600	125.00	71.00	8.00	7.40	10.40	2.40	479.600	0.600	30867	1.200	59149	1.800	85494
020 700	125.00	71.00	10.00	9.20	11.80	1.80	596.300	0.450	42964	0.900	84219	1.350	124124
020 850 **C**	**140.00**	**72.00**	**3.80**		8.70	4.90	329.700	1.225	9514	2.450	14773	3.675	17195
020 900 **B**	**140.00**	**72.00**	**5.00**		9.00	4.00	433.200	1.000	12014	2.000	20982	3.000	27920
021 000 **A**	**140.00**	**72.00**	**8.00**	7.50	11.20	3.20	663.000	0.800	31903	1.600	59967	2.400	85251
021 100	150.00	61.00	5.00		10.30	5.30	565.000	1.325	15292	2.650	25021	3.975	31041
021 250	150.00	61.00	6.00		10.80	4.80	676.800	1.200	19560	2.400	34161	3.600	45456
021 350	150.00	71.00	6.00		10.80	4.80	628.900	1.200	20721	2.400	36189	3.600	48155
021 400	150.00	71.00	8.00	7.50	12.00	4.00	803.600	1.000	35296	2.000	64684	3.000	89851
021 500	150.00	81.00	8.00	7.50	11.70	3.70	732.900	0.925	34518	1.850	63877	2.775	89532
021 600	150.00	81.00	10.00	9.30	13.00	3.00	908.800	0.750	50088	1.500	96121	2.250	139128
021 650 **C**	**160.00**	**82.00**	**4.30**		9.90	5.60	492.200	1.400	12162	2.800	18833	4.200	21843
021 750 **B**	**160.00**	**82.00**	**6.00**		10.50	4.50	679.800	1.125	17203	2.250	30431	3.375	41008
021 800 **A**	**160.00**	**82.00**	**10.00**	9.40	13.50	3.50	1089.000	0.875	50547	1.750	96216	2.625	138331
021 850 **C**	**180.00**	**92.00**	**4.80**		11.00	6.20	705.300	1.550	14646	3.100	22731	4.650	26442
021 950 **B**	**180.00**	**92.00**	**6.00**		11.10	5.10	862.500	1.275	16558	2.550	28552	3.825	37502
022 000 **A**	**180.00**	**92.00**	**10.00**	9,40	14.00	4.00	1381.000	1.000	46850	2.000	88141	3.000	125417
022 100	200.00	82.00	8.00	7.60	14.20	6.20	1554.000	1.550	35029	3.100	60013	4.650	78034
022 200	200.00	82.00	10.00	9.60	15.50	5.50	1962.000	1.375	51105	2.750	93357	4.125	129445
022 300	200.00	82.00	12.00	11.50	16.60	4.60	2351.000	1.150	66924	2.300	127191	3.450	182737
022 400	200.00	92.00	10.00	9.50	15.60	5.60	1840.000	1.400	55136	2.800	100014	4.200	137688
022 500	200.00	92.00	12.00	11.40	16.80	4.80	2208.000	1.200	73913	2.400	139548	3.600	199269
022 600	200.00	92.00	14.00	13.10	18.10	4.10	2537.000	1.025	95633	2.050	184092	3.075	267227
022 650 **C**	**200.00**	**102.00**	**5.50**		12.50	7.00	999.300	1.750	19817	3.500	30882	5.250	36111
022 700 **B**	**200.00**	**102.00**	**8.00**	7.50	13.60	5.60	1363.000	1.400	33367	2.800	57955	4.200	76378
022 800	200.00	102.00	10.00	9.40	15.60	5.60	1708.000	1.400	58757	2.800	106099	4.200	145357
022 900 **A**	**200.00**	**102.00**	**12.00**	11.25	16.20	4.20	2044.000	1.050	66983	2.100	127401	3.150	183020
023 000	200.00	102.00	14.00	13.10	18.20	4.20	2380.000	1.050	103781	2.100	199476	3.150	289181
023 100	200.00	112.00	12.00	11.10	16.20	4.20	1870.000	1.050	72257	2.100	136873	3.150	195830
023 200	200.00	112.00	14.00	12.90	17.50	3.50	2173.000	0.875	91033	1.750	176156	2.625	256758

Original SCHNORR® disc springs standard material — dia. 200 - 250 mm

Article number/ Order reference	Ordering dimensions						Weight	Spring travel s and force F					
							per 1000 pieces	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e [mm]	D_i [mm]	t [mm]	t' [mm]	l_o [mm]	h_o [mm]	[kg]	s [mm]	F [N]	s [mm]	F [N]	s [mm]	F [N]
023 300	200.00	112.00	16.00	14.80	18.80	2.80	2493.000	0.700	105268	1.400	206697	2.100	305100
023 350 **C**	**225.00**	**112.00**	**6.50**	6.20	13.60	7.10	1450.000	1.775	23583	3.550	37417	5.325	44580
023 400 **B**	**225.00**	**112.00**	**8.00**	7.50	14.50	6.50	1754.000	1.625	32870	3.250	55412	4.875	70749
023 500 **A**	**225.00**	**112.00**	**12.00**	11.25	17.00	5.00	2631.000	1.250	64497	2.500	120738	3.750	171016
023 600	250.00	102.00	10.00	9.60	18.00	8.00	3075.000	2.000	56867	4.000	97282	6.000	126387
023 700	250.00	102.00	12.00	11.50	19.00	7.00	3683.000	1.750	73563	3.500	133131	5.250	182962
023 750 **C**	**250.00**	**127.00**	**7.00**	6.70	14.80	7.80	1909.000	1.950	26895	3.900	42527	5.850	50466
023 800 **B**	**250.00**	**127.00**	**10.00**	9.40	17.00	7.00	2678.000	1.750	51871	3.500	90206	5.250	119053
023 900	250.00	127.00	12.00	11.25	19.30	7.30	3205.000	1.825	87633	3.650	156021	5.475	210806
024 000 **A**	**250.00**	**127.00**	**14.00**	13.10	19.60	5.60	3732.000	1.400	93239	2.800	175145	4.200	248828
024 100	250.00	127.00	16.00	15.00	21.80	5.80	4273.000	1.450	140941	2.900	267296	4.350	383017

Corrosion-resistant SCHNORR® disc springs, material 1.4310 (X10 CrNi 18-8) — dia. 6 - 15 mm

Article number/ Order reference	Ordering dimensions					Weight	Spring travel s and force F					
						per 1000 pieces	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e [mm]	D_i [mm]	t [mm]	l_o [mm]	h_o [mm]	[kg]	s [mm]	F [N]	s [mm]	F [N]	s [mm]	F [N]
024 650	6.00	3.20	0.30	0.45	0.15	0.047	0.038	41	0.075	77	0.113	110
025 250	8.00	3.20	0.20	0.40	0.20	0.066	0.050	11	0.100	19	0.150	24
025 400	8.00	3.20	0.30	0.55	0.25	0.098	0.063	42	0.125	73	0.188	96
025 700	8.00	3.20	0.40	0.55	0.15	0.131	0.038	45	0.075	87	0.113	126
026 300	8.00	3.20	0.50	0.70	0.20	0.166	0.050	119	0.100	227	0.150	330
026 700	8.00	4.20	0.20	0.45	0.25	0.057	0.063	20	0.125	31	0.188	36
027 100	8.00	4.20	0.30	0.50	0.20	0.085	0.050	34	0.100	61	0.150	84
027 400	8.00	4.20	0.40	0.60	0.20	0.113	0.050	72	0.100	136	0.150	193
028 910	10.00	3.20	0.30	0.65	0.35	0.165	0.088	47	0.175	75	0.263	91
029 101	10.00	3.20	0.40	0.70	0.30	0.220	0.075	69	0.150	123	0.225	165
029 301	10.00	3.20	0.50	0.70	0.20	0.274	0.050	73	0.100	140	0.150	203
029 602	10.00	4.20	0.40	0.70	0.30	0.202	0.075	73	0.150	130	0.225	175
029 701	10.00	4.20	0.50	0.70	0.20	0.252	0.050	77	0.100	148	0.150	214
030 290	10.00	5.20	0.25	0.55	0.30	0.112	0.075	28	0.150	45	0.225	53
030 800	10.00	5.20	0.40	0.65	0.25	0.179	0.063	62	0.125	113	0.188	157
031 000	10.00	5.20	0.50	0.70	0.20	0.223	0.050	85	0.100	163	0.150	237
032 040	12.00	4.20	0.40	0.80	0.40	0.309	0.100	79	0.200	130	0.300	165
032 500	12.00	4.20	0.50	0.80	0.30	0.386	0.075	86	0.150	158	0.225	220
032 704	12.00	4.20	0.60	0.85	0.25	0.463	0.063	111	0.125	213	0.188	308
033 400	12.00	5.20	0.50	0.80	0.30	0.357	0.075	91	0.150	166	0.225	232
033 500	12.00	5.20	0.60	0.85	0.25	0.429	0.063	118	0.125	225	0.188	325
034 200	12.00	6.20	0.50	0.85	0.35	0.323	0.088	123	0.175	221	0.263	301
034 550	12.00	6.20	0.60	0.85	0.25	0.387	0.063	128	0.125	245	0.188	355
035 040	12.50	5.20	0.50	0.85	0.35	0.395	0.088	103	0.175	184	0.263	251
035 103	12.50	6.20	0.35	0.80	0.45	0.253	0.113	77	0.225	120	0.338	140
035 400	12.50	6.20	0.50	0.85	0.35	0.361	0.088	111	0.175	198	0.263	271
035 601	12.50	6.20	0.70	0.95	0.25	0.504	0.063	178	0.125	344	0.188	503
038 353	14.00	7.20	0.35	0.80	0.45	0.310	0.113	63	0.225	98	0.338	114
038 600	14.00	7.20	0.50	0.90	0.40	0.442	0.100	111	0.200	194	0.300	258
039 040	14.00	7.20	0.80	1.05	0.25	0.706	0.063	213	0.125	414	0.188	609
039 500	15.00	5.20	0.40	0.95	0.55	0.486	0.138	93	0.275	142	0.413	162
039 800	15.00	5.20	0.50	1.00	0.50	0.607	0.125	123	0.250	204	0.375	257
039 971	15.00	5.20	0.60	1.05	0.45	0.728	0.113	158	0.225	279	0.338	376

Corrosion-resistant SCHNORR® disc springs, material 1.4310 (X10 CrNi 18-8) dia. 15 - 25 mm

Article number/ Order reference	Ordering dimensions					Weight	Spring travel s and force F					
						per 1000	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e	D_i	t	l_o	h_o	pieces	s	F	s	F	s	F
	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]	[mm]	[N]	[mm]	[N]	[mm]	[N]
040 130	15.00	5.20	0.70	1.10	0.40	0.849	0.100	197	0.200	365	0.300	512
040 950	15.00	6.20	0.50	1.00	0.50	0.572	0.125	128	0.250	212	0.375	267
041 301	15.00	6.20	0.60	1.00	0.40	0.687	0.100	137	0.200	248	0.300	341
041 700	15.00	6.20	0.70	1.05	0.35	0.801	0.088	172	0.175	323	0.263	461
042 400	15.00	8.20	0.70	1.00	0.30	0.677	0.075	164	0.150	312	0.225	451
042 601	15.00	8.20	0.80	1.10	0.30	0.773	0.075	238	0.150	459	0.225	668
043 750	16.00	8.20	0.40	0.90	0.50	0.464	0.125	77	0.250	121	0.375	142
044 000	16.00	8.20	0.60	1.05	0.45	0.695	0.113	159	0.225	281	0.338	378
044 101	16.00	8.20	0.70	1.05	0.35	0.811	0.088	167	0.175	313	0.263	446
044 201	16.00	8.20	0.80	1.10	0.30	0.926	0.075	200	0.150	386	0.225	562
044 400	16.00	8.20	0.90	1.20	0.30	1.042	0.075	280	0.150	543	0.225	796
045 800	18.00	6.20	0.40	1.00	0.60	0.702	0.150	78	0.300	116	0.450	128
046 003	18.00	6.20	0.50	1.10	0.60	0.878	0.150	120	0.300	190	0.450	226
046 252	18.00	6.20	0.60	1.20	0.60	1.053	0.150	176	0.300	293	0.450	369
046 400	18.00	6.20	0.70	1.25	0.55	1.228	0.138	218	0.275	382	0.413	510
046 505	18.00	6.20	0.80	1.30	0.50	1.403	0.125	264	0.250	482	0.375	669
046 924	18.00	8.20	0.50	1.10	0.60	0.789	0.150	129	0.300	205	0.450	244
047 070	18.00	8.20	0.70	1.20	0.50	1.104	0.125	203	0.250	362	0.375	492
047 300	18.00	8.20	0.80	1.25	0.45	1.262	0.113	247	0.225	457	0.338	643
047 691	18.00	8.20	1.00	1.35	0.35	1.576	0.088	335	0.175	649	0.263	948
047 910	18.00	9.20	0.45	1.05	0.60	0.662	0,150	111	0.300	171	0.450	197
048 050	18.00	9.20	0.70	1.20	0.50	1.029	0.125	215	0.250	384	0.375	522
048 098	18.00	9.20	1.00	1.35	0.35	1.469	0.088	356	0.175	689	0.263	1006
048 051	20.00	8.20	0.50	1.15	0.65	1.029	0.163	118	0.325	183	0.488	213
051 100	20.00	8.20	0.60	1.30	0.70	1.226	0.175	198	0.350	316	0.525	380
052 270	20.00	8.20	0.70	1.35	0.65	1.430	0.163	241	0.325	408	0.488	524
051 450	20.00	8.20	0.80	1.40	0,60	1.634	0.150	291	0.300	514	0.450	693
051 701	20.00	8.20	0.90	1.45	0.55	1.838	0.138	345	0.275	632	0.413	880
051 761	20.00	8.20	1.00	1.45	0.45	2.042	0.113	352	0.225	669	0.338	962
052 803	20.00	10.20	0.50	1.15	0.65	0.910	0.163	130	0.325	202	0.488	234
052 804	20.00	10.20	0.60	1.20	0.60	1.098	0.150	163	0.300	271	0.450	342
053 500	20.00	10.20	0.80	1.35	0.55	1.454	0.138	281	0.275	504	0.413	690
053 701	20.00	10.20	0.90	1.40	0.50	1.635	0.125	334	0.250	619	0.375	872
053 901	20.00	10.20	1.00	1.40	0.40	1.817	0.100	336	0.200	645	0.300	936
054 380	20.00	10.20	1.10	1.50	0.40	1.998	0.100	440	0.200	850	0.300	1240
0552 80	20.00	10.20	1.25	1.55	0.30	2.269	0.075	463	0.150	911	0.225	1349
055 650	20.00	10.20	1.50	1.75	0.25	2.721	0.063	654	0.125	1297	0.188	1934
057 710	22.50	11.20	0.60	1.40	0.80	1.406	0.200	222	0.400	341	0.600	393
057 903	22.50	11.20	0.80	1.45	0.65	1.873	0.163	283	0.325	492	0.488	653
058 050	22.50	11.20	1.25	1.65	0.40	2.924	0.100	494	0.200	961	0.300	1411
058 950	23.00	8.20	0.70	1.50	0.80	1.987	0.200	258	0.400	414	0.600	501
059 210	23.00	8.20	0.80	1.55	0.75	2.271	0.188	306	0.375	517	0.563	663
059 400	23.00	8.20	0.90	1.60	0.70	2.554	0.175	361	0.350	633	0.525	848
059 504	23.00	8.20	1.00	1.60	0.60	2.838	0.150	375	0.300	689	0.450	962
060 460	23.00	10.20	0.90	1.55	0.65	2.352	0.163	341	0.325	608	0.488	825
060 600	23.00	10.20	1.00	1.60	0.60	2.613	0.150	398	0.300	731	0.450	1020
060 901	23.00	10.20	1.25	1.70	0.45	3.264	0.113	512	0.225	989	0.338	1444
001 922	23.00	12.20	1.00	1.60	0.60	2.337	0.150	438	0.300	804	0.450	1122
061 600	23.00	12.20	1.25	1.65	0.40	2.919	0.100	492	0.200	958	0.300	1406
061 951	23.00	12.20	1.50	1.85	0.35	3.501	0.088	722	0.175	1423	0.263	2110
063 872	25.00	10.20	1.00	1.70	0.70	3.205	0.175	409	0.350	732	0.525	998

Corrosion-resistant SCHNORR® disc springs, material 1.4310 (X10 CrNi 18-8) dia. 31.5 - 56 mm

Article number/ Order reference	Ordering dimensions					Weight	Spring travel s and force F					
						per 1000	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e	D_i	t	l_o	h_o	pieces	s	F	s	F	s	F
	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]	[mm]	[N]	[mm]	[N]	[mm]	[N]
082 253	31.50	12.20	1.00	2.10	1.10	5.191	0.275	541	0.550	877	0.825	1076
081 505	31.50	12.20	1.25	2.15	0.90	6.486	0.225	646	0.450	1152	0.675	1564
082 303	31.50	12.20	1.50	2.25	0.75	7.781	0.188	808	0.375	1519	0.563	2164
082 801	31.50	16.30	0.80	1.85	1.05	3.577	0.263	355	0.525	548	0.788	634
083 370	31.50	16.30	1.25	2.00	0.75	5.584	0.188	561	0.375	1029	0.563	1437
083 800	31.50	16.30	1.50	2.15	0.65	6.698	0.163	763	0.325	1454	0.488	2097
084 493	31.50	16.30	1.75	2.30	0.55	7.811	0.138	972	0.275	1892	0.413	2779
084 800	31.50	16.30	2.00	2.50	0.50	8.923	0.125	1289	0.250	2534	0.375	3750
087 900	34.00	12.30	1.00	2.25	1.25	6.187	0.313	588	0.625	920	0.938	1083
088 046	34.00	12.30	1.25	2.35	1.10	7.732	0.275	752	0.550	1287	0.825	1677
088 300	34.00	12.30	1.50	2.40	0.90	9.275	0.225	872	0.450	1600	0.675	2234
089 321	34.00	14.30	1.25	2.30	1.05	7.321	0.263	723	0.525	1250	0.788	1646
089 400	34.00	14.30	1.50	2.35	0.85	8.783	0.213	837	0.425	1549	0.638	2178
090 500	34.00	16.30	1.50	2.30	0.80	8.216	0.200	815	0.400	1520	0.600	2151
091 100	34.00	16.30	2.00	2.60	0.60	10.946	0.150	1293	0.300	2523	0.450	3713
004 543	35.50	18.30	0.90	2.05	1.15	5.132	0.288	422	0.575	657	0.863	767
093 683	35.50	18.30	2.00	2.65	0.65	11.325	0.163	1352	0.325	2628	0.488	3855
094 000	35.50	18.30	1.25	2.25	1.00	7.124	0.250	674	0.500	1178	0.750	1567
093 683	35.50	18.30	2.00	2.65	0.65	11.385	0.163	1352	0.325	2628	0.488	3855
099 423	40.00	14.30	1.25	2.65	1.40	10.752	0.350	834	0.700	1346	1.050	1642
099 461	40.00	14.30	1.50	2.75	1.25	12.899	0.313	1028	0.625	1780	0.938	2348
099 833	40.00	14.30	2.00	2.90	0.90	17.189	0.225	1365	0.450	2593	0.675	3729
100 503	40.00	16.30	1.50	2.70	1.20	12.332	0.300	992	0.600	1732	0.900	2304
100 801	40.00	16.30	2.00	2.90	0.90	16.433	0.225	1406	0.450	2671	0.675	3842
101 755	40.00	18.30	2.00	2.85	0.85	15.584	0.213	1367	0.425	2610	0.638	3770
102 531	40.00	20.40	1.00	2.30	1.30	7.300	0.325	521	0.650	808	0.975	938
103 000	40.00	20.40	1.50	2.60	1.10	10.942	0.275	955	0.550	1697	0.825	2296
103 500	40.00	20.40	2.00	2.80	0.80	14.580	0.200	1345	0.400	2580	0.600	3743
103 953	40.00	20.40	2.25	2.95	0.70	16.397	0.175	1613	0.350	3143	0.525	4618
104 465	40.00	20.40	2.50	3.15	0.65	18.212	0.163	2017	0.325	3961	0.488	5856
110 412	45.00	22.40	1.25	2.90	1.65	11.746	0.413	1023	0.825	1578	1.238	1822
110 501	45.00	22.40	1.75	2,95	1.20	16.434	0.300	1247	0.600	2241	0.900	3068
110 901	45.00	22.40	2.50	3.35	0.85	23.457	0.213	2116	0.425	4105	0.638	6008
115 970	50.00	18.40	1.25	2.85	1.60	16.679	0.400	698	0.800	1086	1.200	1268
116 300	50.00	18.40	1.50	3.30	1.80	20.011	0.450	1272	0.900	2015	1.350	2404
116 653	50.00	18.40	2.00	3.45	1.45	26.669	0.363	1680	0.725	2990	1.088	4054
116 901	50.00	18.40	2.50	3.65	1.15	33.323	0.288	2203	0.575	4176	0.863	5996
117 400	50.00	20.40	2.00	3.40	1.40	25.710	0.350	1634	0.700	2927	1.050	3993
117 703	50.00	20.40	2.50	3.60	1.10	32.123	0.275	2138	0.550	4070	0.825	5864
118 401	50.00	22.40	2.00	3.30	1.30	24.652	0.325	1515	0.650	2747	0.975	3792
000 227	50.00	22.40	2.50	3.60	1.10	30.800	0.275	2209	0.550	4204	0.825	6057
119 950	50.00	25.40	1.25	2.85	1.60	14.248	0.400	787	0.800	1225	1.200	1430
120 103	50.00	25.40	1.50	3.10	1.60	17.168	0.400	1145	0.800	1871	1.200	2317
120 400	50.00	25.40	2.00	3.30	1.30	22.878	0.325	1613	0.650	2926	0.975	4039
120 801	50.00	25.40	2.50	3.50	1.00	28.582	0.250	2097	0.500	4022	0.750	5834
128 599	56.00	28.50	1.50	3.45	1.95	21.495	0.488	1345	0.975	2084	1.463	2419
128 600	56.00	28.50	2.00	3.60	1.60	28.646	0.400	1761	0.800	3076	1.200	4093

Corrosion-resistant SCHNORR® disc springs, material 1.4310 (X10 CrNi 18-8) dia. 60 - 90 mm

Article number/ Order reference	Ordering dimensions					Weight	Spring travel s and force F					
						per 1000	at s = 0.25 h_o		at s = 0.50 h_o		at s ≈ 0.75 h_o	
	D_e	D_i	t	l_o	h_o	pieces	s	F	s	F	s	F
	[mm]	[mm]	[mm]	[mm]	[mm]	[kg]	[mm]	[N]	[mm]	[N]	[mm]	[N]
131 001	60.00	20.50	2.00	4.10	2.10	39.235	0.525	2138	1.050	3507	1.575	4363
003 158	60.00	20.50	2.50	4.05	1.55	49.027	0.388	2239	0.775	4092	1.163	5687
131 801	60.00	25.50	2.50	4.10	1.60	45.471	0.400	2463	0.800	4479	1.200	6196
113 193	60.00	30.50	2.50	4.00	1.50	41.157	0.375	2444	0.750	4488	1.125	6265
138 221	63.00	31.00	1.80	4.10	2.30	33.419	0.575	2086	1.150	3248	1.725	3792
138 503	63.00	31.00	2.50	4.15	1.65	46.389	0.413	2489	0.825	4504	1.238	6202
144 401	70.00	25.50	2.00	4.50	2.50	52.479	0.625	2221	1.250	3478	1.875	4093
146 250	70.00	30.50	2.50	4.70	2.20	61.266	0.550	2984	1.100	5106	1.650	6653
153 014	71.00	36.00	2.00	4.60	2.60	46.249	0.650	2639	1.300	4088	1.950	4744
153 110	71.00	36.00	2.50	4.50	2.00	57.789	0.500	2669	1.000	4662	1.500	6203
159 600	80.00	31.00	2.50	5.30	2.80	84.001	0.700	3393	1.400	5472	2.100	6677
161 220	80.00	41.00	2.25	5.20	2.95	65.586	0.738	3410	1.475	5271	2.213	6099
169 200	90.00	46.00	2.50	5.70	3.20	92.370	0.800	3903	1.600	6073	2.400	7087

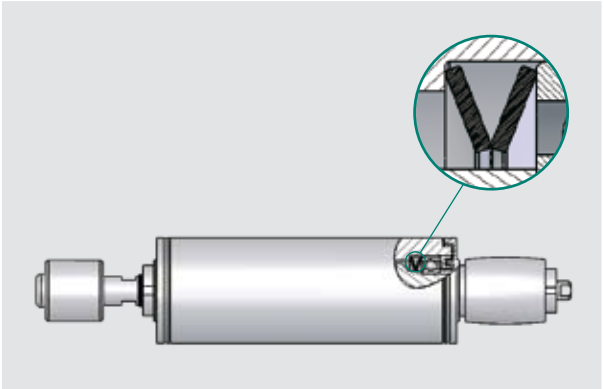
The original SCHNORR® bearing preload springs "K" series

The optimal supplement for ball bearings

Two problems continually occupy design engineers using bearings, the reduction in noise and the elimination of play in ball bearings. A solution of both these problems has been achieved by Schnorr working in close cooperation with SKF. The fitting of a special version of our disc springs effectively reduces both problems and frequently results in simpler designs.

Fitting of bearing preload springs

The drawing illustrates how the outer ring of the ball bearing usually is correctly preloaded using a disc spring "K" series. Depending on the requirements of the design, one or more disc springs can be used. In some cases it is preferable to preload the inner ring of the bearing. That is why the bore holes of disc springs for ball bearings were chosen in such a way that they match the internal diameter of an other ball bearing size. That way, a disc spring suitable for pushing the external ring of the ball bearing 6302, for example, can also be used to pretension the inner rings of the ball bearings 6205 and 6305.



Bearing preload spring

Key advantages speak for bearing preload springs

An important advantage of "K" disc springs is their shape of a simple ring. That ensures an equal bearing surface when multiple discs are installed. As with standard disc springs, here it also applies that in alternating arrangement with the constant force the spring deflections add up, while in case of parallel layering (same laying in) with constant spring deflection the loads add up (see figure page 7). As all springs have a strongly digressive spring characteristic (great h_o/t), the spring force continues to be almost constant over a large deflection range.

Apart from the compensation for play, this brings the following advantages:

- The tolerance built up in the assembly can be accomodated without significant change in preload.
- Length variations due to heat impact are absorbed
- Any subsequent axial movement of the assembly does not alter the preload significantly.

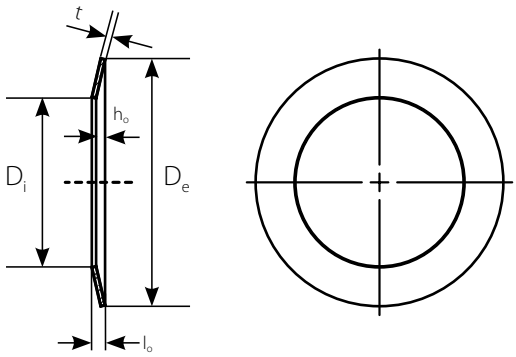
Original SCHNORR® bearing preload springs type "K", non-slotted

How to order

When ordering "K" disc springs to preload the outer ring of the ball bearing please quote the ball bearing size or the article number. In all other cases, please give application details.

Notes on the table

The "K" disc spring sizes listed in the following tables are our standard production and comply with ball bearing series EL, R, 62 and 63. The load and deflections given are at spring deflection of 75 % of the free height h_o. This is the recommended preload for installation of the "K" disc springs.



Designation of a disc spring

D_e = 41.6 mm, D_i = 25.5 mm, t = 0.5 mm

Original SCHNORR® bearing preload springs type "K", non-slotted — **dia. 9.8 - 119 mm**

Article number/ Order reference	Ordering dimensions						Spring travel s and force F		Weight	Ball bearing type			Ball bearing			
							at s ≈ 0.75 h_o		per 1000				External	Internal		
	D_e	D_i	t	l_o	h_o	h_o/t	s	F	pieces				dia	dia		
	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[N]	[kg]				[mm]	[mm]		
241200	9.80	6.20	0.20	0.40	0.20	1.00	0.15	23	0.07	623 (EL3)			10	3		
241 400	12.80	7.20	0.25	0.50	0.25	1.00	0.19	29	0.17	624 (EL4)			13	4		
241 600	15.80	8.20	0.25	0.55	0.30	1.20	0.23	23	0.28	625 (EL5)	634 (R4)		16	5	4	
241 700	18.80	9.20	0.30	0.65	0.35	1.17	0.26	31	0.49	626 (EL6)	635 (R5)		16	6	5	
241 800	18.80	10.20	0.35	0.70	0.35	1.00	0.26	51	0.53	607 (EL7)			19	7		
241 900	21.80	12.30	0.35	0.75	0.40	1.14	0.30	46	0.68	608 (EL8)	627 (R7)		22	8	7	
242 100	23.70	14.30	0.40	0.90	0.50	1.25	0.38	81	0.86	609 (EL9)			24	9		
242 200	25.70	14.30	0.40	0.90	0.50	1.25	0.38	63	1.11	6000	629 (R9)		26	10	9	
242 300	27.70	17.30	0.40	1.00	0.60	1.50	0.45	80	1.13	6001			28	12		
242 500	29.70	17.40	0.40	1.10	0.70	1.75	0.53	83	1.41		6200		30		10	
242 600	31.70	20.40	0.40	1.10	0.70	1.75	0.53	81	1.42	6002	6201		32	15	12	
242 800	34.60	20.40	0.40	1.10	0.70	1.75	0.53	61	1.89			6300	35			10
242 900	34.60	22.40	0.50	1.20	0.70	1.40	0.53	118	2.10	6003	6202		35	17	15	
243 000	36.60	20.40	0.50	1.30	0.80	1.60	0.60	110	2.81			6301	37			12
243 100	39.60	25.50	0.50	1.30	0.80	1.60	0.60	110	2.78		6203		40		17	
243 200	41.60	25.50	0.50	1.40	0.90	1.80	0.68	113	3.28	6004		6302	42	20		15
243 300	46.50	30.50	0.60	1.50	0.90	1.50	0.68	153	4.49	6005	6204	6303	47	25	20	17
243 400	51.50	35.50	0.60	1.50	0.90	1.50	0.68	135	5.06		6205	6304	52		25	20
243 500	54.50	40.50	0.60	1.50	0.90	1.50	0.68	141	4.82	6006			55	30		
243 600	61.50	40.50	0.70	1.80	1.10	1.57	0.83	176	9.12	6007	6206	6305	62	35	30	25
243 700	67.50	50.50	0.70	1.70	1.00	1.43	0.75	161	8.51	6008			68	40		
243 800	71.50	45.50	0.70	2.10	1.40	2.00	1.05	185	12.99			6306	72			30
243 900	71.50	50.50	0.70	2.10	1.40	2.00	1.05	218	10.90		6207		72		35	
244 000	74.50	55.50	0.80	1.90	1.10	1.38	0.83	211	11.99	6009			75	45		
244 100	79.50	50.50	0.80	2.30	1.50	1.88	1.13	228	18.40			6307	80			35
244 200	79.50	55.50	0.80	2.30	1.50	1.88	1.13	263	15.78	6010	6208		80	50	40	
244 300	84.50	60.50	0.90	2.50	1.60	1.78	1.20	359	19.05		6209		85		45	
244 400	89.50	60.50	0.90	2.50	1.60	1.78	1.20	288	23.86			6308	90			40
244 500	89.50	65.50	0.90	2.50	1.60	1.78	1.20	335	20.36	6011	6210		90	55	50	
244 600	94.50	75.50	1.00	2.20	1.20	1.20	0.90	325	19.57	6012			95	60		
244 700	99.00	65.50	1.00	2.60	1.60	1.60	1.20	292	33.64			6309	100			45
244 800	99.00	70.50	1.00	2.60	1.60	1.60	1.20	332	29.44	6013	6211		100	65	55	
244 900	109.00	70.50	1.25	2.70	1.45	1.16	1.09	357	52.80			6310	110			50
245 000	109.00	75.50	1.25	2.70	1.45	1.16	1.09	398	47.17	6014	6212		110	70	60	
245 100	114.00	90.50	1.25	2.45	1.20	0.96	0.90	398	36.49	6015			115	75		
245 200	119.00	75.50	1.25	2.80	1.55	1.24	1.16	320	64.71			6311	120			55

Original SCHNORR® bearing preload springs type "K", non-slotted — dia. 119 - 358 mm

Article number/ Order reference	Ordering dimensions						Spring travel s and force F		Weight	Ball bearing type			Ball bearing			
							at s ≈ 0.75 h_o		per 1000				External	Internal		
	D_e	D_i	t	l_o	h_o	h_o/t	s	F	pieces				dia	dia		
	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[N]	[kg]				[mm]	[mm]		
245 300	119.00	85.50	1.25	2.80	1.55	1.24	1.16	393	52.28		6213		120		65	
245 400	124.00	90.50	1.25	3.00	1.75	1.40	1.31	445	54.75	6016	6214		125	80	70	
245 500	129.00	85.50	1.25	3.20	1.95	1.56	1.46	405	71.28			6312	130			60
245 600	129.00	95.50	1.25	3.20	1.95	1.56	1.46	500	57.31	6017	6215		130	85	75	
245 700	139.00	90.50	1.25	3.25	2.00	1.60	1.50	354	85.11			6313	140			65
245 800	139.00	101.00	1.25	3.25	2.00	1.60	1.50	429	69.58	6018	6216		140	90	80	
245 900	149.00	95.50	1.50	3.20	1.70	1.13	1.28	379	120.10			6314	150			70
246 000	149.00	106.00	1.50	3.20	1.70	1.13	1.28	450	100.50	6020	6217		150	100	85	
246 100	159.00	101.00	1.50	3.50	2.00	1.33	1.50	412	138.50			6315	160			75
246 200	159.00	111.00	1.50	3.50	2.00	1.33	1.50	477	118.90	6021	6218		160	105	90	
246 300	169.00	111.00	1.50	3.80	2.30	1.53	1.73	470	149.20			6316	170			80
246 400	169.00	121.00	1.50	3.80	2.30	1.53	1.73	546	127.70	6022	6219		170	110	95	
246 500	179.00	121.00	2.00	4.20	2.20	1.10	1.65	864	213.10			6317	180			95
246 600	179.00	126.00	2.00	4.20	2.20	1.10	1.65	928	197.80	6024	6220		180	120	100	
246 700	189.00	121.00	2.00	4.30	2.30	1.15	1.73	759	258.30			6318	190			90
246 800	189.00	131.00	2.00	4.30	2.30	1.15	1.73	858	227.10		6221		190		105	
246 900	198.00	131.00	2.00	4.50	2.50	1.25	1.88	812	270.00			6319	200			95
247 000	198.00	141.00	2.00	4.50	2.50	1.25	1.88	923	236.40	6026	6222		200	130	110	
247 100	213.00	151.00	2.25	4.50	2.25	1.00	1.69	941	310.90		6224	6320	215		120	100
247 200	223.00	161.00	2.25	4.60	2.35	1.04	1.76	942	328.00	6030		6321	225	150		105
247 300	228.00	161.00	2.25	4.95	2.70	1.20	2.03	1036	359.20		6226		230		130	
247 400	238.00	161.00	2.25	5.25	3.00	1.33	2.25	1021	423.80	6032		6322	240	160		110
247 500	248.00	171.00	2.50	5.00	2.50	1.00	1.88	1005	494.50		6228		250		140	
247 600	258.00	171.00	2.50	5.50	3.00	1.20	2.25	1106	572.20	6034		6324	260	170		120
247 700	268.00	181.00	2.50	5.70	3.20	1.28	2.40	1155	598.70		6230		270		150	
247 800	278.00	181.00	2.50	6.00	3.50	1.40	2.63	1155	682.70	6036		6326	280	180		130
247 900	288.00	191.00	2.75	5.75	3.00	1.09	2.25	1145	783.70	6038	6232		290	190	160	
248 000	298.00	191.00	2.75	6.35	3.60	1.31	2.70	1307	883.00			6328	300			140
248 100	308.00	202.00	3.00	6.10	3.10	1.03	2.33	1300	995.20	6040	6234		310	200	170	
248 200	318.00	212.00	3.00	6.20	3.20	1.07	2.40	1302	1034.00		6236	6330	320		180	150
248 300	338.00	232.00	3.00	6.60	3.60	1.20	2.70	1415	1112.00	6044	6238	6332	340	220	190	160
248 400	358.00	242.00	3.00	7.00	4.00	1.33	3.00	1424	1281.00	6048	6240	6334	360	240	200	170

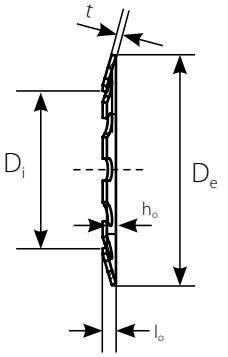
Original SCHNORR® bearing preload springs type "K", with slots

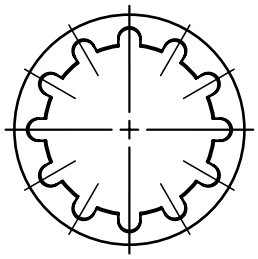
How to order

When ordering these sizes to preload the outer ring of the bearing, please quote the bearing size and the suffix "slotted" or the article number. In all other cases, please give application details.

Slotted version

This special design generates very small loads and accommodates large deflections.





Designation of a disc spring

D_e = 31.7 mm, D_i = 20.4 mm, t = 0.35 mm

Original SCHNORR® bearing preload springs type "K", slotted — **dia. 9.8 - 94.50 mm**

Article number/ Order reference	Ordering dimensions						Spring travel s and force F		Weight	Ball bearing type			Ball bearing			
							at s ≈ 0.75 h_o		per 1000				External	Internal		
	D_e	D_i	t	l_o	h_o	h_o/t	s	F	pieces				dia	dia		
	[mm]	[mm]	[mm]	[mm]	[mm]		[mm]	[N]	[kg]				[mm]	[mm]		
241 150	9.80	6.20	0.15	0.60	0.45	1.00	0.35	13	0.050	623(EL3)			10	3		
241 350	12.80	7.20	0.20	0.65	0.45	0.92	0.35	18	0.130	624(EL4)			13	4		
241 650	15.80	8.20	0.25	0.75	0.50	0.74	0.40	20	0.280	625(EL5)	634(R4)		16	5	4	
241 675	18.80	9.20	0.25	1.00	0.75	0.97	0.55	20	0.440	626(EL6)	635(R5)		16	6	5	
241 750	18.80	10.20	0.25	1.05	0.80	1.15	0.60	24	0.320	607(EL7)			19	7		
241 850	21.80	12.30	0.25	1.25	1.00	1.47	0.75	24	0.420	608(EL8)	627(R7)		22	8	7	
242 050	23.70	14.30	0.30	1.30	1.00	1.21	0.75	25	0.660	609(EL9)			24	9		
242 150	25.70	14.30	0.30	1.40	1.10	1.19	0.80	28	0.700	6000	629(R9)		26	10	9	
242 250	27.70	17.30	0.35	1.45	1.10	1.03	0.80	31	0.984	6001			28	12		
242 450	29.70	17.30	0.35	1.55	1.20	1.30	0.90	32	1.200		6200		30		10	
242 550	31.70	20.40	0.35	1.55	1.20	1.30	0.90	33	1.270	6002	6201		32	15	12	
242 750	34.60	20.40	0.40	1.65	1.25	1.10	1.00	32	1.650			6300	35			10
242 850	34.60	22.40	0.35	1.55	1.20	1.18	0.90	32	1.500	6003	6202		35	17	15	
242 950	36.60	20.40	0.40	1.90	1.50	1.44	1.10	35	2.280			6301	37			12
243 050	39.60	25.50	0.40	1.90	1.50	1.22	1.10	37	1.920		6203		40		17	
243 150	41.60	25.50	0.45	2.05	1.60	1.13	1.20	39	2.500	6004		6302	42	20		15
243 250	46.50	30.50	0.45	2.05	1.60	1.11	1.20	44	2.840	6005	6204	6303	47	25	20	17
243 350	51.50	35.50	0.45	2.10	1.65	1.26	1.25	47	3.070		6205	6304	52		25	20
243 450	54.50	40.50	0.45	2.15	1.70	1.75	1.30	53	3.200	6006			55	30		
243 550	61.50	40.50	0.55	2.55	2.00	1.21	1.50	54	6.050	6007	6206	6305	62	35	30	25
243 650	67.50	50.50	0.55	2.60	2.05	1.36	1.60	78	5.500	6008			68	40		
243 750	71.50	45.50	0.60	2.90	2.30	1.47	1.70	74	9.600			6306	72			30
243 850	71.50	50.50	0.60	2.90	2.30	1.83	1.70	127	8.200		6207		72		35	
243 950	74.50	55.50	0.60	2.90	2.30	1.31	1.70	91	7.580	6009			75	45		
244 125	79.50	50.50	0.70	3.10	2.40	1.36	1.80	83	16.260			6307	80			35
244 150	79.50	55.50	0.70	2.90	2.20	1.51	1.65	127	14.500	6010	6208		80	50	40	
244 250	84.50	60.50	0.75	3.15	2.40	0.87	1.80	78	13.000		6209		85		45	
244 350	89.50	60.50	0.80	3.30	2.50	1.08	1.90	104	18.100			6308	90			40
244 450	89.50	65.50	0.80	3.40	2.60	1.35	1.95	189	16.000	6011	6210		90	55	50	
244 550	94.50	75.50	0.80	3.45	2.65	1.39	2.00	206	13.300	6012			95	60		

Engineering – thoroughly dealing with elaborate customized solutions.

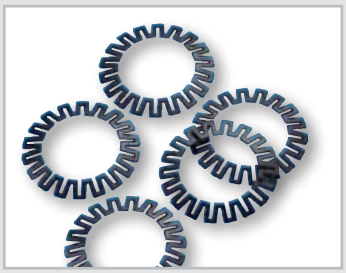
We specialized in developing tailor-made solutions in partnership with our customers; be it in new applications, increasing quality and capacity requirements or specific materials. Our inhouse testing facilities permit sampling or 100% volume inspection according to customer and quality standard requirements.

To facilitate this process we can utilise highly skilled specialists, latest construction tools, specialized manufacturing processes in the appropriate machinery and 100 years experience.

SCHNORR® provide top quality specialised parts from single item to large scale production as well as first class standard products. Our in-house test facilities permit sampling or 100% volume inspection according to customer and quality standard requirements

The fields of application know no bounds. Only some examples are listed below:

- elastic cover plates
- thermal shields
- damper
- fixation
- holding plate
- spring for bayonet lock
- springs for damper elements
- special springs in motor sports



Star springs for very low loads

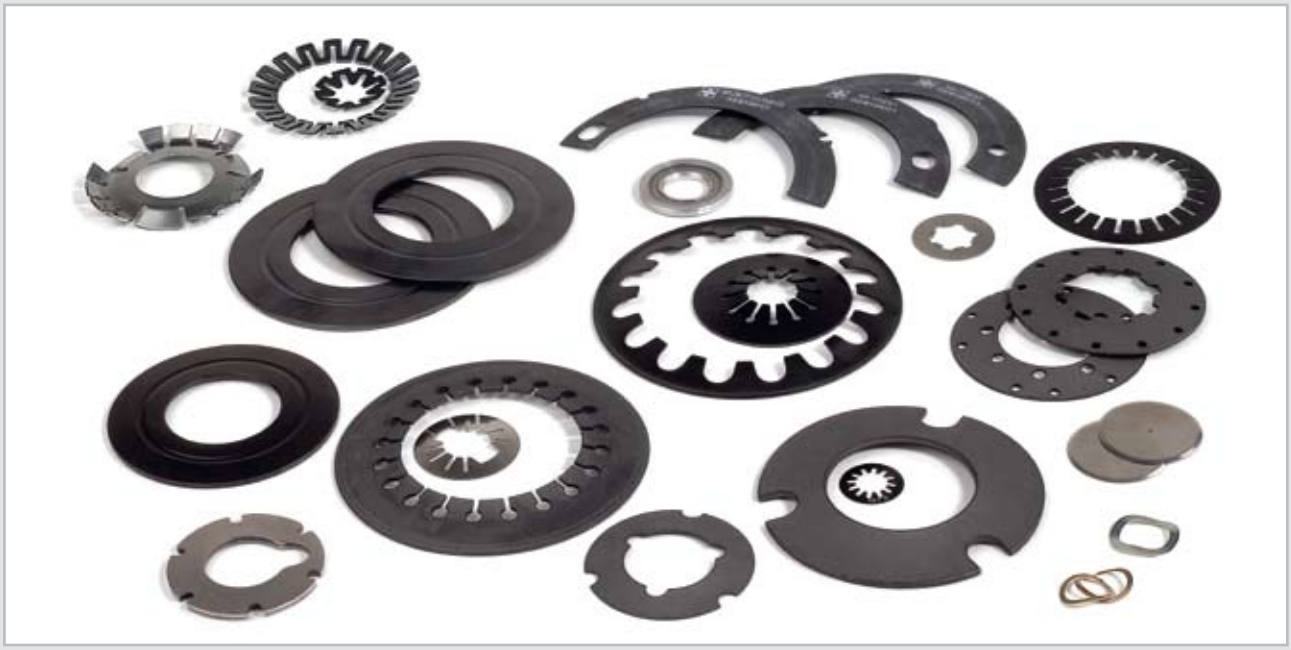
Springs for pressure limitation

Springs slotted on the inside diameter

Dampers

Converted spring columns,
100 % load checked

Gearbox dished washer



Springs with slots on inside and outside diameter

Formed metal plates with a spring function

Pre-assembled spring units

Applications, for example, in slip clutches for torque transformers in hammer drills

We withstand pressure – or hold it.

For example safety systems in power plants (coal- or gas-fired)

Mowing machine

Special safety washer

Heavy-duty crane

Safety washer

Motorbike

Safety washer

Original SCHNORR® safety washers.

The original SCHNORR® safety washers were developed as a reliable and economic bolt locking device with the basic principle of a disc spring. This ingenious form combines the advantage of security through friction and mechanical locking.

Original SCHNORR® safety washers are now used world wide where secure fastening connections to counter the effect of vibration are required.

Applications are manifold, from automotive engineering to machine, aggregate and plant engineering. SCHNORR® safety washers are used, for example, in mowing machines, textile machines, machine tools and a lot of other applications.

The original SCHNORR® safety washer

Offer the following advantages:

① High resistance to vibration due to positive locking of the serrations.

② Concentrical force transmission and uniform axial load eliminate bending torques and deformation of the bolt stem.

③ The design of the serrations prevents friction and damage to components when tightening.

④ Extremely high safety against loss of pretension force and loosening.

⑤ Wide variety for materials and different finishes.

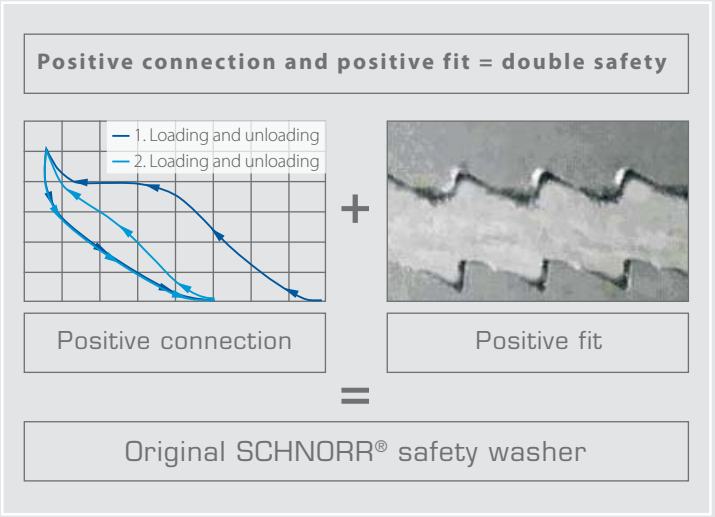
⑥ The closed ring form results in high degree of pretensioning, while avoiding burst-open effect.

⑦ Development and design of the washers take place on the basis of the screw geometrics, tightening torque as well as the constructive circumstances.

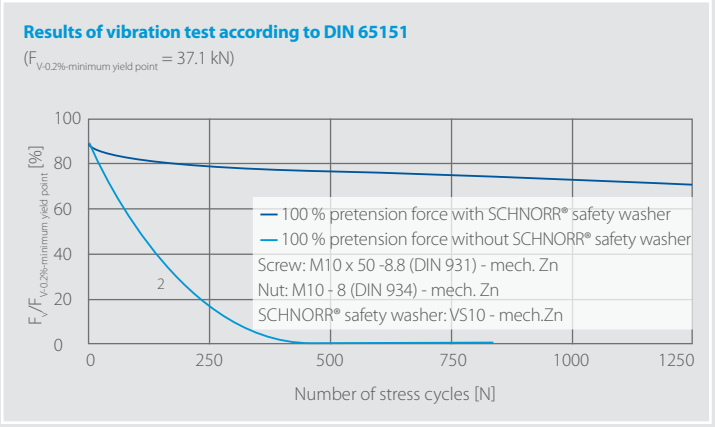
The original SCHNORR® safety washers are in the form of a disc spring but with a trapezoidal cross-section and serrations on both sides. The outer diameter is matched to the head diameter of the pan head and socket head cap screws.

SCHNORR® safety washers are available in two versions:
The standard safety washer type "S" is available for screws of sizes M1.6 to M36 and of the property classes up to 8.8.
For screws of property classes 8.8 and 10.9, higher pretension forces might be necessary. These are covered by our reinforced washers type "VS".

Due to the conical form, optimal traction is achieved at highest positive locking due to the helical gearing.



Vibration test according to DIN 65151



Extensive test series carried out at the "Staatliche Materialprüfungsanstalt" (public material research laboratory) in Darmstadt prove that the original SCHNORR® safety washer manufactured using the a patented manufacturing method brings about a clear improvement of the safety properties.

Conclusion

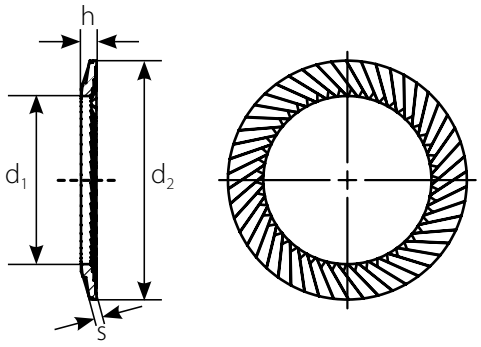
- Connections secured using a SCHNORR® safety washer maintains the pretension force also after 1,500 cycles.
- An unsecured screw connection has lost its pretension already after less than 500 cycles.

The original SCHNORR® safety washer type „S"

The Original SCHNORR® safety washer „S" is suitable for normal requirements and available for bolt sizes from M 1,6 to M 36 in grades up to 8.8. Please enquire should you require an item with different dimensions, material or surface treatment

Explanations on the table:

Article no.: applies to the normal version made of spring steel, hardened, blackened; mechanically galvanized
h max.: maximum dimension as delivered
h min.: minimum dimension after load test
Available material grades: spring steel acc. to DIN EN 10132-4; corrosion-resistant steel 1.4301; Phosphorus Bronze CuSn8; nickel cobalt alloy; creep-resistant steel 1.4122; Inconel
Surface treatments: blackened (standard), bronzed, phosphated, galvanized, zinc lamellar coatings



Sketch of an original SCHNORR® safety washer type "S":
Size 8 made of spring steel = safety washer S 8 FSt.

Original SCHNORR® safety washers type "S" material C60S (1.1211)

Article number/ Order reference	Finish	Size		Ordering dimensions					Packaging	
		Nominal size		d_1	d_2	s	$h_{min.}$	$h_{max.}$	Unit	Weight per 1000 pieces
		[mm]	[Inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[pcs.]	[kg]
402300 450 000	blackened Gal.Zn8 + passivation	1.6		1.7	3.2	0.35	0.4	0.6	2000	0.013
404 400 450 100	blackened Gal.Zn8 + passivation	2.0		2.2	4.0	0.35	0.40	0.6	2000	0.021
406 800 450 200	blackened Gal.Zn8 + passivation	2.5		2.7	4.8	0.45	0.50	0.9	2000	0.039
409 400 450 300	blackened Gal.Zn8 + passivation	3.0	1/8"	3.2	5.5	0.45	0.50	0.9	2000	0.049
411 200 450 400	blackened Gal.Zn8 + passivation	3.5		3.7	6.0	0.45	0.55	0.9	2000	0.055
412 700 450 500	blackened Zn8M + passivation	4.0	5/32"	4.3	7.0	0.50	0.55	1.0	1000	0.085
414 500 450 600	blackened Zn8M + passivation	5.0	3/16"	5.3	9.0	0.60	0.60	1.1	1000	0.167
416 300 450 700	blackened Zn8M + passivation	6.0		6.4	10.0	0.60	0.70	1.2	1000	0.200
418 100 450 800	blackened Zn8M + passivation	6.35	1/4"	6.7	9.5	0.60	0.65	1.2	1000	0.150
419 200 450 900	blackened Zn8M + passivation	7.0		7.4	12.0	0.70	0.80	1.3	1000	0.355
420 400 451 000	blackened Zn8M + passivation	8.0	5/16"	8.4	13.0	0.70	0.90	1.4	1000	0.392
423 000 451 100	blackened Zn8M + passivation	10.0	3/8"	10.5	16.0	0.90	1.10	1.6	1000	0.750
425 100 451 200	blackened Zn8M + passivation	11.1	7/16"	11.6	15.9	0.90	1.05	1.6	500	0.595
426 200 451 300	blackened Zn8M + passivation	12.0		13.0	18.0	1.00	1.15	1.7	500	0.879
427 900 451 400	blackened Zn8M + passivation	12.7	1/2"	13.7	19.0	1.00	1.25	1.8	500	0.976
429 100 451 500	blackened Zn8M + passivation	14.0		15.0	22.0	1.10	1.35	2.0	500	1.641
430 700 451 600	blackened Zn8M + passivation	16.0	5/8"	17.0	24.0	1.30	1.55	2.1	500	1.984

Original SCHNORR® safety washers type "S" material C60S (1.1211)

Article number/ Order reference	Finish	Size		Ordering dimensions					Packaging	
		Nominal size		d_1	d_2	s	$h_{min.}$	$h_{max.}$	Unit	Weight per 1000 pieces
		[mm]	[Inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[pcs.]	[kg]
432 400 451 700	blackened Zn8M + passivation	18.0		19.0	27.0	1.40	1.75	2.3	250	2.970
433 800 451 800	blackened Zn8M + passivation	19	3/4"	20.0	30	1.4	1.90	2.5	250	4.100
435 100 451 900	blackened Zn8M + passivation	20		21.0	30	1.4	1.85	2.5	250	3.742
436 600 452 000	blackened Zn8M + passivation	22	7/8"	23.0	33	1.4	1.95	2.7	100	4.507
437 900 452 100	blackened Zn8M + passivation	24		25.6	36	1.6	2.15	2.9	100	5.910
439 200 452 200	blackened Zn8M + passivation	25,4	1"	27.0	38	1.8	2.35	3.1	100	7.449
440 300 452 300	blackened Zn8M + passivation	27		28.6	39	1.8	2.35	3.1	100	7.369
441 500 452 400	blackened Zn8M + passivation	30	1 1/8"	31.6	45	1.8	2.60	3.6	100	10.780
442 730 452 500	blackened Zn8M + passivation	36	1 3/8"	38.0	54	2.5	3.20	4.2	50	21.280

We would be glad to offer you safety washers type "S" with different finish on request.
Our surfaces are Cr 6-free and comply with the EU "Old Car" (2000/53/EG) RoHS-(2002/95/CE) Directive as well as the WEEE Directive (2002/96/EC)

Original SCHNORR® safety washers type "S" material X5CrNi18-10 (1.4301)

Article number/ Order reference	Size		Ordering dimensions					Packaging	
	Nominal size		d_1	d_2	s	$h_{min.}$	$h_{max.}$	Unit	Weight per 1000 pieces
	[mm]	[Inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[pcs.]	[kg]
403 221	1.6		1.7	3.2	0.5	0.55	0.75	1000	0.019
405 420	2		2.2	4.0	0.5	0.55	0.75	2000	0.029
407 660	2.5		2.7	4.8	0.5	0.55	0.95	2000	0.042
410 750	3	1/8"	3.2	5.5	0.5	0.55	0.95	2000	0.042
412 500	3.5		3.7	6.0	0.7	0.75	1.15	2000	0.084
414 200	4	5/32"	4.3	7.0	0.7	0.75	1.20	1000	0.081
416 100	5	3/16"	5.3	9.0	0.7	0.75	1.20	1000	0.209
417 900	6		6.4	10.0	0.7	0.75	1.20	1000	0.193
418 104	6.35	1/4"	6.7	9.5	0.7	0.75	1.20	1000	0.172
422 700	8	5/16"	8.4	13.0	1.0	1.20	1.60	1000	0.557
424 900	10	3/8"	10.5	16.0	1.0	1.10	1.60	1000	0.731
425 110	11.1	7/16"	11.6	15.9	1.3	1.30	1.85	500	0.825
427 600	12		13.0	18.0	1.3	1.30	1.85	500	1.099
428 950	12.7	1/2"	13.7	19.0	1.3	1.40	1.95	500	1.222
430 500	14		15.0	22.0	1.5	1.65	2.30	500	2.244
432 200	16	5/8"	17.0	24.0	1.5	1.75	2.30	500	2.487
433 650	18		19.0	27.0	1.8	2.05	2.60	250	3.843
433 821	19	3/4"	20.0	30.0	1.8	2.20	2.60	250	5.294
436 400	20		21.0	30.0	1.8	2.15	2.80	250	3.923
437 810	22	7/8"	23.0	33.0	1.8	2.30	3.00	100	5.893
439 091	24		25.6	36.0	2.0	2.35	3.10	100	7.508
439 170	25.4	1"	27.0	37.0	2.5	2.85	3.60	100	10.508
441 410	27		28.6	39.0	2.5	2.85	3.60	100	10.300
442 711	30	1 1/8"	31.6	45.0	2.5	3.10	4.10	100	15.185
442 790	36	1 3/8"	38.0	54.0	3.0	3.70	4.70	100	26.218

We would be glad to offer you safety washers type "S" in further special material grades on request.

Original SCHNORR® safety washers type „VS“

The Original SCHNORR® Safety Washer “VS“ can be used with high-strength bolts of the grade 8.8 -10.9 without any restrictions. This extra strong safety washer has a greater thickness for higher pre-tensioning loads. The outside inside diameter as well and the serrations are the same as the “S“ type. It can be delivered for screws M 5 t o M 30. Special sizes are also available upon request.

Explanations on the table:

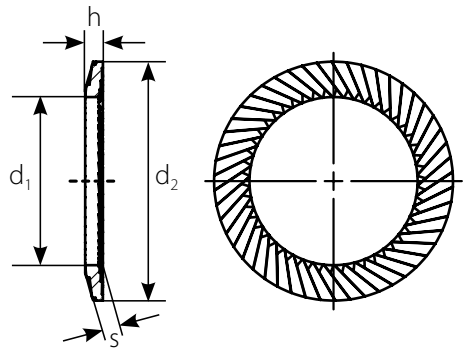
Article no.: applies to the normal version made of spring steel, hardened, blackened; mechanically galvanized

h max.: maximum dimension in delivery condition

h min.: minimum dimension after load test

Available material grades: spring steel acc. to DIN EN 10132-4; corrosion-resistant steel 1.4301; Phosphorus Bronze CuSn8; nickel cobalt alloy, creep-resistant steel 1.4122; Inconel

Available surfaces: blackened (standard), bronzed, phosphated, galvanized, zinc lamellar coatings



Designation of an original SCHNORR® safety washer type “VS”:

Size 16 made of spring steel, surface mechanically galvanized

= safety washer VS 16 FSt. for 8 M + passivation

Original SCHNORR® safety washers type “VS” material C60S (1.1211)

Article number/ Order reference	Finish	Size		Ordering dimensions					Packaging	
		Nominal size		d_1	d_2	s	$h_{min.}$	$h_{max.}$	Unit	Weight per 1000 pieces
		[mm]	[Inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[pcs.]	[kg]
414600 450650	blackened Zn8M + passivation	5	3/16”	5.3	9.0	0.9	0.95	1.3	1000	0.273
416400 450750	blackened Zn8M + passivation	6		6.4	10.0	0.9	0.95	1.4	1000	0.300
420 500 451 050	blackened Zn8M + passivation	8	5/16”	8.4	13.0	1.1	1.15	1.7	1000	0.615
423 100 451 150	blackened Zn8M + passivation	10	3/8”	10.5	16.0	1.4	1.50	2.0	1000	1.167
426 300 451 350	blackened Zn8M + passivation	12		13.0	18.0	1.4	1.55	2.1	500	1.223
429 200 451 550	blackened Zn8M + passivation	14		15.0	22.0	1.4	1.65	2.2	500	2.089
430 800 451 650	blackened Zn8M + passivation	16	5/8”	17.0	24.0	1.9	2.05	2.6	250	3.142
432 500 451 750	blackened Zn8M + passivation	18		19.0	27.0	1.9	2.15	2.7	250	4.041
435 300 451 950	blackened Zn8M + passivation	20		21.0	30.0	1.9	2.10	2.8	250	5.066
436 700 452 050	blackened Zn8M + passivation	22	7/8”	23.0	33.0	1.9	2.30	3.0	100	6.117
438 000 452 150	blackened Zn8M + passivation	24		25.6	36.0	2.4	2.70	3.4	100	8.865
400 974 401 260	blackened Zn8M + passivation	25,4	1”	38.0	27.0	2.5	2.95	3.4	100	10.580
440 400 452 350	blackened Zn8M + passivation	27		28.6	39.0	2.4	2.80	3.5	100	9.731
441 600 452 450	blackened Zn8M + passivation	30	1 1/8”	31.6	45.0	2.4	3.05	3.8	100	14.380
442 801 401 051	blackened Zn8M + passivation	36	1 3/8”	38.0	54.0	3.0	3.75	4.5	50	27.226

We would be glad to offer you safety washers type “VS” with different finish on request.

Our surfaces are Cr 6-free and comply with the EU “Old Car” (2000/53/EG) RoHS-(2002/95/CE) Directive as well as the WEEE Directive (2002/96/EC)

Original SCHNORR® safety washers type "VS" material X5CrNi18-10 (1.4301)

Article number/ Order reference	Size		Ordering dimensions					Packaging	
	Nominal size		d_1	d_2	s	$h_{min.}$	$h_{max.}$	Unit	Weight per 1000 pieces
	[mm]	[Inch]	[mm]	[mm]	[mm]	[mm]	[mm]	[pcs.]	[kg]
416 201	5	3/16"	5.3	9.0	1.0	1.05	1.3	1000	0.298
418001	6		6.4	10.0	1.0	1.10	1.4	1000	0.330
422 901	8	5/16"	8.4	13.0	1.5	1.60	2.0	1000	0.836
425 020	10	3/8"	10.5	16.0	1.8	1.90	2.3	1000	1.501
427 700	12		13.0	18.0	1.8	1.90	2.4	500	1.731
430 660	14		15.0	22.0	1.8	1.95	2.5	500	2.693
430 750	16	5/8"	17.0	24.0	2.5	2.60	3.1	250	4.145
433 621	18		19.0	27.0	2.5	2.65	3.2	250	5.337
435 250	20		21.0	30.0	2.5	2.70	3.3	250	6.709
436 721	22		23.0	33.0	2.5	2.70	3.4	100	8.184
438 021	24		25.4	36.0	3.0	3.20	3.9	100	11.262
441 420	27		28.6	39.0	3.0	3.30	4.0	100	12.360
441 621	30	1 1/8"	31.6	45.0	3.0	3.55	4.3	100	18.222

We would be glad to offer you safety washers type "VS" in further special material grades on request.

Original SCHNORR® safety washers „UV" captive fitting on bolts

For screws with captive safety washers

These safety washers are dimensioned so they can be fitted to bolts or screws from M2.5 to M10. This is done prior to thread rolling so the safety washers are captive.

Original SCHNORR® load washers acc. to DIN 6796

These SCHNORR® load washers have been specially developed for high-strength bolts of grades 8.8 - 12.9. This represents the most powerful form of safety washer in the form of a disc spring. The load of the washers have been matched to these bolts and and are 70 to 90% of the bolt load in the flat state.

These load washers conform to DIN 6796, edition Oct. 1987, and are designed for high demands on the protection of bolt joints. As a highly progressive load increase occurs at the end of the spring deflection when the load washer is flattened the load has been indicated as double the calculated value. Tests have shown that these values are comparable with the measured values.

For the protection of bolted joints only that load is available which remains after the load washer has initially set. The table indicates the respective minimum height after the initial loading of the washer. Thus the maximum loss of height due to setting is limited.

Particular advantages of the SCHNORR® load washer

① High axial load

② Optimum compensation for setting in the joint

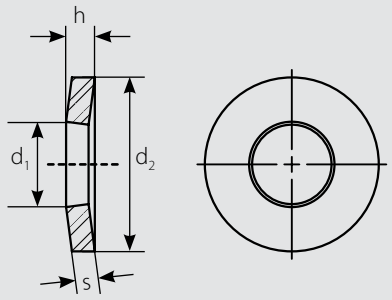
③ Reduction of the dynamic loading of the screw

④ Uniform concentric loading and high safety through a high degree of spring action

⑤ Suitable for captive fitting on a wide range of bolts (combi bolts)

Explanations on the table:

Technical requirements:	according to DIN 267, Part 26
Available material grades:	spring steel acc. to DIN EN 10132-4, other materials on request
Available surfaces:	hardened, blank and oiled; mechanically galvanized; other materials on request
Article no.:	applies to the normal version made of spring steel
h max.:	maximum dimension in delivery condition
h min.:	minimum dimension after setting test according to DIN 267, Part 26
Contact force:	contact forces for the setting test according to DIN 267, Part 26
Minimum residual spring load :	spring load, which rests after load with the contact pressure acc. to DIN 267 part 2 and subsequent relieving of 100 µm



Designation of an original SCHNORR® load washer DIN 6796:
Size 8 made of spring steel
= load washer DIN 6796-8 FSt.

Original SCHNORR® load washers acc. to DIN 6796 material C60 S (1.1211)

Article number/ Order reference	Finish	Size	Ordering dimensions					Contact force	Minimum residual spring load
		Nominal size [mm]	d_1 [mm]	d_2 [mm]	s [mm]	$h_{min.}$ [mm]	$h_{max.}$ [mm]	F [N]	F [N]
700 000 702 110	blank, oiled Zn12M + passivation	2	2.2	5	0.4	0.5	0.60	*	*
700 100 702 120	blank, oiled Zn12M + passivation	2.5	2.7	6	0.5	0.6	0.72	*	*
700 200 702 130	blank, oiled Zn12M + passivation	3	3.2	7	0.6	0.7	0.85	*	*
700 300 702 140	blank, oiled Zn12M + passivation	3.5	3.7	8	0.8	0.9	1.06	*	*
700 400 702 150	blank, oiled Zn12M + passivation	4	4.3	9	1.0	1.1	1.30	4400	1400
700 500 702 160	blank, oiled Zn12M + passivation	5	5.3	11	1.2	1.3	1.55	7200	2300
700 600 702 170	blank, oiled Zn12M + passivation	6	6.4	14	1.5	1.7	2.00	10200	4200
700 700 702 180	blank, oiled Zn12M + passivation	7	7.4	17	1.75	2.0	2.30	14800	6200
700 800 702 190	blank, oiled Zn12M + passivation	8	8.4	18	2.0	2.2	2.60	18600	7700
700 900 702 200	blank, oiled Zn12M + passivation	10	10.5	23	2.5	2.8	3.20	29600	12400
701 000 702 210	blank, geölt Zn12M + passivation	12	13.0	29	3.0	3.4	3.95	43000	18000
701 100 702 220	blank, oiled Zn12M + passivation	14	15.0	35	3.5	4.0	4.65	59100	25000
701 200 702 230	blank, oiled Zn12M + passivation	16	17.0	39	4.0	4.6	5.25	80900	34000
701 300 702 240	blank, oiled Zn12M + passivation	18	19.0	42	4.5	5.1	5.80	102000	57000
701 400 702 250	blank, oiled Zn12M + passivation	20	21.0	45	5.0	5.6	6.40	130000	73000
701 500 702 260	blank, oiled Zn12M + passivation	22	23.0	49	5.5	6.1	7.05	162000	91000
701 600 702 270	blank, oiled Zn12M + passivation	24	25.0	56	6.0	6.8	7.75	188000	122000
701 700 702 280	blank, oiled Zn12M + passivation	27	28.0	60	6.5	7.3	8.35	246000	161000
701 800 702 290	blank, oiled Zn12M + passivation	30	31.0	70	7.0	8.0	9.20	300000	196000

We would be glad to offer you load washers according to DIN 6796 in different finish and material grades on request.

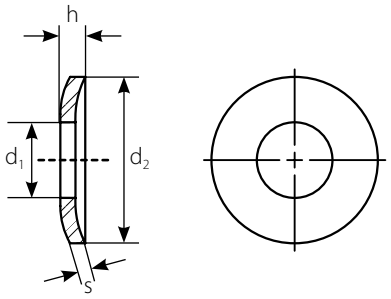
* dimensions not listed in DIN 267 part 26

Original SCHNORR® high stress load washers „HS“

This safety washer is, in principle, a load washer with a smaller outer diameter than those acc. to DIN 6796. A notable feature of these washers is the slightly curved form which provides a progressively increasing characteristic curve. Despite the smaller outside diameter dimensions this makes it possible to achieve the same load as the load washers acc. to DIN 6796. These washers are primarily used when the space available is insufficient for standardised load washers.

Explanations on the table:

Technical requirements: according to DIN 267, Part 26
Available material grades: spring steel acc. to DIN EN 10132-4, other materials on request
Available surfaces: phosphated and oiled; mechanically galvanized, other materials on request
Article no.: applies to the normal version made of spring steel
h max.: maximum dimension in delivery condition
h min.: minimum dimension after setting test according to DIN 267, Part 26
Contact force: contact forces for the setting test according to DIN 267, Part 26
Minimum residual spring load : spring load, which rests after load with the contact pressure acc. to DIN 267 part 2 and subsequent relieving of 100 µm



Description of an original SCHNORR® high stress load washer type “HS“:
Size 12 made of spring steel:
= Safety Washer HS 12 FSt.
phosphated and oiled

Original SCHNORR® safety washers type “HS” material C60 S (1.1211)

Article number/ Order reference	Finish	Size	Ordering dimensions					Contact force	Minimum residual spring load
		Nominal size [mm]	d_1 [mm]	d_2 [mm]	s [mm]	$h_{min.}$ [mm]	$h_{max.}$ [mm]	F [N]	F [N]
416 320 431510	Phosphated and oiled Zn12M + passivation	6	6.4	12	1.5	1.64	1.90	10200	4200
416 520 431 520	Phosphated and oiled Zn12M + passivation	8	8.4	17	2.0	2.10	2.55	18600	7700
423 220 431 530	Phosphated and oiled Zn12M + passivation	10	10.5	21	2.5	2.75	3.15	29600	12400
426 400 431 540	Phosphated and oiled Zn12M + passivation	12	13.0	24	3.0	3.27	3.75	43000	18000
429 320 431 550	Phosphated and oiled Zn12M + passivation	14	15.0	28	3.5	3.80	4.35	59100	25000
430 900 431 560	Phosphated and oiled Zn12M + passivation	16	17.0	30	4.0	4.31	4.95	80900	34000
433 750 431 570	Phosphated and oiled Zn12M + passivation	18	19.0	33	4.5	4.80	5.50	102000	57000
435 320 431 580	Phosphated and oiled Zn12M + passivation	20	21.0	36	5.0	5.30	5.95	130000	73000
436 620 431 590	Phosphated and oiled Zn12M + passivation	22	23.0	40	5.5	5.90	6.70	162000	91000
439 150 431 600	Phosphated and oiled Zn12M + passivation	24	25.0	45	6.0	6.45	7.30	188000	122000
440 100 431 610	Phosphated and oiled Zn12M + passivation	27	28.0	50	6.5	7.00	8.00	246000	161000
442 650 431 620	Phosphated and oiled Zn12M + passivation	30	31.0	58	7.0	7.65	8.90	300000	196000

We would be glad to offer you safety washers type “HS” with different finish on request.

We act in the background – with excellent efficiency.

For example, by using special material grades for particular operational demands.

Materials

Standard materials

- **C60S (1.1211):**
  This spring steel is a quality steel according to DIN EN 10132-4. We use this spring steel exclusively for our original SCHNORR® safety washers and load washers according to DIN 6796.
- **C67S (1.1231) und C75S (1.1248):**
  These stainless steel grades according to DIN EN 10132-4 are used as cold rolled strip for disc springs of group 1 according to DIN 2093 up to a thickness of t < 1.25 mm and for our disc springs of the "K" series.
- **51CrV4 (1.8159):**
  This chromium-vanadium alloyed stainless steel is used in rolled condition (according to DIN 10132-4 or acc. to DIN 10089) for disc springs with a thickness between 1.25 mm to 6 mm. Normally this stainless steel is processed in forged form for disk thicknesses of more than 6 mm.

Materials for special requirements

Corrosive, high temperature and other aggressive environments require the use of materials. These materials, in general, have lower tensile strength than standard materials and should only be specified if absolutely necessary. These springs have a lower overall height than comparable sizes made of standard materials, resulting in lower spring force. This must be taken into consideration when using these materials.

Corrosion-resistant materials

- **X10 CrNi 18-8 (1.4310):**
  This chromium-nickel alloyed steel according to DIN EN 10151 is the most commonly used material for disc springs up to a thickness of t = 3.0 mm. Unfortunately, the cold forming process makes in magnetic.
- **X7 CrNiAl 17-7 (1.4568):**
  This steel alloy according to DIN EN 10151 is a precipitation-hardened spring steel which is processed in cold-strained condition up to a thickness of approx. 2.5 mm. The cold forming process makes this material magnetic.
- **X5 CrNiMo 17-12-2 (1.4401):**
  With this steel according to DIN EN 10151, the strength is somewhat less than that of the previous two. However, it offers higher corrosion resistance and lower magnetism. Small amounts of this material are hard to procure, and it is thus rarely used.

High-temperature materials

- **X22 CrMoV 12-1 (1.4923):**
  This chromium-molybdenum-vanadium steel according to DIN EN 10269 that can be quenched and tempered has proved very well for the use of heat-resistant disc springs.
- **X39 CrMo 17-1 (1.4122):**
  This is a chromium-molybdenum alloyed steel according to DIN EN 10088-2 that can be quenched and tempered. This material grade has also proved very well for the use of heat-resistant disc springs.

Please bear in mind that both steel grades mentioned are not considered as corrosion-resistant steel grades.

Anti-magnetic and corrosion-resistant materials

- **CuSn 8 (2.1030):**
  Tin bronze according to DIN EN 1654 is an alloy consisting of copper and tin, maintaining its spring characteristics due to cold forming. Please bear in mind that the strength values and the spring forces resulting from it are considerably lower than with the standard material.
- **CuBe 2 (2.1247):**
  Copper-beryllium according to DIN EN 1654 is an excellent spring material grade which is suitable for extremely low temperatures up to the vicinity of the absolute zero point.

These copper alloys are absolutely anti-magnetic, and they have a very good electric conductivity. Furthermore they show a high corrosion resistance against many media.

Heat-resistant special materials with a very good corrosion resistance

Due to their composition, these nickel-base alloys show an excellent resistance against a lot of media. Unfortunately, they are expensive and often hard to procure. As these material grades are often used under extreme operational conditions, a potential creeping under load might lead to a loss of installation height/loss of force of the disc spring. This creeping is a function of temperature, time and tension. A disc spring can be used at higher temperatures, for example, when either a low load is chosen or the exposure time is accordingly short. Thus a maximum working temperature cannot be stated. The values stated in the material grade overview table can therefore serve as a guiding value only.

- **NiCr 20 Co 18 Ti (NIMONIC 90) (2.4632):**
  This nickel-cobalt alloy shows very good high temperature strength characteristics and can be used for higher temperatures with corresponding dimensioning.
- **NiCr 15 Fe 7 TiAl (INCONEL X 750) (2.4669) und NiCr 19 NbMo (INCONEL 718) (2.4668):**
  These nickel-chromium alloys are virtually cobalt-free and for this reason they are often used in nuclear reactor technology.

Furthermore, we process special material grades within the SCHNORR® plant which are not listed in detail here. In case of any queries in terms of special material grades, please contact our engineering department.

Materials – synoptic table

Short name	AISI ASTM	Material no.	Norm	Chemical composition in percent by weight					
Steel grades for normal operating demands				C	Si	Mn	P max.	S max.	Cr
Standard material grade									
C 60S	1060	1.1211	DIN EN 10132-4	0.57...0.65	0.15...0.35	0.60...0.90	0.025	0.025	max. 0.40
C 67S	1070	1.1231	DIN EN 10132-4	0.65...0.73	0.15...0.35	0.60...0.90	0.025	0.025	max. 0.40
C 75S	1078	1.1248	DIN EN 10132-4	0.70...0.80	0.15...0.35	0.60...0.90	0.025	0.025	max. 0.40
51 CrV 4	6150	1.8159	DIN EN 10132-4	0.47...0.55	max. 0.40	0.70...1.10	0.025	0.025	0.90...1.20
Special material grades for particular operating demands									
Corrosion-resistant steel grades									
X 10 CrNi 18-8	301	1.4310	DIN EN 10151	0.05...0.15	max. 2.0	max. 2.0	0.045	0.015	16.0...19.0
X 7 CrNiAl 17-7	631	1.4568	DIN EN 10151	max. 0.09	max. 0.7	max. 1.0	0.040	0.015	16.0...18.0
X 5 CrNiMo 17-12-2	316	1.4401	DIN EN 10151	max. 0.07	max. 1.0	max. 2.0	0.045	0.015	16.5...18.5
X 5 CrNi 18-10	304	1.4301	DIN EN 10151	max.0.07	max. 1.0	max. 2.0	0.045	0.015	17,5...19,5
Heat-resistant steel grades									
X 22 CrMoV 12-1	-	1.4923	DIN EN 10269	0.18...0.24	max. 0.5	0.40...0.90	0.025	0.015	11.0...12.5
X 39 CrMo 17-1	-	1.4122	DIN EN 10088-1	0.33...0.45	max. 1.0	max. 1.5	0.040	0.03	15.5...17.5
Copper alloys				**Sn**	**P**	**Be**	**Ni + Co**	**Cu**	
CuSn 8	-	2.1030	DIN EN 1654	7.5...8.5	0.01...0.4	-	-	Rest	
CuBe 2	-	2.1247	DIN EN 1654	-	-	1.8...2.1	max. 0.3	Rest	
Nickel and cobalt alloys				**Ni**	**Cr**	**Co**	**Ti**	**Al**	**C**
NiCr 20 Co 18 Ti	HEV6	2.4632 / 2.4969	DIN EN 10302	Rest	18.0...21.0	15.0...21.0	2.0...3.0	1.0...2.0	0.13 max
(Nimonic 90)	5829C (AMS)								
NiCr 15 Fe 7 Ti Al	688	2.4669	DIN EN 10302	70.0 min.	14.0...17.0	1.0 max.	2.25...2.75	0.40...1.00	0.08 max.
(Inconel X 750)	5542L (AMS)								
NiCr 19 NbMo	5596J (AMS)	2.4668	DIN EN 10302	50.0...55.0	17.0...21.0	1.0 max.	0.70...1.15	0.3...0.7	0.02...0.08
(Inconel 718)									
Nickel and cobalt alloys (continued)				**S**	**P**	**B**	**Nb + Ta**	**Mo**	**W**
NiCr 20 Co 18 Ti	HEV6	2.4632 / 2.4969		0.015 max.	0.03 max.	0.02 max.	-	-	-
(Nimonic 90)	5829C (AMS)								
NiCr 15 Fe 7 Ti Al	688	2.4669		0.015 max.	0.02 max.	-	0.7...1.2	-	-
(Inconel X 750)	5542L (AMS)								
NiCr 19 NbMo	5596J (AMS)	2.4668		0.015 max.	0.015 max.	0.006 max.	4.8...5.5	2.8...3.3	
(Inconel 718)									

					Physical and mechanical properties			
					E module	working	Thickness	Procurement
					in kN/mm²	temperature	range	
V	Mo	Ni		N	at RT	C°	mm	
-	max. 0.10	max. 0.40			206	–20...+100	0.2...7.0	easy
-	max. 0.10	max. 0.40			206		0.1...2.5	easy
-	max. 0.10	max. 0.40			206	–20...+100	0.1...1.5	easy
0.10...0.25	max. 0.10	max. 0.40			206	–50...+200	0.3...80	easy
-	max. 0.8	6.0...9.5		-	190	–200...+200	0.2...2.5	easy
-	-	6.5...7.8		-	195	–200...+300	0.2...4.0	difficult
-	2.0...2.5	10.0...13.0		max. 0.11	180	–200...+200	0.2...1.6	difficult
-	-	8.0...10.5		max. 0.11	185	-200...+200	0.2...1.6	difficult
0.25...0.35	0.80...1.20	0.30...0.80			216	–50...+500	1.5...20	easy
-	0.80...1.30	max. 1.0			215	–50...+400	0.3...6.0	easy
					115	–50...+100	0.1...6.0	easy
					135	–260...+200	0.1...2.5	easy
Si	Mn	Fe	Cu	Zr				
1.0 max.	1.0 max.	1.5 max.	0.2 max.	0.15 max.	220	–200...+700	until 6.35	difficult
0.50 max.	1.0 max.	5.0...9.0	0.5 max.	-	214	–200...+600	until 6.35	difficult
0.35 max.	0.35 max.	Rest	0.2 max.	-	199	-200...+600	until 6.35	difficult

With regard to the maximum working temperatures listed it must be taken into consideration that the setting height of the springs depends on the height of the tensions occurring and on the operating time on temperature. Furthermore, it has to be taken into consideration that with increasing temperature of the elasticity module of the material the strength diminishes. The operating temperature and thickness ranges can serve as reference values only. With heat-resistant steel grades, heat treatment and hardness deviate from the information given in the mentioned standards. In case of any queries regarding material grade selection, please contact our engineering department.

Surfaces

Surface protection

Disc springs are used in many applications where corrosive media is common. When used in outdoor areas, the spring steel is attacked by condensed, rain, river and sea water.

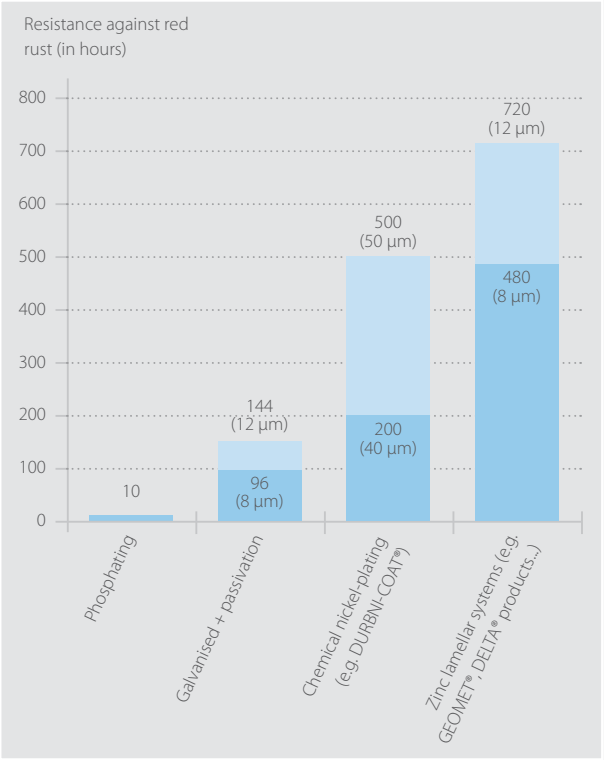
Further applications can be found in automotive building, the food industry, household appliances (e.g. washing machine), bridge building, the aerospace industry etc.

Besides watery or chloride-containing solutions, acids and leaches is various concentrations get in contact with the disc springs here.

In those cases the standard spring steels do not provide sufficient protection and need specific surface treatment to have suitable protection for the working environments.

The criteria given in the following tables are intended to help you find the surface protection best suited for your applications.

Surfaces in the salt spray mist test according to DIN EN ISO 9227



Surface systems**	Layer thickness (µm)	Dimensions (in mm)	Salt-spray mist test DIN 50021 in hours*	Temperature resistance (°C)*	Sea water use	Equal coating	Resistance to atmospheric corrosion	Resistance according to VDA 621-421	Frictional coefficients, adjustable	Domestic standards	Foreign standards	Customer and works standards
Phosphating	8 - 10	De < 600	10	RT	-	+	-	-	N	DIN EN 12476	DIN EN 12476	BOSCH, MIL, DBL
Galvanized + passivation	8 - 12	Ø 10-125 problematic: < Ø 10 and very thin disc springs	96 - 144	150	-	-	o	o	J	DIN EN ISO 12683, DIN 50961, DIN EN 12329	DIN EN ISO 12683, DIN EN 12329, ASTM B 695-04	
Chemical nickel-plating	40 - 50	De < 1000	200 - 500	155	-	+	o	o	J	DIN 50966 DIN EN ISO 4527	DIN EN ISO 4527	
Zinc lamellar systems	8 - 10	De < 1000 problematic: < Ø 10 and very thin disc springs	480 - 720	250 - 300	+	+	+	+	J	DIN EN ISO 12683, DIN 50961, DIN EN 12329	DIN EN ISO 12683, ASTM F 1136, MIL, DIN EN 13858	All common automotive standards VDA 235-104

good (+); medium (o); poor (-)

* In case of extreme demands on resistance, we offer the relevant corrosion-resistant material grades.

** We would be glad to offer you further surfaces on request. Please contact out engineering department.

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certified acc. to
ISO/TS 16949-2002

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DISC SPRING ENGINEERING