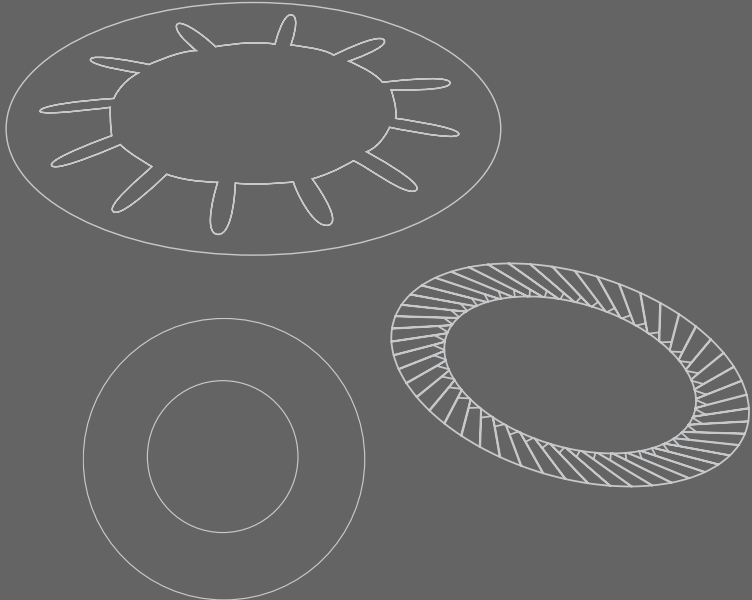




SCHNORR® Product range

EN

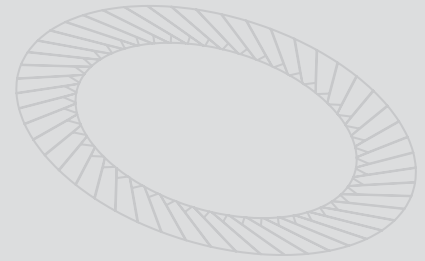
Disc Springs  
Bolt Locking Systems



**SCHNORR**®  
DISC SPRING ENGINEERING



**SCHNORR**<sup>®</sup>  
DISC SPRING ENGINEERING



## Acquired competence for highest precision.

As a pioneer of the disc spring application Adolf Schnorr founded the family-owned company in 1908. Today, after more than 100 years of company history, SCHNORR has grown into an international leading problem solver in the field of disc springs and bolt locking systems and has a worldwide network of sales agencies.

In addition to the standard materials (C60S, C75S, 51CrV4) SCHNORR warehouses a variety of other materials in order to produce on the specific requirements of our customers and to ensure a high flexibility in our production.

With the merger of the HUGO BAUER Nachf. GmbH and the ADOLF SCHNORR GmbH & Co KG to the SCHNORR GmbH by August 1st 2011 additional resources were pooled and the range of parts, manufacturing technologies and production expertise was expanded.

Beside the longstanding experience in stamping and turning, the new company is now also equipped with the technology of fine-blanking, the expertise in manufacturing warp-critical disc springs and an additional product group - the wave spring as a drawing part.

Two strong brands under one roof means for customers and partners the availability of the full potential of two highly-performing companies with a single point of contact and thus the advantages of an even better knowledge and service.

## SCHNORR® GmbH



### Company information

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## Original SCHNORR® Disc Springs



### SCHNORR® DISC SPRINGS Page 7

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## Original SCHNORR® Bolt Locking Systems



### SCHNORR® SAFETY WASHERS Page 27

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## SCHNORR Engineering & technical information



### SCHNORR Engineering Page 37

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### Disc Spring enquiry sheet Page 47

## Facts and figures

workforce:

**248** (by 31.12.2022)

production area:

**approx. 7500** m<sup>2</sup>

Year of foundation:

**1908**

Headquarters:

**Stuttgarter Str. 37  
71069 Sindelfingen-Maichingen  
Germany**

Branch:

**Gottlieb-Daimler-Str. 9  
78234 Engen-Welschingen  
Germany**

## Worldwide sales network

### 8 foreign subsidiaries

- **SCHNORR Corporation** | Ann Arbor, MI, USA
- **SCHNORR GROUP MEXICO S.DE R.L.DE C.V.** | Queretaro, Mexico
- **SCHNORR Shanghai Trading Co.,Ltd.** | Shanghai, China
- **SCHNORR Korea Co. Ltd** | Bisan-Dong, South-Korea
- **SCHNORR Group France S.A.R.L.** | Gallargues-le-Montueux, France
- **SCHNORR Italia s.r.l.** | Trezzano, Italy
- **SCHNORR Espana S.L.U.** | Figueras, Spain
- **SCHNORR Austria GmbH** | Rankweil, Austria

### further 28 foreign sales agencies worldwide

More information on our subsidiaries and sales agencies can be found on [www.schnorr-group.com](http://www.schnorr-group.com)



## History

**1908**

Adolf Schnorr founds a workshop for stamping tools near Stuttgart

**1920er**

Schnorr commences - as the first company ever - the industrial manufacturing of disc springs at the location near Stuttgart. Thus, Adolf Schnorr is considered as the pioneer of the disc spring.

**1956**

Move to a new site in Sindelfingen-Maichingen

**1960er**

Schnorr develops and launches the Original Schnorr® Safety Washers

**1972**

Creation of an international sales network including the foundation of Schnorr Corporation in the USA (Ann Arbor, MI)

**1980**

Foundation of Schnorr Italia near Milan

**1995**

HUGO BAUER NACHF. GmbH becomes member of the Schnorr Group

**2005**

Foundation of Schnorr Espana in Figueras

**2006**

Foundation of Schnorr Group France near Paris

**2008**

Foundation of the subsidiaries Schnorr Shanghai and Schnorr Group Mexico (Queretaro)

**2010**

Foundation of Schnorr Korea near Seoul

**2011**

„Two strong brands under one roof“. The Adolf Schnorr GmbH & Co. KG and the HUGI BAUER NACHF. GmbH merge to become Schnorr GmbH

**2013**

New sales structure. In order to take care of our customers more effectively we subdivided the Schnorr Sales structure into two divisions: Industrial and Automotive

**2016**

The new production building in Sindelfingen-Maichingen is occupied. One year later, the company moves into the new, modern administration building.

**2018**

Implementation of certified environmental management according to EMAS

**2022**

Foundation of Schnorr Austria in Rankweil, Vorarlberg





A photograph of an industrial facility, likely a refinery or chemical plant. The image shows a tall, cylindrical distillation column with a complex network of pipes, ladders, and structural supports. A large, white plume of steam or smoke rises from the left side of the column. The sky is a clear, deep blue. The foreground is dominated by large, metallic pipes and flanges, some of which are partially obscured by a semi-transparent blue overlay containing text.

We put things in motion  
- or hold them securely.

For example, pressure-relief valve in pipelines.



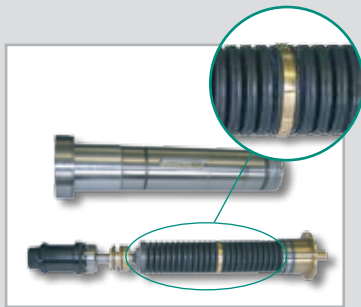
Percussion drilling machine



Overload limitation



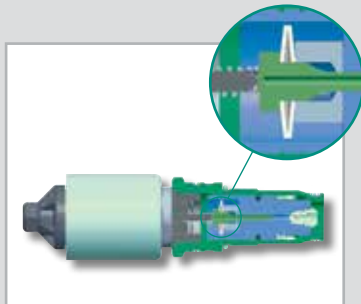
Machine tool



Spindle



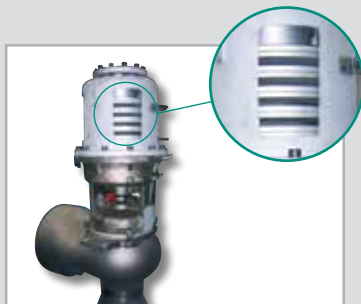
Actuator



Control valve



Pipelines subject to pressure



Pressure-relief valve

# References

Managing maximum force using minimum space.

SCHNORR® disc springs support a lot of dynamic processes in a skillful, 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.

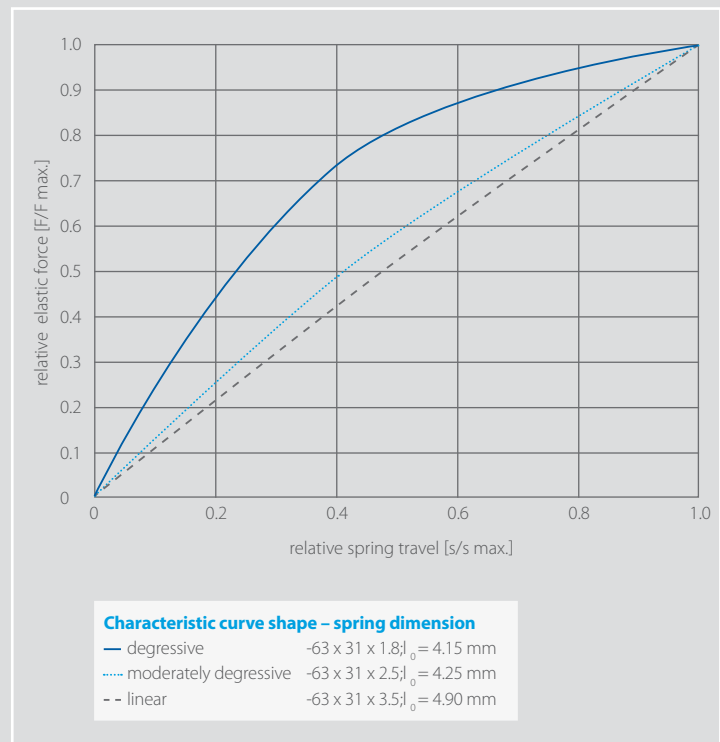
By means of these characteristics, the original SCHNORR® disc spring has developed such a wealth of application areas that nowadays there is scarcely an engineering area where it is not used.



## Effect of spring forces

The importance of disc springs on machines and control systems is very often underestimated. At the same time, any change to 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 according to the application needs.



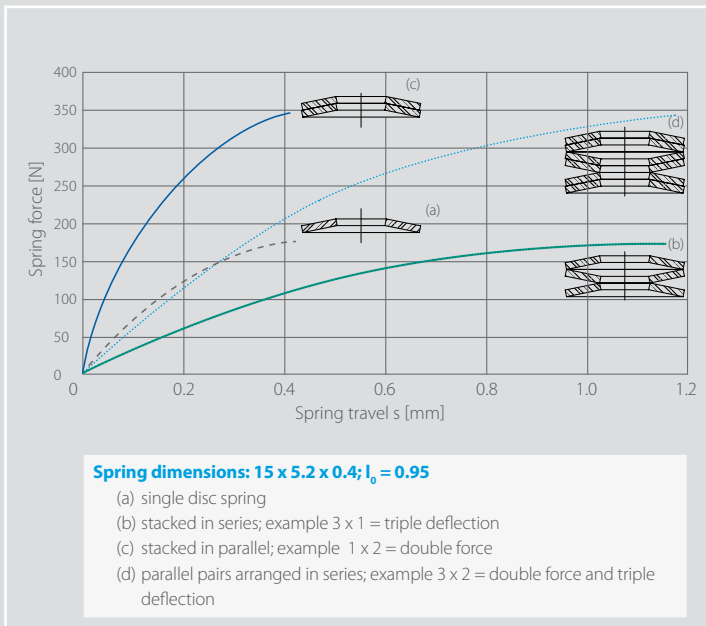
A key advantage of the disc spring is that it can raise a high elastic force with a small spring travel. That is why it is used very often to store potential energy. Apart from this virtual static use, it is also often used in dynamic applications.

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).



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 41).
- ④ Was a suitable surface treatment selected for corrosion protection (see page 44)?

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

V-Card Schnorr



## Original SCHNORR® disc springs

Today DIN EN 16983 (previously DIN 2093) divides three manufacturing methods depending on the relevant thickness:

- Group 1:**  $t < 1,25$ , punching, cold forming, rounding-off edges
- Group 2:**  $1,25 \leq t \leq 6$  mm, punching, cold forming, turning and rounding off edges or fine-blanking, cold forming and rounding off edge
- Group 3:**  $> 6 < t \leq 14$  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.

### Notes on the disc spring table

The following tables, list the springs according to DIN EN 16983 (previously DIN 2093) as well as those to SCHNORR® Internal standards. Sizes according to DIN EN 16983 (previously 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 which 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.

For further technical information, please refer to our technical manual, published in cooperation with Verlag Moderne Industrie in the book series „Die Bibliothek der Technik“ (ISBN 978-3-86236-091-8).



You are able to access this information digitally via the QR code on the right:



The following tolerances apply to springs made of standard materials (C75S and 51CrV4) (Tolerances for springs made of corrosion-resistant materials according to factory standard):

### Load tolerances

Nominal spring thickness		Admissible tolerances	
t bzw. 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 EN 16983 (previously DIN 2093)

\* F with test length  $l_o = l_o - 0,75 \cdot h_o$

### Diameter tolerances

Nominal dimension		Admissible tolerances				
D <sub>e</sub> or D <sub>i</sub> [mm]		D <sub>e</sub> [mm]		D <sub>i</sub> [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 EN 16983 (previously DIN 2093)

### Thickness tolerances

Nominal spring thickness		Admissible tolerances	
t or t' [mm]		t or t' [mm]	
greater than	up to	greater than	up to
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 external and internal diameters and concentricity with springs according to DIN EN 16983 (previously DIN 2093)

### Overall height tolerances

Nominal spring thickness		Admissible tolerances	
t or t' [mm]		l <sub>o</sub> [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 EN 16983 (previously DIN 2093)

## Original SCHNORR® disc springs

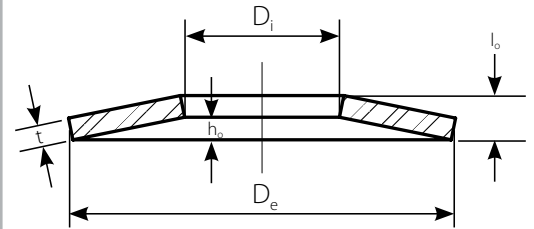
### The following dimension tables describe:

- > Standard materials (C75S and 51CrV4) Page 11-18
- > Corrosion-resistant materials (X10 CrNi 18-8) Page 18-21
- > Corrosion-resistant materials (X7 CrNiAl 17-7) Page 21

### 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 (Inconel X750, Inconel 718)
  - > and other material grades

For this, please see our material grade overview table on pages 42 and 43



### Reference for a disc spring

$D_e = 40 \text{ mm}$ ,  $D_i = 20.4 \text{ mm}$ ,  $t = 1.5 \text{ mm}$ :  
Disc spring 40 x 20.4 x 1.5  
according to DIN EN 16983  
or Article no. 012 800

## Original SCHNORR® disc spring standard material

Ø 6 - 15 mm

Articlenumber	Ordering dimensions							Weight per 1000 pieces [kg]	Spring travel s at $s = 0,75 h_o$ [mm]	Spring force F at $s = 0,75 h_o$ [N]	Test length at $s = 0,75 h_o$ $l_T$ [mm]	Packing Unit [Piece]
	$D_e$ [mm]	$D_i$ [mm]	t [mm]	t' [mm]	$l_o$ [mm]	$h_o$ [mm]	Gr. acc. to DIN EN 16983					
000 100	6,00	3,20	0,30		0,45	0,15	1	0,044	0,113	119	0,338	-
000 200	8,00	3,20	0,20		0,40	0,20	1	0,064	0,150	26	0,250	-
000 300	8,00	3,20	0,30		0,55	0,25	1	0,093	0,188	104	0,363	-
000 400	8,00	3,20	0,40		0,60	0,20	1	0,126	0,150	186	0,450	-
000 550 C	<b>8,00</b>	<b>4,20</b>	<b>0,20</b>		0,45	0,25	1	0,055	0,188	39	0,263	-
000 600 B	<b>8,00</b>	<b>4,20</b>	<b>0,30</b>		0,55	0,25	1	0,080	0,188	118	0,363	-
000 700 A	<b>8,00</b>	<b>4,20</b>	<b>0,40</b>		0,60	0,20	1	0,107	0,150	210	0,450	-
000 800	10,00	3,20	0,30		0,65	0,35	1	0,157	0,263	98	0,388	-
000 900	10,00	3,20	0,40		0,70	0,30	1	0,211	0,225	179	0,475	-
001 000	10,00	3,20	0,50		0,75	0,25	1	0,266	0,188	279	0,563	-
001 100	10,00	4,20	0,40		0,70	0,30	1	0,193	0,225	189	0,475	-
001 200	10,00	4,20	0,50		0,75	0,25	1	0,243	0,188	294	0,563	-
001 300 C	<b>10,00</b>	<b>5,20</b>	<b>0,25</b>		0,55	0,30	1	0,109	0,225	58	0,325	-
001 400 B	<b>10,00</b>	<b>5,20</b>	<b>0,40</b>		0,70	0,30	1	0,170	0,225	209	0,475	-
001 500 A	<b>10,00</b>	<b>5,20</b>	<b>0,50</b>		0,75	0,25	1	0,214	0,188	325	0,563	-
001 600	12,00	4,20	0,40		0,80	0,40	1	0,297	0,300	178	0,500	1000
001 700	12,00	4,20	0,50		0,85	0,35	1	0,374	0,263	284	0,588	1000
001 800	12,00	4,20	0,60		1,00	0,40	1	0,450	0,300	557	0,700	1000
001 900	12,00	5,20	0,50		0,90	0,40	1	0,345	0,300	350	0,600	1000
002 000	12,00	5,20	0,60		0,95	0,35	1	0,415	0,263	506	0,688	1000
002 100	12,00	6,20	0,50		0,85	0,35	1	0,310	0,263	326	0,588	1000
002 200	12,00	6,20	0,60		0,95	0,35	1	0,373	0,263	552	0,688	1000
002 300	12,50	5,20	0,50		0,85	0,35	1	0,382	0,263	272	0,588	1000
002 050 C	<b>12,50</b>	<b>6,20</b>	<b>0,35</b>		0,80	0,45	1	0,251	0,338	151	0,463	1000
002 500 B	<b>12,50</b>	<b>6,20</b>	<b>0,50</b>		0,85	0,35	1	0,346	0,263	293	0,588	1000
002 700 A	<b>12,50</b>	<b>6,20</b>	<b>0,70</b>		1,00	0,30	1	0,488	0,225	660	0,775	1000
002 750 C	<b>14,00</b>	<b>7,20</b>	<b>0,35</b>		0,80	0,45	1	0,308	0,338	123	0,463	1000
002 800 B	<b>14,00</b>	<b>7,20</b>	<b>0,50</b>		0,90	0,40	1	0,425	0,300	279	0,600	1000
002 900 A	<b>14,00</b>	<b>7,20</b>	<b>0,80</b>		1,10	0,30	1	0,676	0,225	797	0,875	1000
003 000	15,00	5,20	0,40		0,95	0,55	1	0,468	0,413	176	0,538	1000
003 100	15,00	5,20	0,50		1,00	0,50	1	0,588	0,375	278	0,625	1000
003 200	15,00	5,20	0,60		1,05	0,45	1	0,708	0,338	407	0,713	1000
003 300	15,00	5,20	0,70		1,10	0,40	1	0,828	0,300	555	0,800	1000
003 500	15,00	6,20	0,50		1,00	0,50	1	0,553	0,375	289	0,625	1000
003 600	15,00	6,20	0,60		1,05	0,45	1	0,665	0,338	424	0,713	1000
003 700	15,00	6,20	0,70		1,10	0,40	1	0,778	0,300	578	0,800	1000
003 800	15,00	8,20	0,70		1,10	0,40	1	0,654	0,300	666	0,800	1000
003 900	15,00	8,20	0,80		1,20	0,40	1	0,740	0,300	982	0,900	1000

Articlenumber	Ordering dimensions							Weight per 1000 pieces [kg]	Spring travels s [mm]	Spring force F at s = 0,75 h <sub>0</sub> F [N]	Test length at s = 0,75 h <sub>0</sub> l <sub>T</sub> [mm]	Packing Unit [Piece]
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	t' [mm]	l <sub>0</sub> [mm]	h <sub>0</sub> [mm]	Gr. acc. to DIN EN 16983					
<b>004 100 C</b>	<b>16,00</b>	<b>8,20</b>	<b>0,40</b>		0,90	0,50	1	0,444	0,375	154	0,525	1000
<b>004 300 B</b>	<b>16,00</b>	<b>8,20</b>	<b>0,60</b>		1,05	0,45	1	0,672	0,338	410	0,713	1000
<b>004 400</b>	16,00	8,20	0,70		1,15	0,45	1	0,786	0,338	637	0,813	1000
<b>004 500</b>	16,00	8,20	0,80		1,20	0,40	1	0,888	0,300	825	0,900	1000
<b>004 600 A</b>	<b>16,00</b>	<b>8,20</b>	<b>0,90</b>		1,25	0,35	1	1,002	0,263	1013	0,988	1000
<b>004 700</b>	18,00	6,20	0,40		1,00	0,60	1	0,677	0,450	139	0,550	1000
<b>004 800</b>	18,00	6,20	0,50		1,10	0,60	1	0,850	0,450	245	0,650	1000
<b>004 900</b>	18,00	6,20	0,60		1,20	0,60	1	1,024	0,450	400	0,750	1000
<b>005 000</b>	18,00	6,20	0,70		1,25	0,55	1	1,197	0,413	553	0,838	1000
<b>005 100</b>	18,00	6,20	0,80		1,30	0,50	1	1,353	0,375	726	0,925	1000
<b>005 200</b>	18,00	8,20	0,50		1,10	0,60	1	0,762	0,450	265	0,650	1000
<b>005 300</b>	18,00	8,20	0,70		1,25	0,55	1	1,073	0,413	596	0,838	1000
<b>005 400</b>	18,00	8,20	0,80		1,30	0,50	1	1,213	0,375	783	0,925	1000
<b>005 500</b>	18,00	8,20	1,00		1,40	0,40	1	1,524	0,300	1181	1,100	1000
<b>005 550 C</b>	<b>18,00</b>	<b>9,20</b>	<b>0,45</b>		1,05	0,60	1	0,651	0,450	214	0,600	1000
<b>005 600 B</b>	<b>18,00</b>	<b>9,20</b>	<b>0,70</b>		1,20	0,50	1	0,999	0,375	566	0,825	1000
<b>005 700 C</b>	<b>18,00</b>	<b>9,20</b>	<b>1,00</b>		1,40	0,40	1	1,418	0,300	1254	1,100	1000
<b>005 800</b>	20,00	8,20	0,60		1,30	0,70	1	1,191	0,525	412	0,775	500
<b>005 900</b>	20,00	8,20	0,70		1,35	0,65	1	1,393	0,488	569	0,863	500
<b>006 000</b>	20,00	8,20	0,80		1,40	0,60	1	1,574	0,450	751	0,950	500
<b>006 100</b>	20,00	8,20	0,90		1,45	0,55	1	1,776	0,413	954	1,038	500
<b>006 200</b>	20,00	8,20	1,00		1,55	0,55	1	1,978	0,413	1294	1,138	500
<b>006 300 C</b>	<b>20,00</b>	<b>10,20</b>	<b>0,50</b>		1,15	0,65	1	0,876	0,488	254	0,663	500
<b>006 400 B</b>	<b>20,00</b>	<b>10,20</b>	<b>0,80</b>		1,35	0,55	1	1,394	0,413	748	0,938	500
<b>006 500</b>	20,00	10,20	0,90		1,45	0,55	1	1,573	0,413	1050	1,038	500
<b>006 600</b>	20,00	10,20	1,00		1,55	0,55	1	1,752	0,413	1425	1,138	500
<b>006 700 A</b>	<b>20,00</b>	<b>10,20</b>	<b>1,10</b>		1,55	0,45	1	1,913	0,338	1521	1,213	500
<b>506 800</b>	20,00	10,20	1,25		1,75	0,50	2 <sup>f</sup>	2,181	0,375	2477	1,375	500
<b>506 900</b>	20,00	10,20	1,50		1,80	0,30	2 <sup>f</sup>	2,610	0,225	2521	1,575	500
<b>007 000 C</b>	<b>22,50</b>	<b>11,20</b>	<b>0,60</b>		1,40	0,80	1	1,361	0,600	425	0,800	500
<b>007 100 B</b>	<b>22,50</b>	<b>11,20</b>	<b>0,80</b>		1,45	0,65	1	1,799	0,488	707	0,963	500
<b>507 200 A</b>	<b>22,50</b>	<b>11,20</b>	<b>1,25</b>		1,75	0,50	2 <sup>f</sup>	2,814	0,375	1929	1,375	500
<b>007 400</b>	23,00	8,20	0,70		1,50	0,80	1	1,939	0,600	544	0,900	500
<b>007 500</b>	23,00	8,20	0,80		1,55	0,75	1	2,192	0,563	719	0,988	500
<b>007 600</b>	23,00	8,20	0,90		1,60	0,70	1	2,472	0,525	919	1,075	500
<b>007 700</b>	23,00	8,20	1,00		1,70	0,70	1	2,753	0,525	1240	1,175	500
<b>007 800</b>	23,00	10,20	0,90		1,65	0,75	1	2,270	0,563	1058	1,088	500
<b>007 900</b>	23,00	10,20	1,00		1,70	0,70	1	2,527	0,525	1315	1,175	500
<b>508 000</b>	23,00	10,20	1,25		1,90	0,65	2 <sup>f</sup>	3,172	0,488	2310	1,413	500
<b>508 100</b>	23,00	12,20	1,00		1,60	0,60	1	2,255	0,450	1217	1,150	500
<b>508 200</b>	23,00	12,20	1,25		1,85	0,60	2 <sup>f</sup>	2,807	0,450	2331	1,400	500
<b>508 350</b>	23,00	12,20	1,50		2,00	0,50	2 <sup>f</sup>	3,359	0,375	3297	1,625	500
<b>008 600</b>	25,00	10,20	1,00		1,75	0,75	1	3,105	0,563	1172	1,188	500
<b>008 700 C</b>	<b>25,00</b>	<b>12,20</b>	<b>0,70</b>		1,60	0,90	1	1,994	0,675	600	0,925	500
<b>008 800 B</b>	<b>25,00</b>	<b>12,20</b>	<b>0,90</b>		1,60	0,70	1	2,543	0,525	862	1,075	500
<b>008 900</b>	25,00	12,20	1,00		1,80	0,80	1	2,832	0,600	1359	1,200	500
<b>509 000</b>	25,00	12,20	1,25		1,95	0,70	2 <sup>f</sup>	3,526	0,525	2214	1,425	500
<b>509 100 A</b>	<b>25,00</b>	<b>12,20</b>	<b>1,50</b>		2,05	0,55	2 <sup>f</sup>	4,219	0,413	2926	1,638	200

2<sup>g</sup> = according to group 2 (DIN EN 16983) - manufacturing process turned (D<sub>e</sub>/D)2<sup>f</sup> = according to group 2 (DIN EN 16983) - manufacturing process fine blanked

Articlenumber	Ordering dimensions							Weight per 1000 pieces [kg]	Spring travels at $s = 0,75 h_0$ s [mm]	Spring force F at $s = 0,75 h_0$ F [N]	Test length at $s = 0,75 h_0$ $l_T$ [mm]	Packing Unit [Piece]
	$D_e$ [mm]	$D_i$ [mm]	t [mm]	$t'$ [mm]	$l_0$ [mm]	$h_0$ [mm]	Gr. acc. to DIN EN 16983					
009 200	28,00	10,20	0,80		1,75	0,95	1	3,233	0,713	662	1,038	200
009 300	28,00	10,20	1,00		1,90	0,90	1	4,062	0,675	1130	1,225	200
509 400	28,00	10,20	1,25		2,05	0,80	2 <sup>f</sup>	5,057	0,600	1853	1,450	200
509 500	28,00	10,20	1,50		2,20	0,70	2 <sup>f</sup>	6,051	0,525	2723	1,675	200
009 600	28,00	12,20	1,00		1,95	0,95	1	3,789	0,713	1268	1,238	200
509 700	28,00	12,20	1,25		2,10	0,85	2 <sup>f</sup>	4,717	0,638	2083	1,463	200
509 800	28,00	12,20	1,50		2,25	0,75	2 <sup>f</sup>	5,645	0,563	3077	1,688	200
009 900 C	<b>28,00</b>	<b>14,20</b>	<b>0,80</b>		1,80	1,00	1	2,760	0,750	801	1,050	200
010 000 B	<b>28,00</b>	<b>14,20</b>	<b>1,00</b>		1,80	0,80	1	3,468	0,600	1107	1,200	200
510 100	28,00	14,20	1,25		2,10	0,85	2 <sup>f</sup>	4,317	0,638	2240	1,463	200
510 200 A	<b>28,00</b>	<b>14,20</b>	<b>1,50</b>		2,15	0,65	2 <sup>f</sup>	5,166	0,488	2841	1,663	200
010 300	31,50	12,20	1,00		2,10	1,10	1	5,035	0,825	1167	1,275	200
010 400	31,50	12,20	1,25		2,20	0,95	2 <sup>g</sup>	6,268	0,713	1805	1,488	200
010 500	31,50	12,20	1,50		2,35	0,85	2 <sup>g</sup>	7,501	0,638	2688	1,713	200
010 650 C	<b>31,50</b>	<b>16,30</b>	<b>0,80</b>		1,85	1,05	1	3,442	0,788	687	1,063	200
510 700 B	<b>31,50</b>	<b>16,30</b>	<b>1,25</b>		2,15	0,90	2 <sup>f</sup>	5,384	0,675	1913	1,475	200
510 800	31,50	16,30	1,50		2,40	0,90	2 <sup>f</sup>	6,443	0,675	3230	1,725	200
510 900 A	<b>31,50</b>	<b>16,30</b>	<b>1,75</b>		2,45	0,70	2 <sup>f</sup>	7,546	0,525	3871	1,925	200
511 000	31,50	16,30	2,00		2,75	0,75	2 <sup>f</sup>	8,605	0,563	6173	2,188	200
011 100	34,00	12,30	1,00		2,25	1,25	1	6,006	0,938	1174	1,313	100
511 200	34,00	12,30	1,25		2,35	1,10	2 <sup>f</sup>	7,477	0,825	1818	1,525	100
511 300	34,00	12,30	1,50		2,50	1,00	2 <sup>f</sup>	8,948	0,750	2725	1,750	100
511 400	34,00	14,30	1,25		2,40	1,15	2 <sup>f</sup>	7,074	0,863	1993	1,538	100
511 500	34,00	14,30	1,50		2,55	1,05	2 <sup>f</sup>	8,465	0,788	2990	1,763	100
511 600	34,00	16,30	1,50		2,55	1,05	2 <sup>f</sup>	7,911	0,788	3155	1,763	100
511 700	34,00	16,30	2,00		2,85	0,85	2 <sup>f</sup>	10,570	0,638	5783	2,213	100
011 850 C	<b>35,50</b>	<b>18,30</b>	<b>0,90</b>		2,05	1,15	1	4,952	0,863	832	1,188	200
511 900 B	<b>35,50</b>	<b>18,30</b>	<b>1,25</b>		2,25	1,00	2 <sup>f</sup>	6,865	0,750	1699	1,500	200
512 000 A	<b>35,50</b>	<b>18,30</b>	<b>2,00</b>		2,80	0,80	2 <sup>f</sup>	10,970	0,600	5187	2,200	100
512 100	<b>40,00</b>	<b>14,30</b>	<b>1,25</b>		2,65	1,40	2 <sup>f</sup>	10,400	1,050	1780	1,600	100
512 200	<b>40,00</b>	<b>14,30</b>	<b>1,50</b>		2,75	1,25	2 <sup>f</sup>	12,450	0,938	2545	1,813	100
512 300	<b>40,00</b>	<b>14,30</b>	<b>2,00</b>		3,05	1,05	2 <sup>f</sup>	16,630	0,788	4769	2,263	100
512 400	40,00	16,30	1,50		2,80	1,30	2 <sup>f</sup>	11,890	0,975	2749	1,825	100
512 500	40,00	16,30	2,00		3,10	1,10	2 <sup>f</sup>	15,890	0,825	5169	2,275	100
512 600	40,00	18,30	2,00		3,15	1,15	2 <sup>f</sup>	15,040	0,863	5656	2,288	100
012 700 C	<b>40,00</b>	<b>20,40</b>	<b>1,00</b>		2,30	1,30	1	7,067	0,975	1017	1,325	100
512 800 B	<b>40,00</b>	<b>20,40</b>	<b>1,50</b>		2,65	1,15	2 <sup>f</sup>	10,530	0,863	2621	1,788	100
512 900	40,00	20,40	2,00		3,10	1,10	2 <sup>f</sup>	14,060	0,825	5701	2,275	100
513 000 A	<b>40,00</b>	<b>20,40</b>	<b>2,25</b>		3,15	0,90	2 <sup>f</sup>	15,720	0,675	6500	2,475	100
513 100	40,00	20,40	2,50		3,45	0,95	2 <sup>f</sup>	17,520	0,713	9390	2,738	100
513 250 C	<b>45,00</b>	<b>22,40</b>	<b>1,25</b>		2,85	1,60	2 <sup>f</sup>	11,340	1,200	1891	1,650	50
513 300 B	<b>45,00</b>	<b>22,40</b>	<b>1,75</b>		3,05	1,30	2 <sup>f</sup>	15,890	0,975	3646	2,075	50
513 400 A	<b>45,00</b>	<b>22,40</b>	<b>2,50</b>		3,50	1,00	2 <sup>f</sup>	22,770	0,750	7716	2,750	50
513 500	50,00	18,40	1,25		2,85	1,60	2 <sup>f</sup>	16,130	1,200	1375	1,650	50
513 600	50,00	18,40	1,50		3,30	1,80	2 <sup>f</sup>	19,310	1,350	2606	1,950	50
513 700	50,00	18,40	2,00		3,50	1,50	2 <sup>f</sup>	25,790	1,125	4572	2,375	50
513 800	50,00	18,40	2,50		4,10	1,60	2 <sup>f</sup>	32,140	1,200	9315	2,900	50
513 900	50,00	18,40	3,00		4,40	1,40	2 <sup>f</sup>	38,350	1,050	13688	3,350	50
514 000	50,00	20,40	2,00		3,50	1,50	2 <sup>f</sup>	24,850	1,125	4687	2,375	50
514 100	50,00	20,40	2,50		3,85	1,35	2 <sup>f</sup>	30,970	1,013	7919	2,838	50
514 200	50,00	22,40	2,00		3,60	1,60	2 <sup>f</sup>	23,820	1,200	5222	2,400	50



Original SCHNORR® disc springs standard material								Ø 50 - 100 mm				
Articlenumber	Ordering dimensions							Weight	Spring travels	Spring force F	Test length	Packing
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	t' [mm]	l <sub>o</sub> [mm]	h <sub>o</sub> [mm]	Gr. acc. to DIN EN 16983	per 1000 pieces [kg]	at s = 0,75 h <sub>o</sub> s [mm]	at s = 0,75 h <sub>o</sub> F [N]	at s = 0,75 h <sub>o</sub> l <sub>t</sub> [mm]	Unit [Piece]
514 300	50,00	22,40	2,50		3,90	1,40	2 <sup>f</sup>	29,680	1,050	8510	2,850	50
514 400 C	<b>50,00</b>	<b>25,40</b>	<b>1,25</b>		2,85	1,60	2 <sup>f</sup>	13,820	1,200	1550	1,650	50
514 500	50,00	25,40	1,50		3,10	1,60	2 <sup>f</sup>	16,540	1,200	2512	1,900	50
514 600 B	<b>50,00</b>	<b>25,40</b>	<b>2,00</b>		3,40	1,40	2 <sup>f</sup>	22,090	1,050	4762	2,350	50
514 700	50,00	25,40	2,50		3,90	1,40	2 <sup>f</sup>	27,520	1,050	9063	2,850	50
514 800 A	<b>50,00</b>	<b>25,40</b>	<b>3,00</b>		4,10	1,10	2 <sup>f</sup>	32,850	0,825	11976	3,275	50
514 950 C	<b>56,00</b>	<b>28,50</b>	<b>1,50</b>		3,45	1,95	2 <sup>f</sup>	20,850	1,463	2622	1,988	25
515 000 B	<b>56,00</b>	<b>28,50</b>	<b>2,00</b>		3,60	1,60	2 <sup>f</sup>	27,810	1,200	4438	2,400	25
515 100 A	<b>56,00</b>	<b>28,50</b>	<b>3,00</b>		4,30	1,30	2 <sup>f</sup>	41,570	0,975	11388	3,325	25
515 200	60,00	20,50	2,00		4,10	2,10	2 <sup>f</sup>	38,160	1,575	4730	2,525	25
515 300	60,00	20,50	2,50		4,30	1,80	2 <sup>f</sup>	47,690	1,350	7302	2,950	25
515 400	60,00	20,50	3,00		4,70	1,70	2 <sup>f</sup>	57,040	1,275	11577	3,425	25
515 500	60,00	25,50	2,50		4,40	1,90	2 <sup>f</sup>	44,200	1,425	8175	2,975	25
515 600	60,00	25,50	3,00		4,65	1,65	2 <sup>f</sup>	52,860	1,238	11784	3,413	25
515 700	60,00	30,50	2,50		4,30	1,80	2 <sup>f</sup>	39,940	1,350	8342	2,950	25
515 800	60,00	30,50	3,00		4,70	1,70	2 <sup>f</sup>	47,770	1,275	13226	3,425	25
515 900	60,00	30,50	3,50		5,00	1,50	2 <sup>f</sup>	55,100	1,125	18153	3,875	25
516 050 C	<b>63,00</b>	<b>31,00</b>	<b>1,80</b>		4,15	2,35	2 <sup>f</sup>	32,530	1,763	4238	2,388	-
516 100 B	<b>63,00</b>	<b>31,00</b>	<b>2,50</b>		4,25	1,75	2 <sup>f</sup>	44,850	1,313	7189	2,938	-
516 200	<b>63,00</b>	<b>31,00</b>	<b>3,00</b>		4,80	1,80	2 <sup>f</sup>	53,860	1,350	12536	3,450	-
516 300 A	<b>63,00</b>	<b>31,00</b>	<b>3,50</b>		4,90	1,40	2 <sup>f</sup>	62,130	1,050	15025	3,850	-
516 400	70,00	25,50	2,00		4,50	2,50	2 <sup>f</sup>	50,780	1,875	4437	2,625	-
516 500	70,00	30,50	2,50		4,90	2,40	2 <sup>f</sup>	59,530	1,800	8031	3,100	-
516 600	70,00	30,50	3,00		5,10	2,10	2 <sup>f</sup>	71,190	1,575	11426	3,525	-
516 700	70,00	35,50	3,00		5,10	2,10	2 <sup>f</sup>	65,210	1,575	12287	3,525	-
516 800	70,00	35,50	4,00		5,80	1,80	2 <sup>f</sup>	86,130	1,350	23923	4,450	-
516 900	70,00	40,50	4,00		5,60	1,60	2 <sup>f</sup>	77,040	1,200	23351	4,400	-
517 000	70,00	40,50	5,00		6,20	1,20	2 <sup>f</sup>	95,150	0,900	33672	5,300	-
517 100 C	<b>71,00</b>	<b>36,00</b>	<b>2,00</b>		4,60	2,60	2 <sup>f</sup>	44,660	1,950	5144	2,650	-
517 200 B	<b>71,00</b>	<b>36,00</b>	<b>2,50</b>		4,50	2,00	2 <sup>f</sup>	56,110	1,500	6725	3,000	-
517 300 A	<b>71,00</b>	<b>36,00</b>	<b>4,00</b>		5,60	1,60	2 <sup>f</sup>	88,630	1,200	20535	4,400	-
517 400	80,00	31,00	2,50		5,30	2,80	2 <sup>f</sup>	82,010	2,100	7239	3,200	-
517 500	80,00	31,00	3,00		5,50	2,50	2 <sup>f</sup>	98,010	1,875	10352	3,625	-
517 600	80,00	31,00	4,00		6,10	2,10	2 <sup>f</sup>	130,000	1,575	19394	4,525	-
517 700	80,00	36,00	3,00		5,70	2,70	2 <sup>f</sup>	91,920	2,025	11919	3,675	-
517 800	80,00	36,00	4,00		6,20	2,20	2 <sup>f</sup>	121,900	1,650	21400	4,550	-
517 850 C	<b>80,00</b>	<b>41,00</b>	<b>2,25</b>		5,20	2,95	2 <sup>f</sup>	63,540	2,213	6613	2,988	-
517 900 B	<b>80,00</b>	<b>41,00</b>	<b>3,00</b>		5,30	2,30	2 <sup>f</sup>	84,920	1,725	10518	3,575	-
518 000	80,00	41,00	4,00		6,20	2,20	2 <sup>f</sup>	112,600	1,650	22874	4,550	-
518 100 A	<b>80,00</b>	<b>41,00</b>	<b>5,00</b>		6,70	1,70	2 <sup>f</sup>	139,500	1,275	33559	5,425	-
518 200 C	<b>90,00</b>	<b>46,00</b>	<b>2,50</b>		5,70	3,20	2 <sup>f</sup>	89,740	2,400	7684	3,300	-
518 300 B	<b>90,00</b>	<b>46,00</b>	<b>3,50</b>		6,00	2,50	2 <sup>f</sup>	125,300	1,875	14161	4,125	-
518 400 B	<b>90,00</b>	<b>46,00</b>	<b>5,00</b>		7,00	2,00	2 <sup>f</sup>	177,600	1,500	31354	5,500	-
518500	100,00	41,00	4,00		7,20	3,20	2 <sup>f</sup>	200,000	2,400	20251	4,800	-
518600	100,00	41,00	5,00		7,75	2,75	2 <sup>f</sup>	248,900	2,063	32361	5,688	-
518 750 C	<b>100,00</b>	<b>51,00</b>	<b>2,70</b>		6,20	3,50	2 <sup>f</sup>	120,100	2,625	8609	3,575	-
518 800 B	<b>100,00</b>	<b>51,00</b>	<b>3,50</b>		6,30	2,80	2 <sup>f</sup>	155,400	2,100	13070	4,200	-
518 900	100,00	51,00	4,00		7,00	3,00	2 <sup>f</sup>	177,600	2,250	20674	4,750	-
519 000	100,00	51,00	5,00		7,80	2,80	2 <sup>f</sup>	221,100	2,100	36339	5,700	-
519 150 A	<b>100,00</b>	<b>51,00</b>	<b>6,00</b>		8,20	2,20	2 <sup>f</sup>	262,800	1,650	48022	6,550	-
019 160	100,00	51,00	7,00	6,55	9,20	2,20	3	300,000	1,650	75840	7,550	-

2<sup>9</sup> = according to group 2 (DIN EN 16983) - manufacturing process turned (D<sub>g</sub>/D)

2<sup>f</sup> = according to group 2 (DIN EN 16983) - manufacturing process fine blanked

## Original SCHNORR® disc springs standard material

Ø 112 - 200 mm

Articlenumber	Ordering dimensions							Weight per 1000 pieces [kg]	Spring travels s [mm]	Spring force F at s = 0,75 h <sub>0</sub> F [N]	Test length at s = 0,75 h <sub>0</sub> l <sub>T</sub> [mm]	Packing Unit [Piece]
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	t' [mm]	l <sub>0</sub> [mm]	h <sub>0</sub> [mm]	Gr. acc. to DIN EN 16983					
<b>519 250 C</b>	<b>112,00</b>	<b>57,00</b>	<b>3,00</b>		6,90	3,90	2 <sup>f</sup>	168,000	2,925	10489	3,975	-
<b>519 300 B</b>	<b>112,00</b>	<b>57,00</b>	<b>4,00</b>		7,20	3,20	2 <sup>f</sup>	222,700	2,400	17752	4,800	-
<b>519 450 A</b>	<b>112,00</b>	<b>57,00</b>	<b>6,00</b>		8,50	2,50	2 <sup>f</sup>	332,100	1,875	43707	6,625	-
<b>019 500</b>	125,00	41,00	4,00		8,20	4,20	2 <sup>g</sup>	338,100	3,150	17346	5,050	-
<b>519 600</b>	125,00	51,00	4,00		8,50	4,50	2 <sup>f</sup>	315,600	3,375	19817	5,125	-
<b>519 700</b>	125,00	51,00	5,00		8,90	3,90	2 <sup>f</sup>	391,500	2,925	30669	5,975	-
<b>519 850</b>	125,00	51,00	6,00		9,40	3,40	2 <sup>f</sup>	465,800	2,550	44307	6,850	-
<b>519 900</b>	125,00	61,00	5,00		9,00	4,00	2 <sup>f</sup>	357,600	3,000	33965	6,000	-
<b>520 050</b>	125,00	61,00	6,00		9,60	3,60	2 <sup>f</sup>	425,400	2,700	50722	6,900	-
<b>520 200 C</b>	<b>125,00</b>	<b>64,00</b>	<b>3,50</b>		8,00	4,50	2 <sup>f</sup>	242,300	3,375	15416	4,625	-
<b>520 300 B</b>	<b>125,00</b>	<b>64,00</b>	<b>5,00</b>		8,50	3,50	2 <sup>f</sup>	346,200	2,625	29908	5,875	-
<b>520 550</b>	125,00	71,00	6,00		9,30	3,30	2 <sup>f</sup>	377,900	2,475	51304	6,825	-
<b>020 100</b>	125,00	61,00	8,00	7,50	10,90	2,90	3	547,300	2,175	93577	8,725	-
<b>020 350</b>	125,00	64,00	8,00	6,55	10,00	3,00	3	466,800	2,250	67216	7,750	-
<b>020 400 A</b>	<b>125,00</b>	<b>64,00</b>	<b>8,00</b>	7,50	10,60	2,60	3	529,900	1,950	85926	8,650	-
<b>020 600</b>	125,00	71,00	8,00	7,40	10,40	2,40	3	479,600	1,800	85494	8,600	-
<b>020 700</b>	125,00	71,00	10,00	9,20	11,80	1,80	3	596,300	1,350	124124	10,450	-
<b>020 850 C</b>	<b>140,00</b>	<b>72,00</b>	<b>3,80</b>		8,70	4,90	2 <sup>g</sup>	329,700	3,675	17195	5,025	-
<b>020 900 B</b>	<b>140,00</b>	<b>72,00</b>	<b>5,00</b>		9,00	4,00	2 <sup>g</sup>	433,200	3,000	27920	6,000	-
<b>021 000 A</b>	<b>140,00</b>	<b>72,00</b>	<b>8,00</b>	7,50	11,20	3,20	3	663,000	2,400	85251	8,800	-
<b>021 100</b>	150,00	61,00	5,00		10,30	5,30	2 <sup>g</sup>	565,000	3,975	31041	6,325	-
<b>021 250</b>	150,00	61,00	6,00		10,80	4,80	2 <sup>g</sup>	676,800	3,600	45456	7,200	-
<b>021 350</b>	150,00	71,00	6,00		10,80	4,80	2 <sup>g</sup>	628,900	3,600	48155	7,200	-
<b>021 400</b>	150,00	71,00	8,00	7,50	12,00	4,00	3	803,600	3,000	89851	9,000	-
<b>021 500</b>	150,00	81,00	8,00	7,50	11,70	3,70	3	732,900	2,775	89532	8,925	-
<b>021 600</b>	150,00	81,00	10,00	9,30	13,00	3,00	3	908,800	2,250	139128	10,750	-
<b>521 650 C</b>	<b>160,00</b>	<b>82,00</b>	<b>4,30</b>		9,90	5,60	2 <sup>f</sup>	492,200	4,200	21843	5,700	-
<b>021 750 B</b>	<b>160,00</b>	<b>82,00</b>	<b>6,00</b>		10,50	4,50	2 <sup>g</sup>	679,800	3,375	41008	7,125	-
<b>021 800 A</b>	<b>160,00</b>	<b>82,00</b>	<b>10,00</b>	9,40	13,50	3,50	3	1089,000	2,625	138331	10,875	-
<b>021 850 C</b>	<b>180,00</b>	<b>92,00</b>	<b>4,80</b>		11,00	6,20	2 <sup>g</sup>	705,300	4,650	26442	6,350	-
<b>021 950 B</b>	<b>180,00</b>	<b>92,00</b>	<b>6,00</b>		11,10	5,10	2 <sup>g</sup>	862,500	3,825	37502	7,275	-
<b>022 000 C</b>	<b>180,00</b>	<b>92,00</b>	<b>10,00</b>	9,40	14,00	4,00	3	1381,000	3,000	125417	11,000	-
<b>022 050</b>	180,00	92,00	13,00	12,10	16,50	3,50	3	1790,500	2,625	237883	13,875	-
<b>022 100</b>	200,00	82,00	8,00	7,60	14,20	6,20	3	1554,000	4,650	78034	9,550	-
<b>022 200</b>	200,00	82,00	10,00	9,60	15,50	5,50	3	1962,000	4,125	129445	11,375	-
<b>022 300</b>	200,00	82,00	12,00	11,50	16,60	4,60	3	2351,000	3,450	182737	13,150	-
<b>022 400</b>	200,00	92,00	10,00	9,50	15,60	5,60	3	1840,000	4,200	137688	11,400	-
<b>022 500</b>	200,00	92,00	12,00	11,40	16,80	4,80	3	2208,000	3,600	199269	13,200	-
<b>022 600</b>	200,00	92,00	14,00	13,10	18,10	4,10	3	2537,000	3,075	267227	15,025	-
<b>022 650 C</b>	200,00	102,00	5,50		12,50	7,00	2 <sup>g</sup>	999,300	5,250	36111	7,250	-
<b>022 700 B</b>	200,00	102,00	8,00	7,50	13,60	5,60	3	1363,000	4,200	76378	9,400	-
<b>022 800</b>	200,00	102,00	10,00	9,40	15,60	5,60	3	1708,000	4,200	145357	11,400	-
<b>022 900 A</b>	200,00	102,00	12,00	11,25	16,20	4,20	3	2044,000	3,150	183020	13,050	-
<b>023 000</b>	200,00	102,00	14,00	13,10	18,20	4,20	3	2380,000	3,150	289181	15,050	-
<b>023 100</b>	200,00	112,00	12,00	11,10	16,20	4,20	3	1870,000	3,150	195830	13,050	-
<b>023 200</b>	200,00	112,00	14,00	12,90	17,50	3,50	3	2173,000	2,625	256758	14,875	-
<b>023 300</b>	200,00	112,00	16,00	14,80	18,80	2,80	3	2493,000	2,100	305100	16,700	-

2<sup>g</sup> = according to group 2 (DIN EN 16983) - manufacturing process turned (D<sub>e</sub>/D)2<sup>f</sup> = according to group 2 (DIN EN 16983) - manufacturing process fine blanked

Original SCHNORR® disc springs standard material								Ø 225 - 250 mm				
Articlenumber	Ordering dimensions							Weight per 1000 pieces [kg]	Spring travel s at s = 0,75 h <sub>0</sub> [mm]	Spring force F at s = 0,75 h <sub>0</sub> [N]	Test length at s = 0,75 h <sub>0</sub> l <sub>T</sub> [mm]	Packing Unit [Piece]
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	t' [mm]	l <sub>0</sub> [mm]	h <sub>0</sub> [mm]	Gr. acc. to DIN EN 16983					
<b>023 350 C</b>	225,00	112,00	6,50	6,20	13,60	7,10	3	1450,000	5,325	44580	8,275	-
<b>023 400 B</b>	<b>225,00</b>	<b>112,00</b>	<b>8,00</b>	7,50	14,50	6,50	3	1754,000	4,875	70749	9,625	-
<b>023 500 A</b>	<b>225,00</b>	<b>112,00</b>	<b>12,00</b>	11,25	17,00	5,00	3	2631,000	3,750	171016	13,250	-
<b>023 550</b>	225,00	112,00	16,00	15,00	20,50	4,50	3				20,500	-
<b>023 600</b>	250,00	102,00	10,00	9,60	18,00	8,00	3	3075,000	6,000	126387	12,000	-
<b>023 700</b>	250,00	102,00	12,00	11,50	19,00	7,00	3	3683,000	5,250	182962	13,750	-
<b>023 750 C</b>	<b>250,00</b>	<b>127,00</b>	<b>7,00</b>	6,70	14,80	7,80	3	1909,000	5,850	50466	8,950	-
<b>023 800 B</b>	<b>250,00</b>	<b>127,00</b>	<b>10,00</b>	9,40	17,00	7,00	3	2678,000	5,250	119053	11,750	-
<b>023 900</b>	250,00	127,00	12,00	11,25	19,30	7,30	3	3205,000	5,475	210806	13,825	-
<b>024 000 A</b>	<b>250,00</b>	<b>127,00</b>	<b>14,00</b>	13,10	19,60	5,60	3	3732,000	4,200	248828	15,400	-
<b>024 100</b>	250,00	127,00	16,00	15,00	21,80	5,80	3	4273,000	4,350	383017	17,450	-

2<sup>9</sup> = according to group 2 (DIN EN 16983) - manufacturing process turned (D<sub>e</sub>/D<sub>i</sub>)      2<sup>f</sup> = according to group 2 (DIN EN 16983) - manufacturing process fine blanked

Corrosion-resistant SCHNORR® disc springs, material 1.4310 (X10 CrNi 18-8)							Ø 6 - 15 mm			
Articlenumber	Ordering dimensions						Weight 1000 pieces [kg]	Spring travel s at s = 0,75 h <sub>0</sub> [mm]	Spring force F at s = 0,75 h <sub>0</sub> [N]	Test length at s = 0,75 h <sub>0</sub> l <sub>T</sub> [mm]
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	l <sub>0</sub> [mm]	h <sub>0</sub> [mm]					
<b>024650</b>	6,00	3,20	0,30	0,45	0,15	0,047	0,113	110	0,338	
<b>025250</b>	8,00	3,20	0,20	0,40	0,20	0,066	0,150	24	0,250	
<b>025400</b>	8,00	3,20	0,30	0,55	0,25	0,098	0,188	96	0,363	
<b>025700</b>	8,00	3,20	0,40	0,55	0,15	0,131	0,113	126	0,438	
<b>026300</b>	8,00	3,20	0,50	0,70	0,20	0,166	0,150	330	0,550	
<b>026700</b>	8,00	4,20	0,20	0,45	0,25	0,057	0,188	36	0,263	
<b>027100</b>	8,00	4,20	0,30	0,50	0,20	0,085	0,150	84	0,350	
<b>027400</b>	8,00	4,20	0,40	0,60	0,20	0,113	0,150	193	0,450	
<b>028910</b>	10,00	3,20	0,30	0,65	0,35	0,165	0,263	91	0,388	
<b>029301</b>	10,00	3,20	0,50	0,70	0,20	0,274	0,150	203	0,550	
<b>029602</b>	10,00	4,20	0,40	0,70	0,30	0,202	0,225	174	0,475	
<b>029701</b>	10,00	4,20	0,50	0,70	0,20	0,252	0,150	214	0,550	
<b>030290</b>	10,00	5,20	0,25	0,55	0,30	0,112	0,225	53	0,325	
<b>030800</b>	10,00	5,20	0,40	0,65	0,25	0,179	0,188	157	0,463	
<b>031000</b>	10,00	5,20	0,50	0,70	0,20	0,223	0,150	237	0,550	
<b>032040</b>	12,00	4,20	0,40	0,80	0,40	0,309	0,300	165	0,500	
<b>032500</b>	12,00	4,20	0,50	0,80	0,30	0,386	0,225	220	0,575	
<b>032704</b>	12,00	4,20	0,60	0,85	0,25	0,463	0,188	308	0,663	
<b>033400</b>	12,00	5,20	0,50	0,80	0,30	0,357	0,225	232	0,575	
<b>033500</b>	12,00	5,20	0,60	0,85	0,25	0,429	0,188	325	0,663	
<b>034200</b>	12,00	6,20	0,50	0,85	0,35	0,323	0,263	301	0,588	
<b>034550</b>	12,00	6,20	0,60	0,85	0,25	0,387	0,188	355	0,663	
<b>035103</b>	12,50	6,20	0,35	0,80	0,45	0,253	0,338	140	0,463	
<b>035400</b>	12,50	6,20	0,50	0,85	0,35	0,361	0,263	271	0,588	
<b>035601</b>	12,50	6,20	0,70	0,95	0,25	0,504	0,188	503	0,763	
<b>038353</b>	14,00	7,20	0,35	0,80	0,45	0,310	0,338	114	0,463	
<b>038600</b>	14,00	7,20	0,50	0,90	0,40	0,442	0,300	258	0,600	
<b>039040</b>	14,00	7,20	0,80	1,05	0,25	0,706	0,188	608	0,863	
<b>039500</b>	15,00	5,20	0,40	0,95	0,55	0,486	0,413	162	0,538	
<b>039800</b>	15,00	5,20	0,50	1,00	0,50	0,607	0,375	257	0,625	
<b>040130</b>	15,00	5,20	0,70	1,10	0,40	0,849	0,300	512	0,800	
<b>040950</b>	15,00	6,20	0,50	1,00	0,50	0,572	0,375	267	0,625	
<b>041700</b>	15,00	6,20	0,70	1,05	0,35	0,801	0,263	461	0,788	

## Corrosion-resistant SCHNORR® disc springs, material 1.4310 (X10 CrNi 18-8)

Ø 15 - 28 mm

Articlenumber	Ordering dimensions					Weight 1000 Pieces [kg]	Spring travel s at $s = 0,75 h_0$ [mm]	Spring force F at $s = 0,75 h_0$ [N]	Test length at $s = 0,75 h_0$ [mm]
	$D_e$ [mm]	$D_i$ [mm]	t [mm]	$l_0$ [mm]	$h_0$ [mm]				
042400	15,00	8,20	0,70	1,00	0,30	0,677	0,225	451	0,775
042601	15,00	8,20	0,80	1,10	0,30	0,773	0,225	668	0,875
043750	16,00	8,20	0,40	0,90	0,50	0,464	0,375	142	0,525
044000	16,00	8,20	0,60	1,05	0,45	0,695	0,338	378	0,713
044101	16,00	8,20	0,70	1,05	0,35	0,811	0,263	446	0,788
044201	16,00	8,20	0,80	1,10	0,30	0,926	0,225	561	0,875
044400	16,00	8,20	0,90	1,20	0,30	1,042	0,225	796	0,975
045800	18,00	6,20	0,40	1,00	0,60	0,702	0,450	128	0,550
046003	18,00	6,20	0,50	1,10	0,60	0,878	0,450	226	0,650
046252	18,00	6,20	0,60	1,20	0,60	1,053	0,450	369	0,750
046505	18,00	6,20	0,80	1,30	0,50	1,403	0,375	669	0,925
047070	18,00	8,20	0,70	1,20	0,50	1,104	0,375	492	0,825
047300	18,00	8,20	0,80	1,25	0,45	1,262	0,338	643	0,913
047691	18,00	8,20	1,00	1,35	0,35	1,576	0,263	948	1,088
047910	18,00	9,20	0,45	1,05	0,60	0,662	0,450	197	0,600
048050	18,00	9,20	0,70	1,20	0,50	1,029	0,375	522	0,825
048098	18,00	9,20	1,00	1,35	0,35	1,469	0,263	1006	1,088
048051	20,00	8,20	0,50	1,15	0,65	1,029	0,488	213	0,663
051100	20,00	8,20	0,60	1,30	0,70	1,226	0,525	380	0,775
052270	20,00	8,20	0,70	1,35	0,65	1,430	0,488	524	0,863
051450	20,00	8,20	0,80	1,40	0,60	1,634	0,450	693	0,950
051701	20,00	8,20	0,90	1,45	0,55	1,838	0,413	880	1,038
051761	20,00	8,20	1,00	1,45	0,45	2,042	0,338	962	1,113
052803	20,00	10,20	0,50	1,15	0,65	0,910	0,488	234	0,663
052804	20,00	10,20	0,60	1,20	0,60	1,098	0,450	342	0,750
053500	20,00	10,20	0,80	1,35	0,55	1,454	0,413	690	0,938
053701	20,00	10,20	0,90	1,40	0,50	1,635	0,375	872	1,025
053901	20,00	10,20	1,00	1,40	0,40	1,817	0,300	936	1,100
054380	20,00	10,20	1,10	1,50	0,40	1,998	0,300	1240	1,200
055280	20,00	10,20	1,25	1,55	0,30	2,269	0,225	1349	1,325
006605	20,00	10,20	1,25	1,75	0,50	2,284	0,380	2284	1,370
055650	20,00	10,20	1,50	1,75	0,25	2,721	0,188	1934	1,563
057710	22,50	11,20	0,60	1,40	0,80	1,406	0,600	392	0,800
057903	22,50	11,20	0,80	1,45	0,65	1,873	0,488	653	0,963
058001	22,50	11,20	1,25	1,65	0,40	2,939	0,300	1411	1,350
058950	23,00	8,20	0,70	1,50	0,80	1,987	0,600	501	0,900
059400	23,00	8,20	0,90	1,60	0,70	2,554	0,525	848	1,075
059504	23,00	8,20	1,00	1,60	0,60	2,838	0,450	962	1,150
060600	23,00	10,20	1,00	1,60	0,60	2,613	0,450	1020	1,150
001922	23,00	12,20	1,00	1,60	0,60	2,337	0,450	1122	1,150
061600	23,00	12,20	1,25	1,65	0,40	2,919	0,300	1406	1,350
015471	23,00	12,20	1,25	1,65	0,40	2,934	0,300	1406	1,350
060903	23,00	12,20	1,25	1,70	0,45	3,279	0,338	1444	1,362
061951	23,00	12,20	1,50	1,85	0,35	3,501	0,263	2110	1,588
063872	25,00	10,20	1,00	1,70	0,70	3,205	0,525	998	1,175
064400	25,00	12,20	0,70	1,60	0,90	2,052	0,675	553	0,925
064900	25,00	12,20	0,90	1,60	0,70	2,637	0,525	795	1,075
065104	25,00	12,20	1,00	1,65	0,65	2,929	0,488	987	1,163
065400	25,00	12,20	1,50	1,95	0,45	4,389	0,338	2193	1,613
071600	28,00	10,20	0,80	1,75	0,95	3,351	0,713	610	1,038
071601	28,00	10,20	1,25	2,05	0,80	5,247	0,600	1709	1,450
072105	28,00	10,20	1,50	2,10	0,60	6,277	0,450	2134	1,650

Articlenumber	Ordering dimensions					Weight 1000 pieces [kg]	Spring travel s	Spring force F	Test length
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	l <sub>0</sub> [mm]	h <sub>0</sub> [mm]		at s = 0,75 h <sub>0</sub> s [mm]	at s = 0,75 h <sub>0</sub> F [N]	at s = 0,75 h <sub>0</sub> l <sub>T</sub> [mm]
072750	28,00	12,20	1,00	1,95	0,95	3,911	0,713	1170	1,238
073300	28,00	12,20	1,50	2,05	0,55	5,862	0,413	2045	1,638
075260	28,00	14,20	0,80	1,80	1,00	2,870	0,750	739	1,050
075700	28,00	14,20	1,00	1,80	0,80	3,586	0,600	1021	1,200
075925	28,00	14,20	1,25	1,90	0,65	4,480	0,488	1535	1,413
076160	28,00	14,20	1,50	2,05	0,55	5,373	0,413	2199	1,638
076110	28,00	14,20	1,50	2,15	0,65	5,393	0,488	2620	1,662
082801	31,50	16,30	0,80	1,85	1,05	3,577	0,788	634	1,063
004842	31,50	16,30	1,25	2,00	0,75	5,374	0,563	1437	1,438
083800	31,50	16,30	1,50	2,15	0,65	6,698	0,488	2097	1,663
084493	31,50	16,30	1,75	2,30	0,55	7,811	0,413	2779	1,888
083370	31,50	16,30	1,25	2,00	0,75	5,607	0,563	1437	1,437
084800	31,50	16,30	2,00	2,50	0,50	8,923	0,375	3750	2,125
087900	34,00	12,30	1,00	2,25	1,25	6,187	0,938	1083	1,313
007698	34,00	12,30	1,50	2,40	0,90	9,304	0,675	2234	1,725
088300	34,00	12,30	1,50	2,40	0,90	9,275	0,675	2234	1,725
089321	34,00	14,30	1,25	2,30	1,05	7,321	0,788	1646	1,513
089400	34,00	14,30	1,50	2,35	0,85	8,783	0,638	2178	1,713
090500	34,00	16,30	1,50	2,30	0,80	8,216	0,600	2151	1,700
091100	34,00	16,30	2,00	2,60	0,60	10,946	0,450	3713	2,150
004543	35,50	18,30	0,90	2,05	1,15	5,132	0,863	767	1,188
094000	35,50	18,30	1,25	2,25	1,00	7,124	0,750	1567	1,500
093683	35,50	18,30	2,00	2,65	0,65	11,385	0,488	3855	2,163
099423	40,00	14,30	1,25	2,65	1,40	10,752	1,050	1642	1,600
100503	40,00	16,30	1,50	2,70	1,20	12,332	0,900	2304	1,800
100801	40,00	16,30	2,00	2,90	0,90	16,433	0,675	3842	2,225
101755	40,00	18,30	2,00	2,85	0,85	15,584	0,638	3770	2,213
102531	40,00	20,40	1,00	2,30	1,30	7,300	0,975	938	1,325
103000	40,00	20,40	1,50	2,60	1,10	10,942	0,825	2296	1,775
103500	40,00	20,40	2,00	2,80	0,80	14,580	0,600	3743	2,200
103953	40,00	20,40	2,25	2,95	0,70	16,397	0,525	4618	2,425
104465	40,00	20,40	2,50	3,15	0,65	18,212	0,488	5856	2,663
004443	45,00	22,40	1,25	2,90	1,65	11,690	1,238	1822	1,663
110412	45,00	22,40	1,25	2,90	1,65	11,746	1,238	1822	1,663
115970	50,00	18,40	1,25	2,85	1,60	16,679	1,200	1268	1,650
116300	50,00	18,40	1,50	3,30	1,80	20,011	1,350	2404	1,950
116901	50,00	18,40	2,50	3,65	1,15	33,323	0,863	5996	2,788
117400	50,00	20,40	2,00	3,40	1,40	25,710	1,050	3993	2,350
117703	50,00	20,40	2,50	3,60	1,10	32,123	0,825	5864	2,775
118401	50,00	22,40	2,00	3,30	1,30	24,652	0,975	3792	2,325
014401	50,00	25,40	1,25	2,85	1,60	13,792	1,200	1430	1,650
119950	50,00	25,40	1,25	2,85	1,60	14,314	1,200	1430	1,650
120103	50,00	25,40	1,50	3,10	1,60	17,168	1,200	2317	1,900
120400	50,00	25,40	2,00	3,30	1,30	22,878	0,975	4039	2,325
120801	50,00	25,40	2,50	3,50	1,00	28,582	0,750	5834	2,750
121001	50,00	25,40	3,00	3,85	0,85	34,353	0,638	8465	3,212
128599	56,00	28,50	1,50	3,45	1,95	21,495	1,463	2419	1,988
128600	56,00	28,50	2,00	3,60	1,60	28,646	1,200	4093	2,400
129051	56,00	28,50	3,00	4,05	1,05	43,038	0,788	8400	3,262
131801	60,00	25,50	2,50	4,10	1,60	45,471	1,200	6196	2,900
138221	63,00	31,00	1,80	4,10	2,30	33,419	1,725	3792	2,375
138503	63,00	31,00	2,50	4,15	1,65	46,389	1,238	6202	2,913
138725	63,00	31,00	3,00	4,40	1,40	55,711	1,050	8804	3,350



## Corrosion-resistant SCHNORR® disc springs, material 1.4310 (X10 CrNi 18-8)

Ø 70 - 100 mm

Articlenumber	Ordering dimensions					Weight per 1000 pieces [kg]	Spring travel s at s = 0,75 h <sub>0</sub> s [mm]	Force F at s = 0,75 h <sub>0</sub> F [N]	Test length at s = 0,75 h <sub>0</sub> l <sub>T</sub> [mm]
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	l <sub>0</sub> [mm]	h <sub>0</sub> [mm]				
144401	70,00	25,50	2,00	4,50	2,50	52,479	1,875	4092	2,625
146250	70,00	30,50	2,50	4,70	2,20	61,266	1,650	6653	3,050
169200	90,00	46,00	2,50	5,70	3,20	92,370	2,400	7087	3,300
175680	100,00	51,00	3,00	6,40	3,40	137,036	2,550	10062	3,850

## Corrosion-resistant SCHNORR® disc springs, material 1.4310 (X10 CrNi 18-8)

Ø 31,5 - 90 mm

Articlenumber	Ordering dimensions					Weight per 1000 pieces [kg]	Spring travel s at s = 0,75 h <sub>0</sub> s [mm]	Force F at s = 0,75 h <sub>0</sub> F [N]	Test length at s = 0,75 h <sub>0</sub> l <sub>T</sub> [mm]
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	l <sub>0</sub> [mm]	h <sub>0</sub> [mm]				
084150	31,50	16,30	1,75	2,30	0,55	7,800	0,413	2852	1,887
094210	35,50	18,30	2,00	2,65	0,65	11,400	0,487	3956	2,163
103515	40,00	20,40	2,00	2,80	0,80	14,600	0,600	3841	2,200
104295	40,00	20,40	2,25	2,95	0,70	16,400	0,525	4740	2,425
110601	45,00	22,40	1,75	2,80	1,05	16,500	0,787	2711	2,013
110870	45,00	22,40	2,50	3,30	0,80	23,500	0,600	5792	2,700
120520	50,00	25,40	2,00	3,15	1,15	22,900	0,862	3617	2,288
001889	50,00	25,40	2,50	3,50	1,00	28,600	0,750	5988	2,750
120955	50,00	25,40	3,00	3,85	0,85	34,400	0,638	8688	3,212
128656	56,00	28,50	2,00	3,40	1,40	28,700	1,050	3598	2,350
129025	56,00	28,50	3,00	4,05	1,05	43,000	0,787	8621	3,263
000637	63,00	31,00	2,50	3,95	1,45	46,400	1,088	5513	2,862
153061	71,00	36,00	2,50	4,25	1,75	57,800	1,313	5452	2,937
000136	80,00	41,00	3,00	4,90	1,90	87,400	1,425	8005	3,475
001041	90,00	46,00	2,50	5,05	2,55	92,400	1,912	5365	3,138



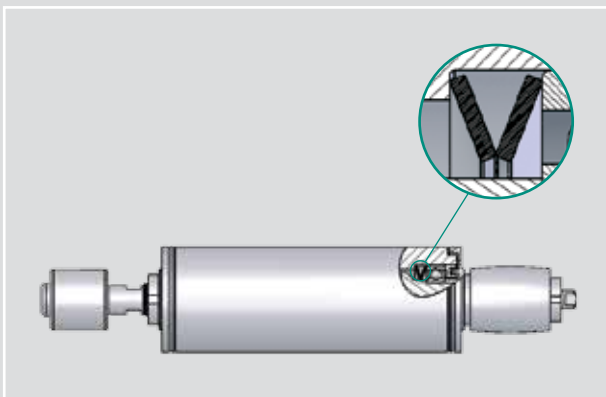
## Original SCHNORR® bearing preload spring

### 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 well-known ball bearings manufacturers. 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 being round. 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  $h_0/t$ ), 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 accommodated 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.



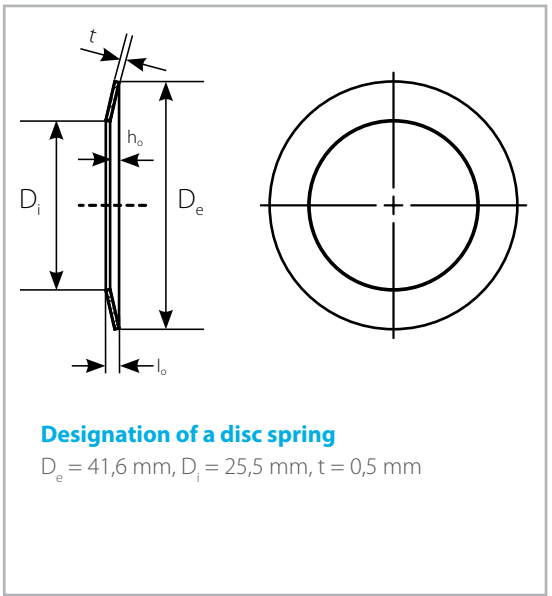
## Original SCHNORR® bearing preload springs type “K”, non-slotted

### 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.



### Original SCHNORR® bearing preload springs type “K”, non-slotted

Ø 9,8 - 119 mm

Article-number	Ordering Dimensions						Spring travel and force		Weight per 1000 pieces [kg]	Ball bearing type		Ball bearing			Packaging
	$D_e$ [mm]	$D_i$ [mm]	$t$ [mm]	$l_o$ [mm]	$h_o$ [mm]	$h_o/t$	at $s \approx 0,75 h_o$					Ext. dia Ø [mm]	Internal dia Ø [mm]		Unit [piece]
							$s$ [mm]	$F$ [N]							
241 200	9,80	6,20	0,20	0,40	0,20	1,00	0,15	23	0,07	623 (EL3)	10	3		1000	
241 400	12,80	7,20	0,25	0,50	0,25	1,00	0,19	29	0,17	624 (EL4)	13	4		1000	
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		1000	
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		1000	
241 800	18,80	10,20	0,35	0,70	0,35	1,00	0,26	51	0,53	607 (EL7)	19	7		1000	
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		1000	
242 100	23,70	14,30	0,40	0,90	0,50	1,25	0,38	81	0,86	609 (EL9)	24	9		500	
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		500	
242 300	27,70	17,30	0,40	1,00	0,60	1,50	0,45	80	1,13	6001	28	12		500	
242 500	29,70	17,40	0,40	1,10	0,70	1,75	0,53	83	1,41	6200	30	10		500	
242 600	31,70	20,40	0,40	1,10	0,70	1,75	0,53	81	1,42	6002 6201	32	15 12		500	
242 800	34,60	20,40	0,40	1,10	0,70	1,75	0,53	61	1,89	6300	35	10		500	
242 900	34,60	22,40	0,50	1,20	0,70	1,40	0,53	118	2,10	6003 6202	35	17 15		500	
243 000	36,60	20,40	0,50	1,30	0,80	1,60	0,60	110	2,81	6301	37	12		500	
243 100	39,60	25,50	0,50	1,30	0,80	1,60	0,60	110	2,78	6203	40	17		250	
243 200	41,60	25,50	0,50	1,40	0,90	1,80	0,68	113	3,28	6004 6302	42	20 15		200	
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		200	
243 400	51,50	35,50	0,60	1,50	0,90	1,50	0,68	135	5,06	6205 6304	52	25 20		100	
243 500	54,50	40,50	0,60	1,50	0,90	1,50	0,68	141	4,82	6006	55	30		100	
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		100	
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 (DIN EN 10132-4)**
**Ø 119 - 358 mm**

Article-number	Ordering Dimensions						Spring travel and force		Weight per 1000 pieces [kg]	Ball bearing type		Ball bearing			Packaging		
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	l <sub>o</sub> [mm]	h <sub>o</sub> [mm]	h <sub>o</sub> /t	s [mm]	F [N]				Ext. dia Ø [mm]	Internal dia Ø [mm]		Unit [piece]		
245 300	119,00	85,50	1,25	2,80	1,55	1,24	1,16	393	52,28		6213	120	65		1000		
245 400	124,00	90,50	1,25	3,00	1,75	1,40	1,31	445	54,75	6016	6214	125	80	70	1000		
245 500	129,00	85,50	1,25	3,20	1,95	1,56	1,46	405	71,28		6312	130	60		1000		
245 600	129,00	95,50	1,25	3,20	1,95	1,56	1,46	500	57,31	6017	6215	130	85	75	1000		
245 700	139,00	90,50	1,25	3,25	2,00	1,60	1,50	354	85,11		6313	140	65		1000		
245 800	139,00	101,00	1,25	3,25	2,00	1,60	1,50	429	69,58	6018	6216	140	90	80	1000		
245 900	149,00	95,50	1,50	3,20	1,70	1,13	1,28	379	120,10		6314	150	70		500		
246 000	149,00	106,00	1,50	3,20	1,70	1,13	1,28	450	100,50	6020	6217	150	100	85	500		
246 100	159,00	101,00	1,50	3,50	2,00	1,33	1,50	412	138,50		6315	160	75		500		
246 200	159,00	111,00	1,50	3,50	2,00	1,33	1,50	477	118,90	6021	6218	160	105	90	500		
246 300	169,00	111,00	1,50	3,80	2,30	1,53	1,73	470	149,20		6316	170	80		500		
246 400	169,00	121,00	1,50	3,80	2,30	1,53	1,73	546	127,70	6022	6219	170	110	95	500		
246 500	179,00	121,00	2,00	4,20	2,20	1,10	1,65	864	213,10		6317	180	95		500		
246 600	179,00	126,00	2,00	4,20	2,20	1,10	1,65	928	197,80	6024	6220	180	120	100	500		
246 700	189,00	121,00	2,00	4,30	2,30	1,15	1,73	759	258,30		6318	190	90		250		
246 800	189,00	131,00	2,00	4,30	2,30	1,15	1,73	858	227,10		6221	190	105		200		
246 900	198,00	131,00	2,00	4,50	2,50	1,25	1,88	812	270,00		6319	200	95		200		
247 000	198,00	141,00	2,00	4,50	2,50	1,25	1,88	923	236,40	6026	6222	200	130	110	100		
247 100	213,00	151,00	2,25	4,50	2,25	1,00	1,69	941	310,90		6224	6320	215	120	100	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	100		
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	-

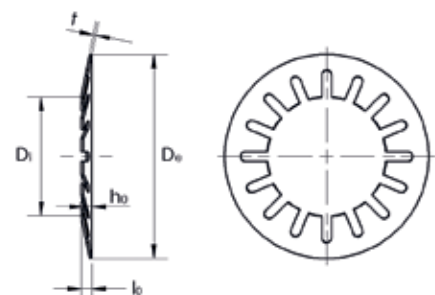
**Original SCHNORR® bearing preload springs**  
 type "K", with slots

**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<sub>e</sub> = 29,7 mm, D<sub>i</sub> = 17,3 mm, t = 0,35 mm

**Original SCHNORR® bearing preload springs type "K", slotted (DIN EN 10132-4)**
**Ø 9,8 - 31,7 mm**

Article-number	Ordering Dimensions						Spring travel and force		Weight per 1000 pieces [kg]	Ball bearing type		Ball bearing			Packaging
	D <sub>e</sub> [mm]	D <sub>i</sub> [mm]	t [mm]	l <sub>o</sub> [mm]	h <sub>o</sub> [mm]	h <sub>o</sub> /t	s [mm]	F [N]				Ext. dia Ø [mm]	Internal dia Ø [mm]		Unit [piece]
241 150	9,80	6,20	0,15	0,60	0,45	3,00	0,35	13	0,050	623(EL3)		10	3		1000
241 850	21,80	12,30	0,25	1,25	1,00	4,00	0,75	24	0,420	608(EL8)	627(R7)	22	8		1000
242 550	31,70	20,40	0,35	1,55	1,20	3,43	0,90	33	1,270	6002	6201	32	15	12	500

# We withstand pressure - or hold it.

e. g. in hydrogen tanks







Mowing machine



Safety washer



Heavy-duty crane



Safety washer



Motorbike



Safety washer



Photovoltaics



Safety washer

# References

## 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 Concentric 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..



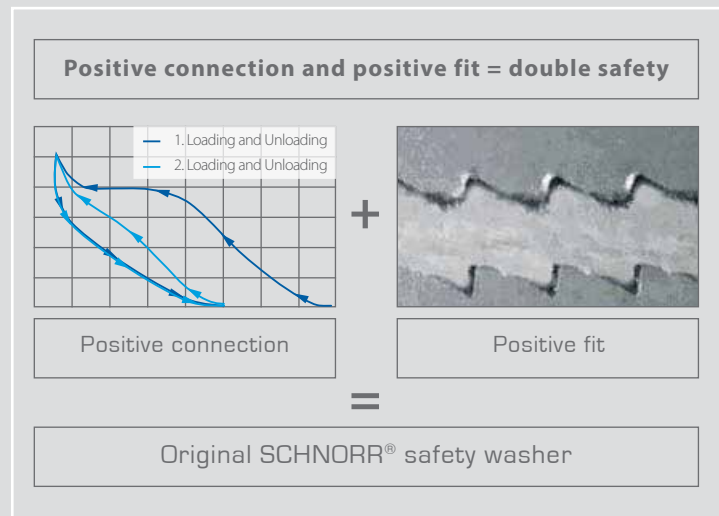
The original SCHNORR® safety washers are in the form of a disc spring but with a trapezoidal cross-section and serrations on both sides. The outer diameter is matched to the head diameter of the pan head and socket head cap screws.

SCHNORR® safety washers are available in two versions:

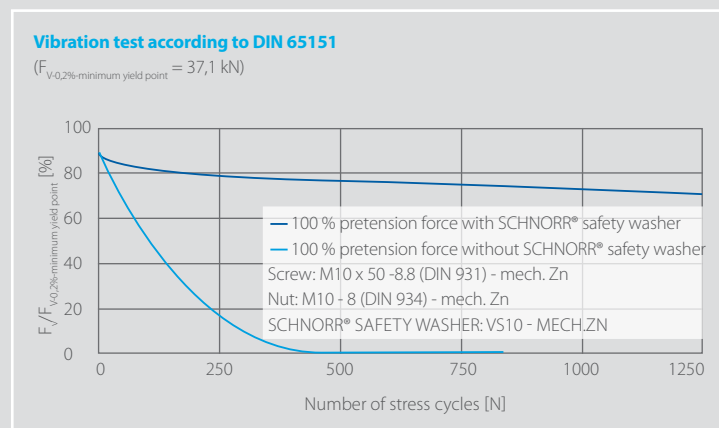
The standard safety washer type "S" is available for screws of sizes M1.6 to M36 and of the property classes up to 8.8.

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 independent public material research laboratories prove that the original SCHNORR® safety washer brings about a clear improvement of the safety properties

## Conclusions

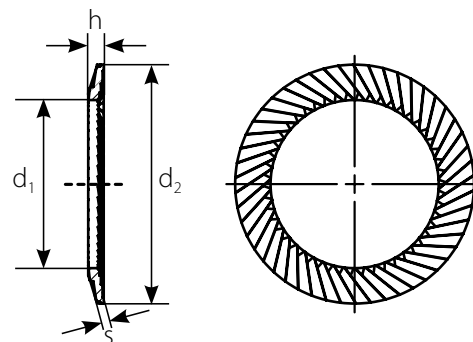
- Connections secured using a SCHNORR® safety washer maintains the pretension force also after 1,500 cycles.
- An unsecured screw connection has lost its pretension already after less than 500 cycles.

## 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:

<b>Article-no.:</b>	applies to the normal version made of spring steel, hardened, blackened; mechanically plate
<b>h max.:</b>	maximum dimension as delivered
<b>h min.:</b>	minimum dimension after load test
<b>Available material gra.:</b>	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
<b>Surface treatments:</b>	blackened (standard), bronzed, phosphated, zinc-coated, 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 1.1211 (C60S)

Article-number	Finish	Size		Ordering dimensions				Packaging	
		Nominal size [mm] [Inch]	d <sub>1</sub> [mm]	d <sub>2</sub> [mm]	s [mm]	h <sub>min.</sub> [mm]	h <sub>max.</sub> [mm]	Unit [pcs.]	Weight per 1000 pieces [kg]
402 300	blackened	1,6	1,70	3,20	0,35	0,40	0,60	2000	0,014
450 000	Gal.Zn8 + passivation								
404 400	blackened	2,0	2,20	4,00	0,35	0,40	0,60	2000	0,022
450 100	Gal.Zn8 + passivation								
406 800	blackened	2,5	2,70	4,80	0,45	0,50	0,90	2000	0,040
450 200	Gal.Zn8 + passivation								
409 400	blackened	3,0	3,20	5,50	0,45	0,50	0,90	2000	0,050
450 300	Gal.Zn8 + passivation								
411 200	blackened	3,5	3,70	6,00	0,50	0,55	0,90	2000	0,050
450 400	Gal.Zn8 + passivation								
412 700	blackened	4,0	4,30	7,00	0,50	0,55	1,00	1000	0,076
450 500	Zn8M + passivation								
414 500	blackened	5,0	5,30	9,00	0,60	0,60	1,10	1000	0,167
450 600	Zn8M + passivation								
460 050	Zn-Flake 720h								
416 300	blackened	6,0	6,40	10,00	0,60	0,70	1,20	1000	0,180
450 700	Zn8M + passivation								
460 060	Zn-Flake 720h								
418 100	blackened	6,35	6,70	9,50	0,60	0,65	1,20	1000	0,135
450 800	Zn8M + passivation								
460 635	Zn-Flake 720h								
419 200	blackened	7,0	7,40	12,00	0,70	0,80	1,30	1000	0,325
450 900	Zn8M + passivation								
460 070	Zn-Flake 720h								
420 400	blackened	8,0	8,40	13,00	0,70	0,90	1,40	1000	0,370
451 000	Zn8M + passivation								
460 080	Zn-Flake 720h								
423 000	blackened	10,0	10,50	16,00	0,90	1,10	1,60	1000	0,680
451 100	Zn8M + passivation								
460 100	Zn-Flake 720h								
425 100	blackened	11,1	11,60	15,90	0,90	1,05	1,60	500	0,560
451 200	Zn8M + passivation								
460 110	Zn-Flake 720h								

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

Article-number	Finish	Size		Ordering dimensions					Packaging	
		Nominal size [mm]	[Inch]	d <sub>1</sub> [mm]	d <sub>2</sub> [mm]	s [mm]	h <sub>min.</sub> [mm]	h <sub>max.</sub> [mm]	Unit [pcs.]	Weight per 1000 pieces [kg]
426 200	blackened									
451 300	Zn8M + passivation	12		13,00	18,00	1,00	1,15	1,70	500	0,790
460 120	Zn-Flake 720h									
427 900	blackened									
451 400	Zn8M + passivation	12,7	1/2"	13,70	19,00	1,00	1,25	1,80	500	0,890
460 127	Zn-Flake 720h									
429 100	blackened									
451 500	Zn8M + passivation	14		15,00	22,00	1,10	1,35	2,00	500	1,641
460 140	Zn-Flake 720h									
430 700	blackened									
451 600	Zn8M + passivation	16	5/8"	17,00	24,00	1,20	1,55	2,10	500	1,790
460 160	Zn-Flake 720h									
432 400	blackened									
451 700	Zn8M + passivation	18	3/4"	20,00	30,00	1,40	1,90	2,50	250	2,720
460 180	Zn-Flake 720h									
433 800	blackened									
451 800	Zn8M + passivation	19	3/4"	20,00	30,00	1,40	1,90	2,50	250	3,790
460 190	Zn-Flake 720h									
435 100	blackened									
451 900	Zn8M + passivation	20		21,00	30,00	1,40	1,85	2,50	250	3,420
460 200	Zn-Flake 720h									
436 600	blackened									
452 000	Zn8M + passivation	22	7/8"	23,00	33,00	1,40	1,95	2,70	100	4,200
460 220	Zn-Flake 720h									
437 900	blackened									
452 100	Zn8M + passivation	24		25,60	36,00	1,60	2,15	2,90	100	5,480
460 240	Zn-Flake 720h									
439 200	blackened									
452 200	Zn8M + passivation	25,4	1"	27,00	38,00	1,80	2,35	3,10	100	6,770
460 254	Zn-Flake 720h									
440 300	blackened									
452 300	Zn8M + passivation	27		28,60	39,00	1,80	2,35	3,10	100	6,800
460 270	Zn-Flake 720h									
441 500	blackened									
452 400	Zn8M + passivation	30	1 1/8"	31,60	45,00	1,80	2,60	3,60	100	10,000
460 300	Zn-Flake 720h									
401 292	blackened									
401 144	Zn8M + passivation	33		34,60	50,00	2,50		4,00	50	20,010
460 330	Zn-Flake 720h									
442 730	blackened									
452 500	Zn8M + passivation	36	1 3/8"	38,00	54,00	2,50	3,20	4,20	50	21,140
460 360	Zn-Flake 720h									

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 1.4301 (X5CrNi18-10 )

Article-number	Size		Ordering dimensions					Packaging	
	Nominal size		d <sub>1</sub> [mm]	d <sub>2</sub> [mm]	s [mm]	h <sub>min.</sub> [mm]	h <sub>max.</sub> [mm]	Unit [pcs.]	Weight per 1000 pieces [kg]
	[mm]	[Inch]							
403 221	1,6		1,70	3,20	0,50	0,55	0,75	2000	0,016
405 420	2		2,20	4,00	0,50	0,55	0,75	2000	0,032
407 660	2,5		2,70	4,80	0,50	0,55	0,95	2000	0,039
410 750	3	1/8"	3,20	5,50	0,50	0,55	0,95	2000	0,046
412 500	3,5		3,70	6,00	0,70	0,75	1,15	2000	0,082
414 200	4	5/32"	4,30	7,00	0,70	0,75	1,20	1000	0,102
416 100	5	3/16"	5,30	9,00	0,70	0,75	1,20	1000	0,196
417 900	6		6,40	10,00	0,70	0,75	1,20	1000	0,220
418 104	6,35	1/4"	6,70	9,50	0,70	0,75	1,20	1000	0,155
422 700	8	5/16"	8,40	13,00	1,00	1,20	1,60	1000	0,530
424 900	10	3/8"	10,50	16,00	1,00	1,10	1,60	1000	0,760
425 110	11,1	7/16"	11,60	15,90	1,30	1,30	1,85	500	0,890
427 600	12		13,00	18,00	1,30	1,30	1,85	500	1,250
428 950	12,7	1/2"	13,70	19,00	1,30	1,40	1,95	500	1,120
430 500	14		15,00	22,00	1,50	1,65	2,30	500	1,950
432 200	16	5/8"	17,00	24,00	1,50	1,75	2,30	500	2,250
433 650	18		19,00	27,00	1,80	2,05	2,60	250	3,700
433 821	19	3/4"	20,00	30,00	1,80	2,20	2,60	250	4,730
436 400	20		21,00	30,00	1,80	2,15	2,80	250	4,500
437 810	22	7/8"	23,00	33,00	1,80	2,30	3,00	100	5,350
439 091	24		25,60	36,00	2,00	2,35	3,10	100	6,760
439 170	25,4	1"	27,00	38,00	2,50	2,85	3,60	100	10,570
441 410	27		28,60	39,00	2,50	2,85	3,60	100	9,500
442 711	30	1 1/8"	31,60	45,00	2,50	3,10	4,10	100	14,490
442 790	36	1 3/8"	38,00	54,00	3,00	3,70	4,70	50	26,440

We would be glad to offer you safety washers type "S" with different finish on request.

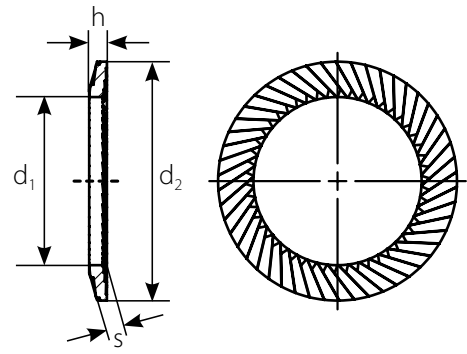


## Original SCHNORR® safety washers type „VS“

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

### Explanations on the table:

<b>Article-no.:</b>	applies to the normal version made of spring steel, hardened, blackened; mechanically plated
<b>h max.:</b>	maximum dimension in delivery condition
<b>h min.:</b>	minimum dimension after load test
<b>Available material grad.:</b>	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
<b>Available surfaces:</b>	blackened (standard), bronzed, phosphated, zinc-coated, zinc lamellar coatings



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

Size 16 made of spring steel, surface mechanically plated  
= safety washer VS 16 FSt. for 8 M + passivation

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

Article-number	Finish	Size		Ordering dimensions					Packaging	
		Nominal size [mm]	[Inch]	d <sub>1</sub> [mm]	d <sub>2</sub> [mm]	s [mm]	h <sub>min.</sub> [mm]	h <sub>max.</sub> [mm]	Unit [pcs.]	Weight per 1000 pieces [kg]
414 600	blackened	5	3/16"	5,30	9,00	0,90	0,95	1,30	1000	0,260
450 650	Zn8M + passivation									
461 050	Zn-Flake 720h									
416 400	blackened	6		6,40	10,00	0,90	0,95	1,40	1000	0,277
450 750	Zn8M + passivation									
461 060	Zn-Flake 720h									
420 500	blackened	8	5/16"	8,40	13,00	1,10	1,15	1,70	1000	0,570
451 050	Zn8M + passivation									
461 080	Zn-Flake 720h									
423 100	blackened	10	3/8"	10,50	16,00	1,40	1,50	2,00	1000	1,038
451 150	Zn8M + passivation									
461 100	Zn-Flake 720h									
426 300	blackened	12		13,00	18,00	1,40	1,55	2,10	500	1,100
451 350	Zn8M + passivation									
461 120	Zn-Flake 720h									
429 200	blackened	14		15,00	22,00	1,40	1,65	2,20	500	1,920
451 550	Zn8M + passivation									
461 140	Zn-Flake 720h									
430 800	blackened	16	5/8"	17,00	24,00	1,90	2,05	2,60	250	2,800
451 650	Zn8M + passivation									
461 160	Zn-Flake 720h									
432 500	blackened	18		19,00	27,00	1,90	2,15	2,70	250	4,100
451 750	Zn8M + passivation									
461 180	Zn-Flake 720h									
435 300	blackened	20		21,00	30,00	1,90	2,10	2,80	250	4,571
451 950	Zn8M + passivation									
461 200	Zn-Flake 720h									
436 700	blackened	22	7/8"	23,00	33,00	1,90	2,30	3,00	100	5,650
452 050	Zn8M + passivation									
461 220	Zn-Flake 720h									



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

Article-number	Finish	Size		Ordering dimensions					Packaging	
		Nominal size [mm] [Inch]		d <sub>1</sub> [mm]	d <sub>2</sub> [mm]	s [mm]	h <sub>min.</sub> [mm]	h <sub>max.</sub> [mm]	Unit [pcs.]	Weight per 1000 pieces [kg]
438 000	blackened	24		25,60	36,00	2,40	2,70	3,40	100	8,250
452 150	Zn8M + passivation									
461 240	Zn-Flake 720h									
400 974	blackened	25,4	1"	27,00	38,00	2,40	2,95	3,40	100	9,050
401 260	Zn8M + passivation									
461 254	Zn-Flake 720h									
440 400	blackened	27		28,60	39,00	2,40	2,80	3,50	100	8,940
452 350	Zn8M + passivation									
461 300	Zn-Flake 720h									
441 600	blackened	30	1 1/8"	31,60	45,00	2,40	3,05	3,80	100	13,420
452 450	Zn8M + passivation									
461 300	Zn-Flake 720h									
401 303	blackened	33		34,60	50,00	3,00		4,50	50	24,000
401 068	Zn8M + passivation									
461 330	Zn-Flake 720h									
442 801	blackened	36	1 3/8"	38,00	54,00	3,00	3,75	4,50	50	26,500
401 051	Zn8M + passivation									
461 360	Zn-Flake 720h									

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 1.4301 (X5CrNi18-10)**

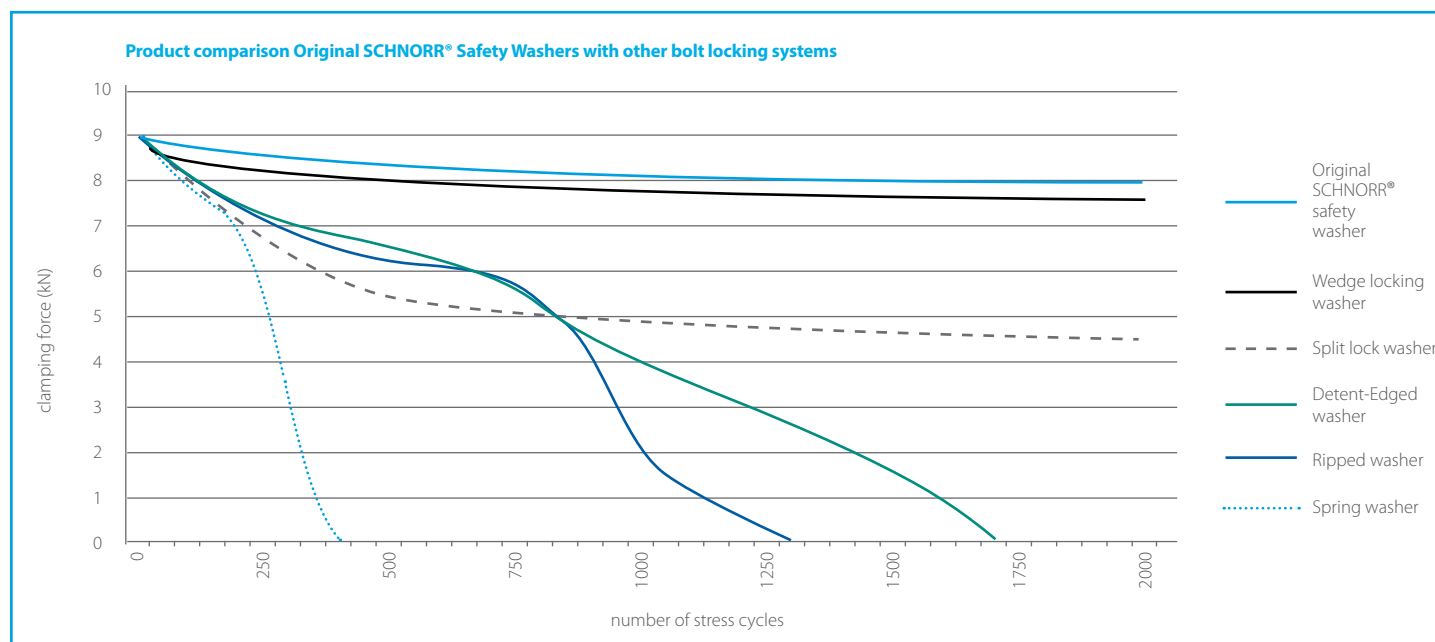
Article-number	Size		Ordering dimensions					Packaging	
	Nominal size [mm] [Inch]		d <sub>1</sub> [mm]	d <sub>2</sub> [mm]	s [mm]	h <sub>min.</sub> [mm]	h <sub>max.</sub> [mm]	Unit [pcs.]	Weight per 1000 pieces [kg]
416 201	5	3/16"	5,30	9,00	1,00	1,05	1,30	1000	0,270
418 001	6		6,40	10,00	1,00	1,10	1,40	1000	0,295
422 901	8	5/16"	8,40	13,00	1,50	1,60	2,00	1000	0,730
425 020	10	3/8"	10,50	16,00	1,80	1,90	2,30	1000	1,400
427 700	12		13,00	18,00	1,80	1,90	2,40	500	1,340
430 660	14		15,00	22,00	1,80	1,95	2,50	500	2,740
430 750	16	5/8"	17,00	24,00	2,50	2,60	3,10	250	3,800
433 621	18		19,00	27,00	2,50	2,65	3,20	250	5,390
435 250	20		21,00	30,00	2,50	2,70	3,30	250	6,250
436 721	22		23,00	33,00	2,50	2,70	3,40	100	7,750
438 021	24		25,60	36,00	3,00	3,20	3,90	100	10,300
441 420	27		28,60	39,00	3,00	3,30	4,00	100	12,360
441 621	30	1 1/8"	31,60	45,00	3,00	3,55	4,30	100	18,250

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



Video SCHNORR®-Safety Washers -  
functionality and correct use

### Vibration test according to DIN 65151



### 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 - 10.9. 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 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.

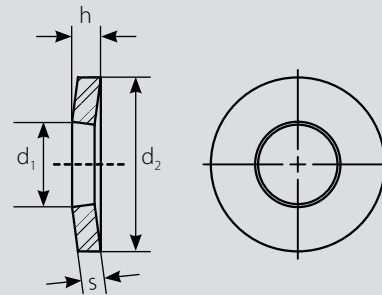
Thus the maximum loss of height due to setting is limited.

### 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:

<b>Technical requirements:</b>	according to DIN 267, Part 26
<b>Available material grad.:</b>	spring steel acc. to DIN EN 10132-4, other materials on request
<b>Available surfaces:</b>	hardened, blank and oiled; mechanically plated; other materials on request
<b>Article-no.:</b>	applies to the normal version made of spring steel
<b>h max.:</b>	maximum dimension in delivery condition
<b>h min.:</b>	minimum dimension after setting test according to DIN 267, Part 26
<b>Contact force:</b>	contact forces for the setting test according to DIN 267, Part 26
<b>Min. residual spring load:</b>	spring load, which rests after load with the contact pressure acc. to DIN 267, Part 26 and subsequent relieving of 20 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 DIN 6796 material 1.1211 (C60 S)**

Article-number	Finish	Size	Ordering dimensions					Contact force	Minimum residual spring load	Packaging	
			Nominal-size [mm]	d <sub>1</sub> [mm]	d <sub>2</sub> [mm]	s [mm]	h <sub>min.</sub> [mm]			h <sub>max.</sub> [mm]	F [N]
<b>700 000</b> <b>702 110</b>	blank, oiled Zn12M + passivation	2	2,2	5	0,4	0,5	0,60	*	*	-	0,05
<b>700 100</b> <b>702 120</b>	blank, oiled Zn12M + passivation	2,5	2,7	6	0,5	0,6	0,72	*	*	-	0,089
<b>700 200</b> <b>702 130</b>	blank, oiled Zn12M + passivation	3	3,2	7	0,6	0,7	0,85	*	*	-	0,143
<b>700 300</b> <b>702 140</b>	blank, oiled Zn12M + passivation	3,5	3,7	8	0,8	0,9	1,06	*	*	-	0,248
<b>700 400</b> <b>702 150</b>	blank, oiled Zn12M + passivation	4	4,3	9	1,0	1,1	1,30	4400	1400	-	0,385
<b>700 500</b> <b>702 160</b>	blank, oiled Zn12M + passivation	5	5,3	11	1,2	1,3	1,55	7200	2300	2500	0,687
<b>700 600</b> <b>702 170</b>	blank, oiled Zn12M + passivation	6	6,4	14	1,5	1,7	2,00	10200	4200	2500	1,434
<b>700 700</b> <b>702 180</b>	blank, oiled Zn12M + passivation	7	7,4	17	1,75	2,0	2,30	14800	6200	1000	2,527
<b>700 800</b> <b>702 190</b>	blank, oiled Zn12M + passivation	8	8,4	18	2,0	2,2	2,60	18600	7700	500	2,993
<b>700 900</b> <b>702 200</b>	blank, oiled Zn12M + passivation	10	10,5	23	2,5	2,8	3,20	29600	12400	250	6,201
<b>701 000</b> <b>702 210</b>	blank, oiled Zn12M + passivation	12	13,0	29	3,0	3,4	3,95	43000	18000	250	12,05
<b>701 100</b> <b>702 220</b>	blank, oiled Zn12M + passivation	14	15,0	35	3,5	4,0	4,65	59100	25000	100	21,58
<b>701 200</b> <b>702 230</b>	blank, oiled Zn12M + passivation	16	17,0	39	4,0	4,6	5,25	80900	34000	100	29,61
<b>701 300</b> <b>702 240</b>	blank, oiled Zn12M + passivation	18	19,0	42	4,5	5,1	5,80	102000	57000	100	37,93
<b>701 400</b> <b>702 250</b>	blank, oiled Zn12M + passivation	20	21,0	45	5,0	5,6	6,40	130000	73000	50	47,63
<b>701 500</b> <b>702 260</b>	blank, oiled Zn12M + passivation	22	23,0	49	5,5	6,1	7,05	162000	91000	25	62,04
<b>701 600</b> <b>702 270</b>	blank, oiled Zn12M + passivation	24	25,0	56	6,0	6,8	7,75	188000	122000	20	90,88
<b>701 700</b> <b>702 280</b>	blank, oiled Zn12M + passivation	27	28,0	60	6,5	7,3	8,35	246000	161000	20	110,5
<b>701 800</b> <b>702 290</b>	blank, oiled Zn12M + passivation	30	31,0	70	7,0	8,0	9,20	300000	196000	-	166,9

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

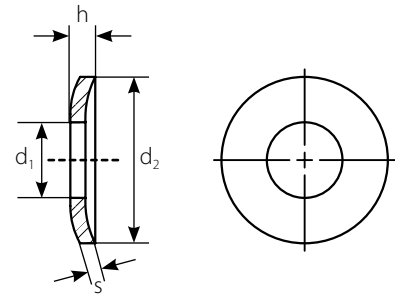
\* dimensions not listed in DIN 267 part 26

## The original SCHNORR® HS-Washer

This bolt locking device 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:

<b>Technical requirements:</b>	according to DIN 267, Part 26
<b>Available material grades:</b>	spring steel acc. to DIN EN 10132-4, other materials on request
<b>Available surfaces:</b>	phosphated and oiled; mechanically plated, other materials on request
<b>Article no.:</b>	applies to the normal version made of spring steel
<b>h max.:</b>	maximum dimension in delivery condition
<b>h min.:</b>	minimum dimension after setting test according to DIN 267, Part 26
<b>Contact force:</b>	contact forces for the setting test according to DIN 267, Part 26
<b>Minimum residual spring load :</b>	spring load, which rests after load with the contact pressure acc. to DIN 267, Part 26 and subsequent relieving of 20 µm




### Description of an original SCHNORR® HS-Washer:

Size 12 made of spring steel:  
= Safety Washer HS 12 FSt.  
phosphated and oiled

## Original SCHNORR® HS-Washers material 1.1211 (C60S)

Article-number	Finish	Size	Ordering dimensions					Contact force F [N]	Min. residual spring load F [N]	Packaging	
			Nominal-size [mm]	d <sub>1</sub> [mm]	d <sub>2</sub> [mm]	s [mm]	h <sub>min.</sub> [mm]			h <sub>max.</sub> [mm]	Unit (piece)
<b>416 320</b> <b>431 510</b>	Phosphated and oiled Zn20M + passivation	6	6,4	12	1,5	1,64	1,90	10200	4200	1000	0,943
<b>416 520</b> <b>431 520</b>	Phosphated and oiled Zn20M + passivation	8	8,4	17	2,0	2,10	2,55	18600	7700	500	2,438
<b>423 220</b> <b>431 530</b>	Phosphated and oiled Zn20M + passivation	10	10,5	21	2,5	2,75	3,15	29600	12400	250	4,915
<b>426 400</b> <b>431 540</b>	Phosphated and oiled Zn20M + passivation	12	13,0	24	3,0	3,27	3,75	43000	18000	250	7,194
<b>429 320</b> <b>431 550</b>	Phosphated and oiled Zn20M + passivation	14	15,0	28	3,5	3,80	4,35	59100	25000	100	11,61
<b>430 900</b> <b>431 560</b>	Phosphated and oiled Zn20M + passivation	16	17,0	30	4,0	4,31	4,95	80900	34000	200	14,5
<b>433 750</b> <b>431 570</b>	Phosphated and oiled Zn20M + passivation	18	19,0	33	4,5	4,80	5,50	102000	57000	100	19,36
<b>435 320</b> <b>431 580</b>	Phosphated and oiled Zn20M + passivation	20	21,0	36	5,0	5,30	5,95	130000	73000	50	25,33
<b>436 620</b> <b>431 590</b>	Phosphated and oiled Zn20M + passivation	22	23,0	40	5,5	5,90	6,70	162000	91000	50	35,07
<b>439 150</b> <b>431 600</b>	Phosphated and oiled Zn20M + passivation	24	25,0	45	6,0	6,45	7,30	188000	122000	25	50,28
<b>440 100</b> <b>431 610</b>	Phosphated and oiled Zn20M + passivation	27	28,0	50	6,5	7,00	8,00	246000	161000	20	66,94
<b>442 650</b> <b>431 620</b>	Phosphated and oiled Zn20M + passivation	30	31,0	58	7,0	7,65	8,90	300000	196000	-	101

We would be glad to offer you HS-Washers with different finish on request.



We act in the  
background with  
excellent efficiency.

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



## Disc spring engineering

Thoroughly dealing with elaborate customized solutions.

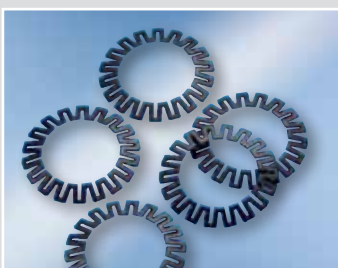
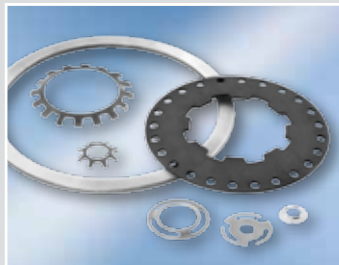
We specialise in developing tailor-made solutions in partnership with our customers; be it in new applications, increasing quality and capacity requirements or specific materials. Our inhouse testing facilities permit sampling or 100% volume inspection according to customer and quality standard requirements.

To facilitate this process we can utilise highly skilled specialists, latest construction tools, FEM-Calculations, specialized manufacturing processes in the appropriate machinery as well as our 100 years of experience.

SCHNORR® provide top quality specialised disc springs 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:

- special springs for bayonet catches
- star springs for very low loads
- springs for damper parts
- special springs for motorsports
- converted spring columns und spring stacks
- springs for pressure limitation
- special springs for clutches
- special springs for torque limiters





## Wave Springs

The SCHNORR GmbH is both able to deliver wave springs according to drawings, and to develop wave springs according to customer requirements. Wave springs are wound or stamped parts made of spring steel, which usually are made of flats (can also be made of round material)

Wave springs with static to medium dynamic usage show huge space-saving potential with reductions of installation height up to 50%. Based on the specific geometry and function of the wave spring, it ensues a very low hysteresis in comparison to the use of a disc spring. For the manufacturing of wave springs a variety of materials is suitable.

The SCHNORR GmbH manufactures wave springs with the dimension range of:

- Thickness: 0,25 – 5,00 mm
- Outer diameter: 5,00 – 250,00 mm
- Inner diameter: 2,00 – 240,00 mm

### Only some examples for wave springs are listed below:

- ball bearings
- automatic transmissions
- tensioning devices



## stamped parts | deep drawing parts | fine-blanked parts

With our machinery and our expertise in the processing of spring steels, we are able to manufacture any kind of stamped parts made of spring steel as well as other materials according to your requirements.

Furthermore, we develop and manufacture deep drawing and fine blanking parts made of a wide range of materials tailored to your requirements.

Here again SCHNORR® creates high-quality solutions for you!

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

- vibration damper
- spring steel cover sheets
- heat shields
- retaining plates
- other stamped parts made of spring steel
- deep drawing parts made of spring steel
- special fine blanked parts
- bar springs





## Safety washers

In addition to the standard sizes and standard materials mentioned on page 29 to 32, our engineers and technicians are able to develop safety washers with special dimensions and also special materials in cooperation with you.



## Load washers

In addition to the standard sizes and standard materials of the DIN 6796 load washers and the original SCHNORR® HS-Washers mentioned on page 34 to 35, we are able to develop load washers and HS-Washers with special dimensions and special materials according to customer requirements and in close cooperation with our customers





# 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 spring steel grades according to DIN EN 10132-4 are used as cold rolled strip for disc springs of group 1 according to DIN EN 16983 (previously 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 spring 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 it 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.

### • X5 CrNi 18-10 (1.4301):

Like 1.4310, this steel is an austenitic spring steel to DIN 10151. According to DIN 10151. Due to its stable austenite, it achieves the same stable austenite with the same percentage of work hardening lower strength values than 1.4310. However, it has better corrosion resistance and is the most commonly used austenitic steel.

## 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 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.



We act sustainably -  
including certification.

according to DIN 14001 and EMAS



## Materials – synoptic table

Short name	AISI ASTM	Material no.	Norm	Chemical composition in percent by weight					
				C	Si	Mn	P max.	S max.	Cr
<b>Steel grades for normal operating demands</b>									
<b>Standard material grade</b>									
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
<b>Special material grades for particular operating demands</b>									
<b>Corrosion-resistant steel grades</b>									
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
<b>Heat-resistant steel grades</b>									
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
<b>Copper alloys</b>				<b>Sn</b>	<b>P</b>	<b>Be</b>	<b>Ni + Co</b>	<b>Cu</b>	
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	
<b>Nickel and cobalt alloys</b>				<b>Ni</b>	<b>Cr</b>	<b>Co</b>	<b>Ti</b>	<b>Al</b>	<b>C</b>
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)									
<b>Nickel and cobalt alloys (continued)</b>				<b>S</b>	<b>P</b>	<b>B</b>	<b>Nb + Ta</b>	<b>Mo</b>	<b>W</b>
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			
V	Mo	Ni		N	E module in kN/mm <sup>2</sup> at RT	working temperature C°	Thickness range mm	Procurement
-	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	difficult*
-	0.80...1.30	max. 1.0			215	-50...+400	0.3...6.0	difficult*
					115	-50...+100	0.1...6.0	easy
					135	-260...+200	0.1...2.5	easy
Si	Mn	Fe	Cu	Zr				
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.

\* Please note the minimum order quantities for these materials

# 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 condensation, rain, river and sea water.

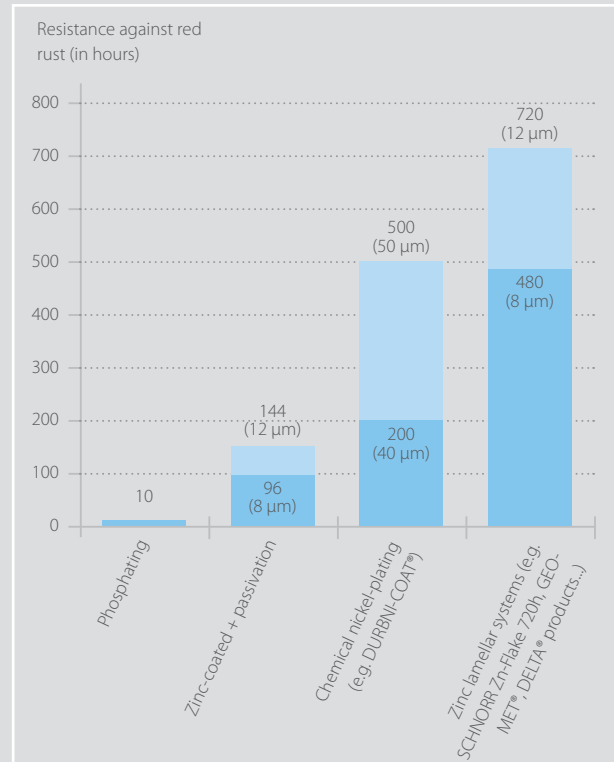
Further applications can be found in automotive building, the food industry, household appliances (e.g. washing machine), bridge building, the aerospace industry etc.

Besides watery or chloride-containing solutions, acids and leaches in 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 test according to DIN EN ISO 9227



Surface systems**	Layer thickness (µm)	Dimensions (in mm)	Salt spray test DIN 9227 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
<b>Phosphating</b>	8 - 10	De < 600	10	RT	-	+	-	-	N	DIN EN 12476	DIN EN 12476	BOSCH, MIL, DBL
<b>Zinc-coated + passivation</b>	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	ASTM B 695-04, DIN EN ISO 12683	
<b>Chemical nickel-plating</b>	40 - 50	De < 1000	200 - 500	155	-	+	o	o	J	DIN EN ISO 4527	DIN EN ISO 4527	
<b>Zinc lamellar systems</b>	8 - 10	De < 1000 problematic: < Ø 10 and very thin disc springs	480 - 720	250 - 300	+	+	+	+	J	DIN EN ISO 10683	DIN EN ISO 10683, 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 our engineering department.



## TIGHTENING TORQUES FOR ORIGINAL SCHNORR® SAFETY WASHERS BLACKENED

Table is valid for shank bolts with metric standard thread acc. to DIN ISO 262, head dimensions of hexagonal bolts acc. to DIN EN ISO 4014 to 4018, hexalobular external driving head bolts acc. to DIN 34800, cylindrical bolts acc. to DIN EN ISO 4762 and hole "medium" acc. to DIN EN 20273.

**All specifications are non-binding approximate values.**

## TIGHTENING TORQUES FOR ORIGINAL SCHNORR® SAFETY WASHERS MECHANICALLY GALVANIZED & ZINC LAMELLAR SYSTEMS

Table is valid for shank bolts with metric standard thread acc. to DIN ISO 262, head dimensions of hexagonal bolts acc. to DIN EN ISO 4014 to 4018, hexalobular external driving head bolts acc. to DIN 34800, cylindrical bolts acc. to DIN EN ISO 4762 and hole "medium" acc. to DIN EN 20273.

**All specifications are non-binding approximate values.**

## TIGHTENING TORQUES FOR ORIGINAL SCHNORR® SAFETY WASHERS CORROSION RESISTANT

Table is valid for Shank bolts with metric standard thread acc. to DIN ISO 262, head dimensions of hexagonal bolts acc. to DIN EN ISO 4014 to 4018, hexalobular external driving head bolts acc. to DIN 34800, cylindrical bolts acc. to DIN EN ISO 4762 and hole "medium" acc. to DIN EN 20273" made of A2/A4.

**All specifications are non-binding approximate values.**

Nominal size	Tightening torque (Nm) for $\mu K = \mu G = 0,14$			
	Type S		Type VS	
	Strength grade			
	5.8	8.8	10.9	12.9
M 4	1,7	3,6	5,3	6,2
M 5	3,3	7,2	10,5	12,3
M 6	5,7	12,4	18,2	21,2
M 7	-	20,6	30,3	35,4
M 8	13,9	30,0	44,1	51,6
M 10	27,8	59,4	86,9	102,3
M 12	47,3	102,3	150,7	176,0
M 14	75,9	162,8	239,8	280,5
M 16	117,7	253,0	371,8	434,5
M 18	162,8	361,9	515,9	603,9
M 20	229,9	510,4	727,1	850,3
M 22	310,2	697,4	994,4	1162,7
M 24	394,9	877,8	1249,6	1461,9
M 27	583,0	1293,6	1841,4	2154,9
M 30	790,9	1756,7	2501,4	2928,2
M 33	1072,5	2377,1	3385,8	3961,1
M 36	1378,3	3055,8	4352,7	5094,1

Nominal size	Tightening torque (Nm) for $\mu K = \mu G = 0,10$			
	Type S		Type VS	
	Strength grade			
	5.8	8.8	10.9	12.9
M 4	1,3	2,9	4,3	5,0
M 5	2,6	5,7	8,4	9,8
M 6	4,5	9,9	14,5	16,9
M 7	-	16,3	23,9	27,9
M 8	11,0	23,8	35,0	40,9
M 10	22,1	47,3	69,3	80,3
M 12	37,4	80,3	118,8	138,6
M 14	60,5	128,7	189,2	221,1
M 16	92,4	198,0	290,4	339,9
M 18	128,7	284,9	405,9	475,2
M 20	180,4	399,6	568,7	665,5
M 22	242,0	544,5	774,4	906,4
M 24	310,2	687,5	979,0	1145,1
M 27	455,4	1006,5	1434,4	1678,6
M 30	619,3	1370,6	1952,5	2284,7
M 33	836,0	1846,9	2631,2	3078,9
M 36	1076,9	2380,4	3390,2	3967,7

Nominal size	Tightening torque (Nm) for $\mu K = \mu G = 0,20$		
	Type S	Type VS	
	Strength grade		
	50	70	80
M 4	1,1	1,2	1,8
M 5	1,4	2,9	3,9
M 6	2,6	5,6	7,6
M 7	4,5	9,7	13,0
M 8	11,1	23,5	31,6
M 10	22,3	48,4	63,8
M 12	38,3	81,4	110,0
M 14	61,6	130,9	174,9
M 16	94,6	201,3	269,5
M 18	134,2	286,0	380,6
M 20	190,3	407,0	543,4
M 22	249,7	536,8	715,0
M 24	312,4	668,8	891,0
M 27	463,1	-	-
M 30	628,1	-	-
M 33	856,9	-	-
M 36	1097,8	-	-

# Disc Spring enquiry sheet

1. Application:

2. Purpose of the springs:

Single spring     Spring stack [ \_\_\_\_ set(s) per | \_\_\_\_ spring(s) in parallel

3. Dimension of the disc spring (minimum und maximum):

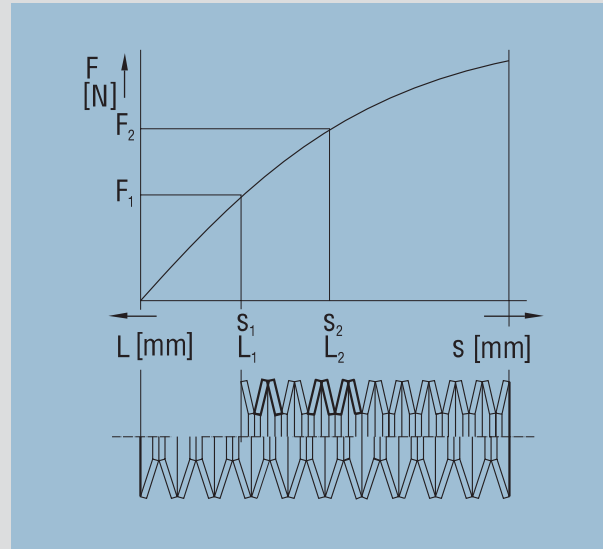
Outside diameter  $D_e =$   mm

Inside diameter  $D_i =$   mm

Thickness  $t =$   mm

Reduced thickness  $t' =$   mm

Overall height  $l_o =$   mm



4. Installation space (max.  $D_e$ , min.  $D_i$  and max. length):

Outside diameter  $D_e =$   mm

Inside diameter  $D_i =$   mm

Length  $L =$   mm

5. Loads and deflection:

installed length	Spring deflection	Spring force	upstroke $\Delta s$ ( $L_1-L_n$ )
$L_1 =$ <input type="text"/> mm	$s_1 =$ <input type="text"/> mm	$F_1 =$ <input type="text"/> mm	
$L_2 =$ <input type="text"/> mm	$s_2 =$ <input type="text"/> mm	$F_2 =$ <input type="text"/> mm	$L_1-L_2 =$ <input type="text"/> mm
$L_3 =$ <input type="text"/> mm	$s_3 =$ <input type="text"/> mm	$F_3 =$ <input type="text"/> mm	$L_1-L_3 =$ <input type="text"/> mm

6. Type of load     static     dynamic

7. Form of load     impact     sinusoidal

8. Number of cycles required:

9. Working temperature (at the springs):  °C

10. Guidebar     inner     outer

11. Position of the spring stack     vertical     horizontal

12. Is corrosion protection necessary?     no     yes

13. Aggressive medium:

14. Remarks:

15. Estimated annual usage:

contact name: \_\_\_\_\_

phone: \_\_\_\_\_

Email: \_\_\_\_\_

signature and official company stamp





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#### Contact details



### Certifications:

IATF 16949:2016  
ISO 14001-2015  
EMAS 1221/2009  
AS PER AD LEAFLET W0/TRD 100  
ISO 45001

#### Certifications



**SCHNORR**<sup>®</sup>  
DISC SPRING ENGINEERING