

As a global partner of the automobile industry, Mubea has divisions worldwide. We develop, manufacture, and sell high-quality suspension springs and stabilizer bars, valve springs, disc springs, hose clamps, belt tensioner systems, tubular shafts, camshafts, headrest supports, and Tailor Rolled Products.

Mubea Disc Springs . 6800 Industrial Road Florence . KY 41042 USA  
Phone: (859) 746-2155 . discspringsales@mubeausa.com . www.mubea-discsprings.com

Mubea

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Mubea  
engineering for mobility

Mubea  
Disc Springs



Mubea has specialized in the production of high-quality disc springs for over 40 years. Because of their versatility, disc springs are used extensively in a variety of applications, from safety valve systems 3000 m under the sea to satellites in space. We also specialize in the production of related components including complex precision fine blanked parts and high-quality roll pins.

Mubea stocks disc springs manufactured per the requirements of DIN 2093 as well as per our own internal standards. Mubea is capable of producing conventional disc springs with outer diameters up to 800 mm, internally and externally slotted disc springs, and wave springs. All of our products are manufactured in-house, starting with the production of the raw material in our own cold-rolling mill. Furthermore, all tooling is designed, manufactured, and maintained in-house. In addition to 50 CrV 4, Mubea stocks a variety of antimagnetic, corrosion resistant, and high/low temperature materials for special applications. This allows us to respond quickly to requests for disc springs of non-standard size and/or materials.

Mubea disc springs are shot-peened as part of our standard manufacturing process. This is especially advantageous in dynamic applications requiring a long fatigue life. We maintain well-equipped laboratories capable of performing a wide variety of tests as required by our customers. Our team of highly qualified engineers is dedicated finding the optimal solution for every spring application through the use of new technologies, innovative approaches, and creativity. We look forward to working with you.

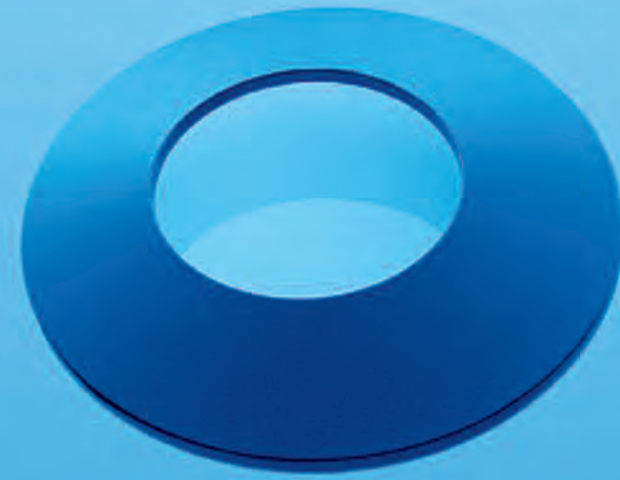
**Reduced lead time by up to 70% offered by:**

- **Streamlined customer service**
  - Creation of a customer service and order entry department
  - Increased staff in production and engineering
- **All standard disc spring sizes in stock**
- **Large safety stock for special spring dimensions**
- **Continuous improvement of the production process by investing in the latest technologically advanced manufacturing equipment**
  - Expansion of the tool shop
  - Fine blanking and deburring
  - Turning, hardening, and shot-peening
  - Pre-setting and testing per customer requirements
  - Surface treatment
  - Packaging per customer requirements

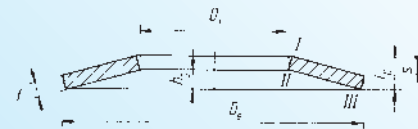




## Disc Springs – High loads in small spaces

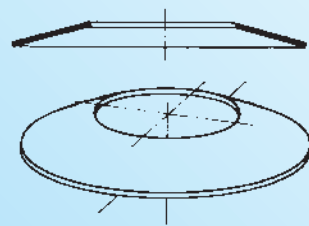


## Disc Springs – High versatility



Disc springs are shallow conical rings that are subjected to axial loads. Depending upon the application, disc springs can be subjected to static or dynamic loads and are defined by:

- outer diameter  $D_e$ ,
- inner diameter  $D_i$ ,
- material thickness  $t$  and
- overall height  $L_o$

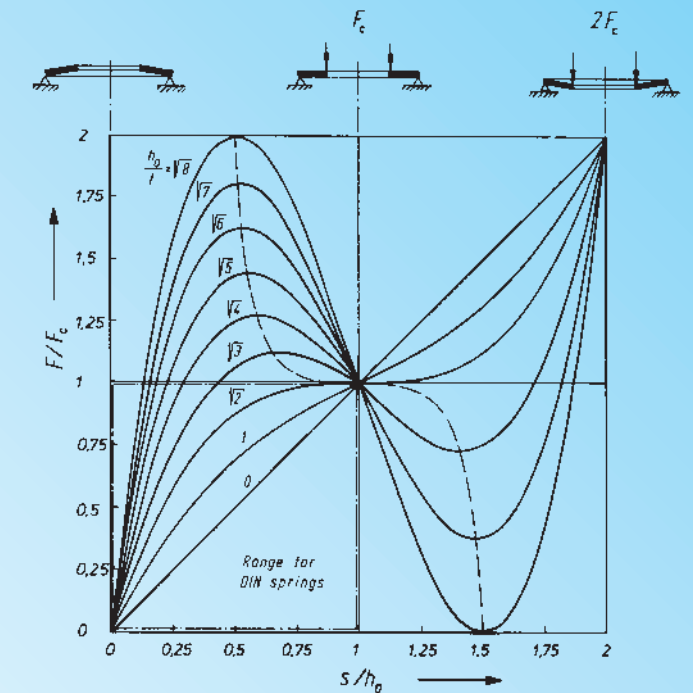


Disc springs are distinguished from other spring types by the following characteristics:

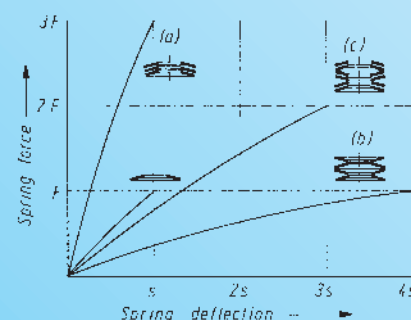
- high load capacity with a small spring deflection
- better space utilization when compared to other spring types
- different combinations of springs can be designed to achieve the desired load characteristics

Because of their versatility, disc springs are used extensively in a variety of applications, from safety valve systems 3000 m under the sea to satellites up to 36,000 km in space. Disc springs must function in temperatures from  $-269^{\circ}\text{C}$  up to  $500^{\circ}\text{C}$ . Mubea stocks the necessary materials to meet the required load and fatigue life requirements even under these severe conditions. In addition, disc springs can be coated with highly durable surface protections to withstand and guarantee a long life in a corrosive atmosphere.

Due to the versatility of disc springs, they are used in a variety of applications including the machine-tool industry, the oil industry, the automobile industry, as well as the aerospace industry.



The relationship between disc spring height and material thickness ( $h_0/t$ ) determines the characteristic load curve of the spring



In a parallel spring stack, the load is proportional to the number of individual springs (a).

In a series spring stack, the deflection of the stack is the sum of the deflection of the individual springs (b).

It is possible to combine these methods of stacking (c).



## Mubea Disc Spring Product Overview

### 1 Conventional disc springs

- Disc springs to DIN 2093 (Group 1, Group 2, Group 3)
- Disc springs to Mubea Factory Standards or to customer requirements
- Size range: outer diameter 8.0 mm to 800 mm
- Materials to DIN 2093 (DIN 17 221, DIN 17 222) and special materials
- Disc springs with a thickness of 0.5 mm and greater are shot-peened to improve fatigue life

### 2 Disc spring stacks

Disc Springs are mostly assembled in stacks. On request, Mubea can deliver disc springs pre-assembled in stacks or on a guiding device. Advantages include:

- Assembly is more efficient with pre-assembled stacks
- Ability to provide stack specific load-deflection diagrams (our load testing machines can measure loads up to 1000 kN)
- Small load tolerances possible
- 100% load testing can be used to verify proper stacking

### 3 Internally or externally slotted disc springs

- Size range: outer diameter 20 to 300 mm
- Slotted disc springs are typically developed in close collaboration with customers
- Special production processes are used to maintain extremely tight load tolerances and to achieve the maximum possible fatigue life.

### 4 Special springs

As necessary, Mubea will work with the customer to develop special springs to meet the requirements of specific applications.

### 5 Wave springs

Mubea produces wave springs with outer diameters ranging from 20 mm to 300 mm. Wave springs are often used to improve shift quality in automatic transmissions. Wave springs are designed per the specific requirements of each customer.

1

2

3

4

5

6



## Disc Springs Application examples

### ❶ Pre-assembled spring stacks

Plant construction, power station construction, and machine construction

Spring stacks are used for boiler suspension systems. The spring assemblies compensate for localized deflections in the bearing surface and thus guarantee an even lowering of the boiler with load fluctuations due to thermal expansion.

### ❷ Overload clutches

Plant construction, machine construction, and motor vehicle construction

In overload clutches, disc springs provide the load required to maintain sufficient friction to transmit the torque. The load level can be regulated with adjuster nuts. If overload occurs, the transmission of torque is interrupted.

### ❸ Backlash compensation

Plant and machine construction

Disc springs are often used to compensate for geometric tolerances in component assemblies.

### ❹ Valves

Plant and machine construction, chemical industry

In quick-action stop valves, the disc spring stack is hydraulically pre-loaded when in the open position. If a failure occurs, the hydraulic pressure drops and the disc spring stack is released, closing the valve and thus interrupting the flow. Often ball-centered disc spring stacks are used for this purpose.

### ❺ Piston return springs

Machine construction and motor vehicle construction

The disc spring ensures that the hydraulically actuated piston returns to its original position after the load on the coupling is released.

### ❻ Tool clamping components

Machine construction, tool-making

In tool clamping components, the function of the disc spring stack is to hold the tool securely in the tapered holder.

### ❼ Energy storage for safety systems

Circuit breakers, machine construction

In hydraulic spring mechanisms, energy storage is often achieved by means of a disc spring stack.

### ❽ Cableway grip

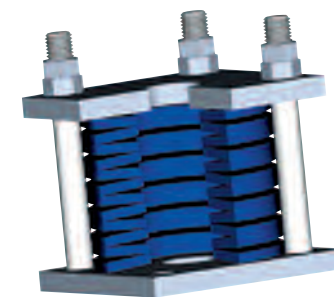
Plant construction

On cableways, a disc spring stack generates a friction lock between the cable grip and wire cable. Depending on the type of grip, the load can be static or dynamic.

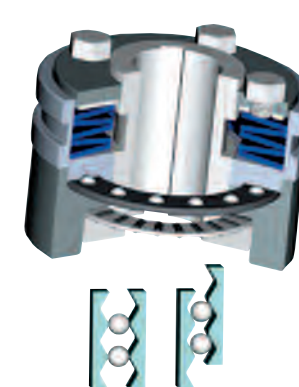
### ❾ Spring-actuated brakes

Plant construction, machine construction, and motor vehicle construction

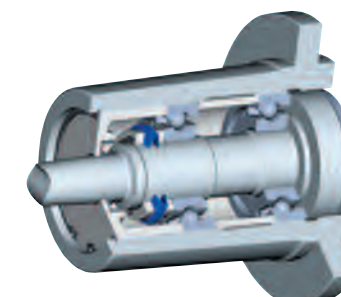
The braking load is generated by the disc springs when the hydraulic pressure is reduced to a predetermined level.



❶



❷



❸



❹



❺



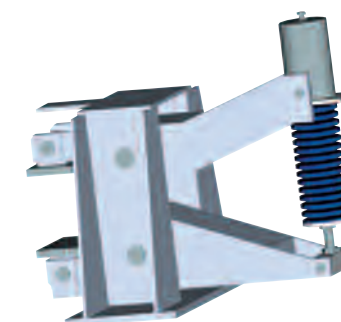
❻



❼



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❾

Disc Springs –  
Mubea, your competent partner

Designation	DIN mate- rial number	Modulus of elasticity (kN/mm²) at							
		20°C	100°C	200°C	300°C	400°C	500°C	600°C	700°C
Ck 67	1.1231	206	202						
50 CrV 4	1.8159	206	202	196					
51 CrMo 4	1.7701	206	202	196					
X 12 CrNi 17 7	1.4310	190	185	178					
X 7 CrNiAl 17 7	1.4568	200	195	190					
X 5 CrNiMo 18 10	1.4401	190	185	178					
X 35 CrMo 17	1.4122	209	205	199	192				
X 30 WCrV 5 3	1.2567	206	202	196	189	178			
X 22 CrMoV 12 1	1.4923	209	205	200	193				
Cu Be 2	2.1247	135	131	126					
Ni Be 2	2.4132	200	195	189	182	176			
Inconel 718 (Ni Cr 19 Nb Mo)	2.4668	200	196	190	186	179	172		
Inconel X 750 (Ni Cr 15 Fe 7 Ti Al)	2.4669	214	207	198	190	179	170		
Nimonic 90 (Ni Cr 20 Co 18 Ti)	2.4969	206	201	195	189	181	175	167	160

Effects of temperature on modulus of elasticity  
(recommended values for design purposes)

Classification according to DIN 2093

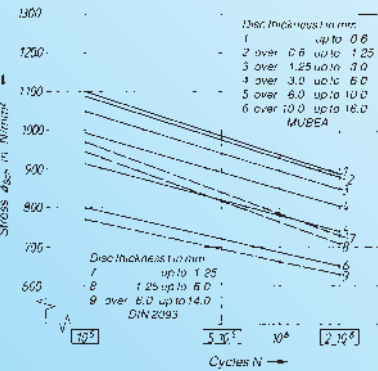
Disc spring design, sizing, and manufacture have been standardized according to DIN 2092 (Disc springs, Calculation) and DIN 2093 (Disc springs, Calculation, Dimensions, Quality requirements). Disc springs in accordance with DIN 2093 are classified into 3 groups:

- Group 1: Disc thickness, t, less than 1.25 mm
- Group 2: Disc thickness, t, from 1.25 mm to 6 mm
- Group 3: Disc thickness, t, over 6 mm up to 14 mm

Group 1 and 2 springs are manufactured without contact surfaces, Group 3 springs are manufactured with contact surfaces.

Mubea Engineering

As a first step, we can provide our design calculation program for disc springs. This program is based on the equations defined by DIN 2092 and can be downloaded from our website at [www.mubea-discsprings.com](http://www.mubea-discsprings.com). Additionally, we maintain a team of highly qualified engineers that is dedicated finding the optimal solution for every spring application, including the selection of the proper material and surface protection. Prototypes typically required during product development are manufactured in our sample shop, which is equipped with all necessary testing equipment.



Woehler diagrams  
showing comparison  
between Mubea and  
DIN 2093

Disc Springs –  
Highly stressed spring elements

Materials for Disc Springs

For standard applications, the spring material 51CrV4 (No. 1.8159) is used. Furthermore, special materials can be used for applications at very high and low temperatures or in a corrosive atmosphere. Depending upon the specific requirements, Mubea uses thermally stable materials (No. 1.4122, 1.2567, 1.4923), corrosion resistant materials (No. 1.4310, 1.4568, 1.4401), nickel based materials (2.4668, 2.4669, 2.4969) and beryllium copper alloys (2.1247, 2.4132).

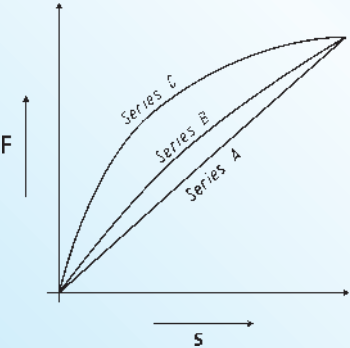
Increased Fatigue Life

Nearly all Mubea disc springs are shot-peened in-house. Shot-peening creates residual compressive stresses that result in a considerably higher fatigue life than required by DIN 2093.

Corrosion protection for Disc Springs

The standard corrosion protection for disc springs is zinc-phosphating and oiling. If a higher level of corrosion protection is required due to the operating environment of the disc spring, the following alternatives are available:

- Zinc-phosphating and waxing
- Galvanizing
- Mechanical zinc plating and chromating
- Delta Tone/Delta Seal Coating
- Dacromet/Geomet Coating
- Chemical (Electroless) nickel plating

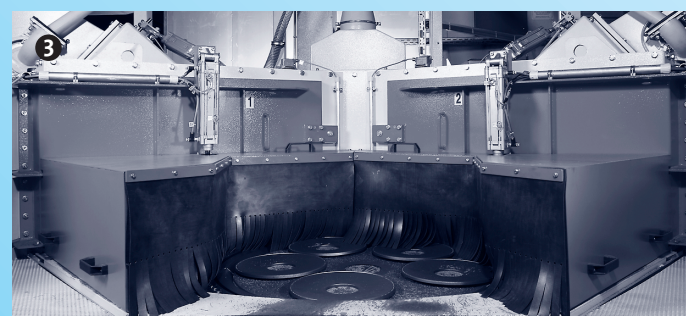


Calculated characteristic load  
curves for disc springs to DIN 2093,  
Series A, B, and C

Process	Coating composition	Coating thickness (µm)	Stability in salt-spray testing per DIN 50 021
Phosphating	Zinc phosphate + oil	10–15	0 200 400 600 800 1000 Standard protection
Phosphating	Zinc phosphate + wax	10–40	
Electro-galvanising	Zinc	≥ 8	
Electro-galvanising	Zinc	≥ 12	
Electro-galvanising + yellow chromate	Zinc + yellow chromate	≥ 8	
Electro-galvanising + yellow chromate	Zinc + yellow chromate	≥ 12	
Mech. zinc plating	Zinc	≥ 12	
Mech. zinc plating + yellow chromate	Zinc + yellow chromate	≥ 12	
Delta-Tone	Zinc phosphate + Zinc powder coating	10–15	
Delta-Seal	Zinc phosphate + org. coat + oil	10–15	
Dacromet 500-A	Chromated zinc flakes	≥ 5	
Dacromet 500-B	Chromated zinc flakes	≥ 8	
Chem. nickel plating	Nickel	approx. 25	



## Disc Springs – Highest Quality from Mubea



### Complete In-House Production

It is Mubea's philosophy to control all manufacturing processes in order to insure the quality of the disc spring and to maintain the most stringent tolerances. Commonly used materials are manufactured in our own cold-rolling mill, using the most modern rolling technology.

### Fine Blanking (picture 1)

Disc Springs with material thickness between 1 mm and 6 mm are generally fine blanked. This method improves the fatigue life of the spring.

### Heat Treatment (picture 2)

The heat treatment of disc springs is a fundamental production step for achieving the required spring characteristics. Depending upon the spring dimensions, modern continuous feed furnaces or chamber ovens are available. We have austempering and quenching and tempering processes available.

### Shot-peening (picture 3)

A standard production process at Mubea is shot-peening. It results in a significantly higher fatigue life.

### Pre-setting (picture 4)

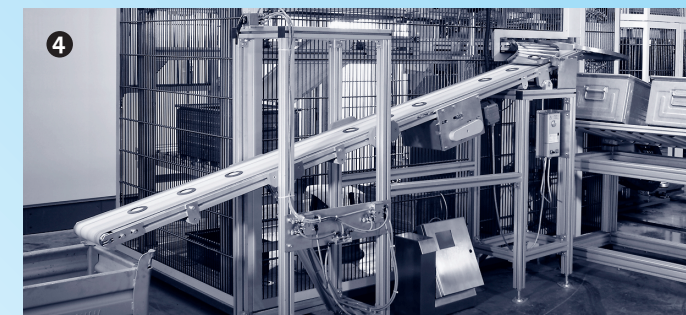
Set loss can occur due to high stresses of the spring. In order to reduce the risk of set loss, Mubea pre-sets all disc springs at least to the flat position. This process greatly improves the quality of the spring and therefore is a requirement of the DIN 2093 standard.

### Phosphating (picture 5)

The standard corrosion protection, zinc phosphating and oiling, is made with a fully automated continuous flow process. This guarantees a uniform coating thickness at a reasonable cost.

### Delivery of disc spring stacks

Disc springs are often used in pre-assembled stacks. Mubea is able to deliver pre-assembled stacks and if desired, install these stacks in the final assembly device. Mubea can also manufacture these assembly devices per customer request. Test certificates (e.g. 100 % load testing) or certificates according to DIN EN 10204 (2.2/2.3/3.1B) can also be provided upon request.



*Certified to the highest  
quality standards*





List of disc springs in stock per DIN 2093 as well as per our own internal standards.

Order No.	Dimensions (mm)			Order No.	Dimensions (mm)			Order No.	Dimensions (mm)			Order No.	Dimensions (mm)			Order No.	Dimensions (mm)		
	De	Di	t		De	Di	t		De	Di	t		De	Di	t		De	Di	t
17 0001	8	3,2	0,30	17 0058	20	10,2	0,40	18 0033	40	20,4	2,25	18 0090	80	31	4,00	18 0147*	150	71	6,00
17 0002	8	3,2	0,40	17 0059	20	10,2	0,50	18 0034	40	20,4	2,50	18 0091*	80	31	4,00	18 0148	160	82	4,30
17 0003	8	3,2	0,50	17 0060	20	10,2	0,80	18 0035	45	22,4	1,25	18 0092	80	35,5	4,00	18 0149*	160	82	4,30
17 0004	8	4,2	0,20	17 0061	20	10,2	0,90	18 0036	45	22,4	1,75	18 0093*	80	35,5	4,00	18 0150	160	82	6,00
17 0005	8	4,2	0,30	17 0062	20	10,2	1,00	18 0037	45	22,4	2,50	18 0094	80	36	3,00	18 0151*	160	82	10,00
17 0006	8	4,2	0,40	17 0063	20	10,2	1,10	18 0038	48	16,3	1,50	18 0095	80	41	2,25	18 0152	180	92	4,80
17 0007	10	3,2	0,30	17 0064	22,5	11,2	0,60	18 0039	50	18,4	1,25	18 0096	80	41	3,00	18 0153*	180	92	6,00
17 0008	10	3,2	0,40	17 0065	22,5	11,2	0,80	18 0040	50	18,4	1,50	18 0097	80	41	4,00	18 0154	180	92	6,00
17 0009	10	3,2	0,50	17 0066	23	8,2	0,70	18 0041	50	18,4	2,00	18 0098*	80	41	4,00	18 0155*	180	92	6,00
17 0010	10	4,2	0,10	17 0067	23	8,2	0,80	18 0042	50	18,4	2,50	18 0099	80	41	5,00	18 0156	200	102	5,50
17 0011	10	4,2	0,50	17 0068	23	8,2	0,90	18 0043	50	18,4	3,00	18 0100*	80	41	5,00	18 0157*	200	102	5,50
17 0012	10	4,2	0,60	17 0069	23	10,2	0,90	18 0044	50	20,4	2,00	18 0101	90	46	2,50	19 0001	100	51	7,00
17 0013	10	5,2	0,25	17 0070	23	10,2	1,00	18 0045	50	20,4	2,50	18 0102	90	46	3,50	19 0002	125	61	8,00
17 0014	10	5,2	0,40	17 0071	23	12,2	1,00	18 0046	50	22,4	2,00	18 0103	90	46	5,00	19 0003	125	64	7,00
17 0015	10	5,2	0,50	17 0072	25	12,2	0,70	18 0047	50	22,4	2,50	18 0104*	90	46	5,00	19 0004	125	64	8,00
17 0016	12	4,2	0,40	17 0073	25	12,2	0,90	18 0048	50	25,4	1,25	18 0105	100	41	4,00	19 0005	125	71	8,00
17 0017	12	4,2	0,50	17 0074	28	10,2	0,80	18 0049	50	25,4	1,50	18 0106*	100	41	4,00	19 0006	125	71	10,00
17 0018	12	4,2	0,60	17 0075	28	10,2	1,00	18 0050	50	25,4	2,00	18 0107	100	41	5,00	19 0007	140	72	8,00
17 0019	12	5,2	0,50	17 0076	28	12,2	1,00	18 0051	50	25,4	2,25	18 0108*	100	41	5,00	19 0008	150	61	7,00
17 0020	12	5,2	0,60	17 0077	28	14,2	0,80	18 0052	50	25,4	2,50	18 0109	100	51	2,70	19 0009	150	71	8,00
17 0021	12	6,2	0,50	17 0078	28	14,2	1,00	18 0053	50	25,4	3,00	18 0110	100	51	3,50	19 0010	150	81	8,00
17 0022	12	6,2	0,60	17 0079	31,5	16,3	0,80	18 0054	56	28,5	1,50	18 0111	100	51	4,00	19 0011	150	81	10,00
17 0023	12,5	6,2	0,35	17 0080	34	12,3	1,00	18 0055	56	28,5	2,00	18 0112*	100	51	4,00	19 0012	160	82	11,00
17 0024	12,5	6,2	0,50	17 0081	35,5	18,3	0,90	18 0056	56	28,5	2,50	18 0113	100	51	5,00	19 0013	160	82	4,80
17 0025	12,5	6,2	0,70	17 0082	40	20,4	1,00	18 0057	56	28,5	3,00	18 0114*	100	51	5,00	19 0014	180	92	10,00
17 0026	14	7,2	0,35	18 0001	22,5	11,2	1,25	18 0058	60	20,5	2,00	18 0115	100	51	6,00	19 0015	180	92	13,00
17 0027	14	7,2	0,50	18 0002	23	12,2	1,25	18 0059	60	20,5	2,50	18 0116*	100	51	6,00	19 0016	200	82	8,00
17 0028	14	7,2	0,60	18 0003	23	12,2	1,50	18 0060	60	20,5	3,00	18 0117	112	57	3,00	19 0017	200	82	10,00
17 0029	15	5,2	0,40	18 0004	25	12,2	1,50	18 0061	60	25,5	2,50	18 0118	112	57	4,00	19 0018	200	82	12,00
17 0030	15	5,2	0,50	18 0005	28	10,2	1,25	18 0062	60	25,5	3,00	18 0119*	112	57	4,00	19 0019	200	92	10,00
17 0031	15	5,2	0,60	18 0006	28	10,2	1,50	18 0063	60	30,5	2,50	18 0120	112	57	6,00	19 0020	200	92	12,00
17 0032	15	5,2	0,70	18 0007	28	12,2	1,25	18 0064	60	30,5	2,75	18 0121*	112	57	6,00	19 0021	200	92	14,00
17 0033	15	6,2	0,50	18 0008	28	12,2	1,50	18 0065	60	30,5	3,00	18 0122	125	51	4,00	19 0022	200	102	8,00
17 0034	15	6,2	0,60	18 0009	28	14,2	1,25	18 0066	60	30,5	3,50	18 0123*	125	51	4,00	19 0023	200	102	10,00
17 0035	15	6,2	0,70	18 0010	28	14,2	1,50	18 0067	63	31	1,80	18 0124	125	51	5,00	19 0024	200	102	12,00
17 0036	15	8,2	0,70	18 0011	31,5	16,3	1,25	18 0068	63	31	2,50	18 0125*	125	51	5,00	19 0025	200	102	14,00
17 0037	15	8,2	0,80	18 0012	31,5	16,3	1,50	18 0069	63	31	3,00	18 0126	125	51	6,00	19 0026	200	112	12,00
17 0038	16	8,2	0,40	18 0013	31,5	16,3	1,75	18 0070	63	31	3,50	18 0127*	125	51	6,00	19 0027	200	112	14,00
17 0039	16	8,2	0,60	18 0014	31,5	16,3	2,00	18 0071	70	24,5	3,00	18 0128	125	61	5,00	19 0028	200	112	16,00
17 0040	16	8,2	0,90	18 0015	34	12,3	1,25	18 0072	70	24,5	3,50	18 0129*	125	61	5,00	19 0029	225	112	6,50
17 0041	18	6,2	0,40	18 0016	34	12,3	1,50	18 0073	70	25,5	2,00	180130	125	61	6,00	19 0030	225	112	8,00
17 0042	18	6,2	0,50	18 0017	34	14,3	1,25	18 0074	70	30,5	2,50	18 0131*	125	61	6,00	19 0031	225	112	12,00
17 0043	18	6,2	0,60	18 0018	34	14,3	1,50	18 0075	70	30,5	3,00	18 0132	125	64	3,50	19 0032	225	112	16,00
17 0044	18	6,2	0,70	18 0019	34	16,3	1,50	18 0076	70	35,5	3,00	18 0133	125	64	5,00	19 0033	250	102	10,00
17 0045	18	6,2	0,80	18 0020	34	16,3	2,00	18 0077	70	35,5	3,50	18 0134*	125	64	5,00	19 0034	250	102	12,00
17 0046	18	8,2	0,70	18 0021	35,5	18,3	1,25	18 0078	70	35,5	4,00	18 0135	125	64	6,00	19 0035	250	127	7,00
17 0047	18	8,2	0,80	18 0022	35,5	18,3	2,00	18 0079*	70	35,5	4,00	18 0136*	125	64	6,00	19 0036	250	127	8,00
17 0048	18	8,2	1,00	18 0023	40	14,3	1,25	18 0080	70	40,5	4,00	18 0137	125	71	6,00	19 0037	250	127	10,00
17 0049	18	9,2	0,45	18 0024	40	14,3	1,50	18 0081*	70	40,5	4,00	18 0138*	125	71	6,00	19 0038	250	127	12,00
17 0050	18	9,2	0,70	18 0025	40	14,3	1,75	18 0082	70	40,5	5,00	18 0139	140	72	3,80	19 0039	250	127	14,00
17 0051	18	9,2	1,00	18 0026	40	14,3	2,00	18 0083*	70	40,5	5,00	18 0140	140	72	5,00	19 0040	250	127	16,00
17 0052	20	8,2	0,50	18 0027	40	16,3	1,50	18 0084	71	36	2,00	18 0141*	140	72	5,00				
17 0053	20	8,2	0,60	18 0028	40	16,3	1,75	18 0085	71	36	2,50	18 0142	150	61	5,00				
17 0054	20	8,2	0,70	18 0029	40	16,3	2,00	18 0086	71	36	4,00	18 0143*	150	61	5,00				
17 0055	20	8,2	0,80	18 0030	40	18,3	2,00	18 0087*	71	36	4,00	18 0144	150	61	6,00				
17 0056	20	8,2	0,90	18 0031	40	20,4	1,50	18 0088	80	30,5	2,50	18 0145*	150	61	6,00				
17 0057	20	8,2	1,00	18 0032	40	20,4	2,00	18 0089	80	31	3,00	18 0146	150	71	6,00				

Order No.	Dimensions (mm)			Order No.	Dimensions (mm)			Order No.	Dimensions (mm)		
	De	Di	t		De	Di	t		De	Di	t
18 0079	70,00	35,50	4,00	19 0062	270	127	10,65	19 0119	340	172	17,3
18 0081	70,00	40,50	4,00	19 0063	270	142	22	19 0120	340	172	18
18 0083	70,00	40,50	5,00	19 0064	280	127	12	19 0121	340	172	20
18 0087	71,00	36,00	4,00	19 0065	280	127	19	19 0122	340	172	22
18 0091	80,00	31,00	4,00	19 0066	280	142	12	19 0123	360	182	15,5
18 0093	80,00	35,50	4,00	19 0067	280	142	15	19 0124	360	182	20
18 0098	80,00	41,00	4,00	19 0068	280	142	16,6	19 0125	360	182	21
18 0100	80,00	41,00	5,00	19 0069	280	142	17,45	19 0126	360	182	21,5
18 0104	90,00	46,00	5,00	19 0070	280	142	18	19 0127	360	182	23
18 0106	100,00	41,00	4,00	19 0071	280	142	18,9	19 0128	370	202	25
18 0108	100,00	41,00	5,00	19 0072	280	142	20,3	19 0129	370	202	26
18 0112	100,00	51,00	4,00	19 0073	280	142	22	19 0130	380	152	19
18 0114	100,00	51,00	5,00	19 0074	280	152	12,8	19 0131	380	192	13,5
18 0116	100,00	51,00	6,00	19 0075	280	152	15	19 0132	380	192	25
18 0119	112,00	57,00	4,00	19 0076	280	152	18,5	19 0133	380	202	12
18 0121	112,00	57,00	6,00	19 0077	300	127	12	19 0134	380	202	15
18 0123	125,00	51,00	4,00	19 0078	300	127	13	19 0135	380	212	18
18 0125	125,00	51,00	5,00	19 0079	300	127	14	19 0136	400	202	10
18 0127	125,00	51,00	6,00	19 0080	300	127	15,3	19 0137	400	202	12
18 0129	125,00	61,00	5,00	19 0081	300	127	16	19 0138	400	202	14
18 0131	125,00	61,00	6,00	19 0082	300	127	17	19 0139	400	202	16
18 0134	125,00	64,00	5,00	19 0083	300	127	17,4	19 0140	400	202	19
18 0136	125,00	64,00	6,00	19 0084	300	152	8,5	19 0141	400	202	20,3
18 0138	125,00	71,00	6,00	19 0085	300	152	10	19 0142	400	202	21,2
18 0141	140,00	72,00	5,00	19 0086	300	152	12	19 0143	400	202	22,5
18 0143	150,00	61,00	5,00	19 0087	300	152	13	19 0144	400	202	30
18 0145	150,00	61,00	6,00	19 0088	300	152	14	19 0145	440	212	18,5
18 0147	150,00	71,00	6,00	19 0089	300	152	14,5	19 0146	440	252	25
18 0149	160,00	82,00	4,30	19 0090	300	152	15	19 0147	450	202	25,5
18 0151	160,00	82,00	6,00	19 0091	300	152	15,5	19 0148	450	252	21
18 0153	180,00	92,00	4,80	19 0092	300	152	16,1	19 0149	450	252	25
18 0155	180,00	92,00	6,00	19 0093	300	152	16,5	19 0150	470	237	33
18 0173	200,00	82,00	5,00	19 0094	300	152	17	19 0151	480	252	20,3
18 0174	200,00	82,00	6,00	19 0095	300	152	18	19 0152	480	252	20,7
19 0041	200,00	82,00	8,50	19 0096	300	152	18,5	19 0153	500	202	37
19 0042	200,00	82,00	13,00	19 0097	300	152	19,5	19 0154	500	242	32
18 0157	200,00	102,00	5,50	19 0098	300	152	20	19 0155	500	252	19
19 0043	200,00	102,00	8,30	19 0099	300	152	20,5	19 0156	600	282	22
19 0044	200,00	102,00	9,00	19 0100	300	182	12	19 0157	600	282	24
19 0045	200,00	102,00	11,00	19 0101	320	172	8,1				
18 0175	200,00	112,00	6,00	19 0102	320	172	9				
19 0046	200,00	112,00	15,00	19 0103	320	172	13				
19 0047	225,00	112,00	9,00	19 0104	320	172	15				
19 0048	225,00	112,00	10,00	19 0105	340	172	9,2				
19 0049	225,00	112,00	10,80	19 0106	340	172	9,5				
19 0050	250,00	127,00	7,50	19 0107	340	172	10,5				
19 0051	250,00	127,00	9,00	19 0108	340	172	11				
19 0052	250,00	127,00	9,20	19 0109	340	172	11,5				
19 0053	250,00	127,00	10,50	19 0110	340	172	12,5				
19 0054	250,00	127,00	11,00	19 0111	340	172	13,5				
19 0055	250,00	127,00	13,00	19 0112	340	172	13,7				
19 0056	250,00	127,00	13,50	19 0113	340	172	14,2				
19 0057	250,00	127,00	14,50	19 0114	340	172	14,6				
19 0058	250,00	127,00	15,00	19 0115	340	172	15,3				
19 0059	250,00	127,00	16,80	19 0116	340	172	15,8				
19 0060	250,00	127,00	17,50	19 0117	340	172	16,2				
19 0061	250,00	127,00	18,50	19 0118	340	172	17				