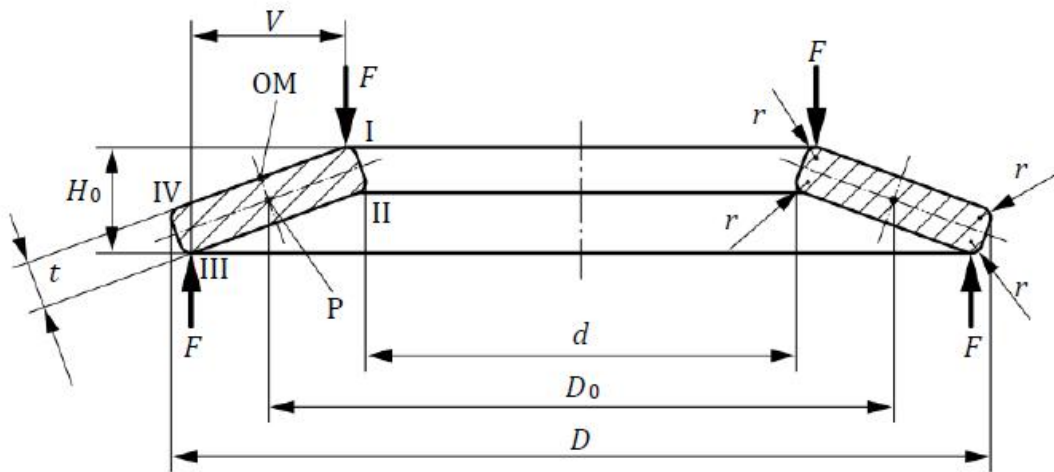
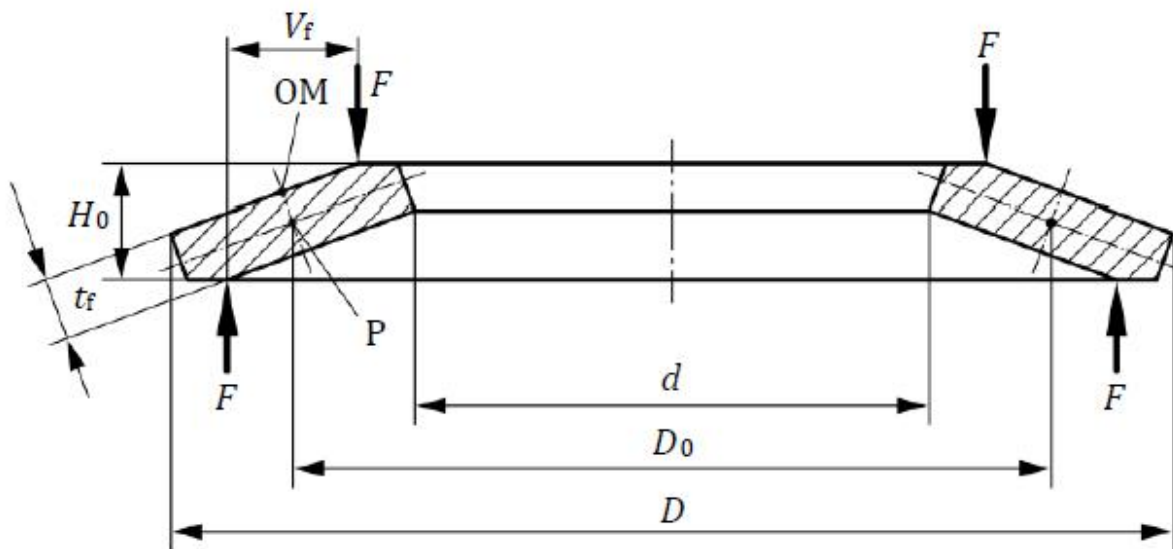


Dimensions and designation

- General



Without flat bearings: group 1 and group 2



With flat bearings: group 3

Key

D	external diameter of spring
Do	diameter of centre of rotation
d	internal diameter of spring
F	spring load
Ho	free height of spring
OM	point at upper surface of the spring perpendicular to the centre line at point P
P	theoretical centre rotation of disc cross section
r	chamfer radius at edge
t	thickness of spring
tf	reduced thickness of single disc spring with flat bearings
V	length of lever arms
Vf	length of lever arms with flat bearings
I	position I
II	position II
III	position III
IV	position IV

Figure 1 – Single disc spring including the relevant positions of loading

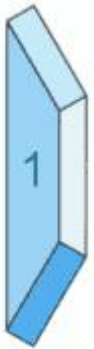
● Disc Spring groups:

Group	t (mm)	With flat bearings and reduced thickness
1	$0,2 \leq t < 1,25$	No
2	$1,25 \leq t \leq 6,0$	No
3	$6,0 < t \leq 14,0$	Yes

● Disc Spring Series:

Dimensional series	ho/t	tf/t	D/t
A	Approx.0,40	Approx.0,94	Approx.18
B	Approx.0,75	Approx.0,94	Approx.28
C	Approx.1,30	Approx.0,96	Approx.40

● **Different Disc Spring stacking:**



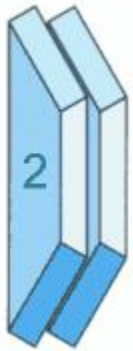
Single Disc Spring

Total force =

Force of single disc spring

Total Deflection =

Deflection of single disc spring



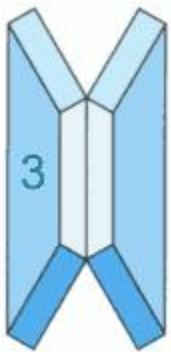
Disc Springs in Parallel

Total Force =

2 x Force of single disc spring

Total Deflection =

Deflection of single disc spring



Disc Springs in Series

Total Force =

Force of single disc spring

Total Deflection =

2 x Deflection of single disc spring



Disc Springs in Series and Parallel

Total force =

2 x Force of single disc spring

Total Deflection =

2 x Deflection of single disc spring

Disc Spring Characteristic features:

- Disc spring, also called Belleville washer, can act as a shock absorber or perform a dampening function.
- High load capacity in a small space not possible with ordinary coil springs, thus effecting large load with small deformation.
- With the characteristics of positive stiffness, zero stiffness, and negative stiffness, different characteristic curves can be obtained by changing the ratio of the inner cone height h_0 to the thickness t of the disc spring, h_0/t in Figure 2.
- Various Load characteristics can be obtained from the various combinations or stacking in Figure 3.
- In order to increase the life of disc spring, shot peening is provided during production for disc spring thickness $>0.50\text{mm}$.
- Each disc spring is loaded until it is in the flat position after heat treatment. After loading the disc spring with twice of its spring test load F_t , the tolerances for the spring load shall be met according to DIN2093 Standard.
- Commonly used in heavy machinery equipment such as large forging presses, boiler hangers, etc.
- It is also used in safety valves and ball valves, as well as in the control mechanism of automation devices.

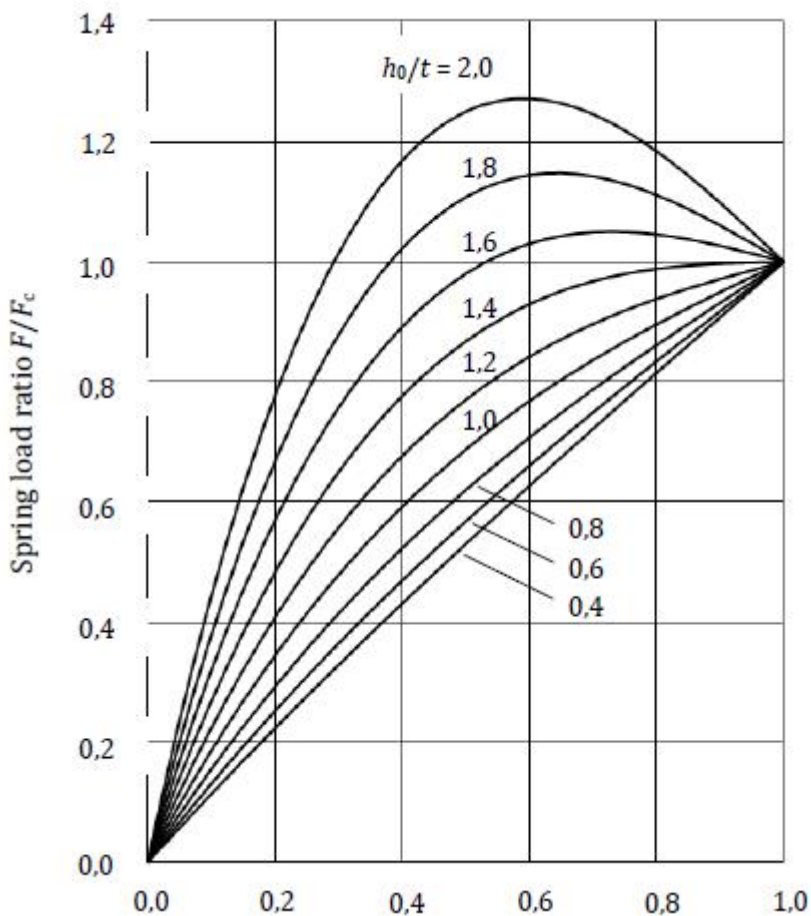


Figure 2 - Spring Load/deflection curves for various h_0/t ratios

Figure 3 - Stacking in parallel

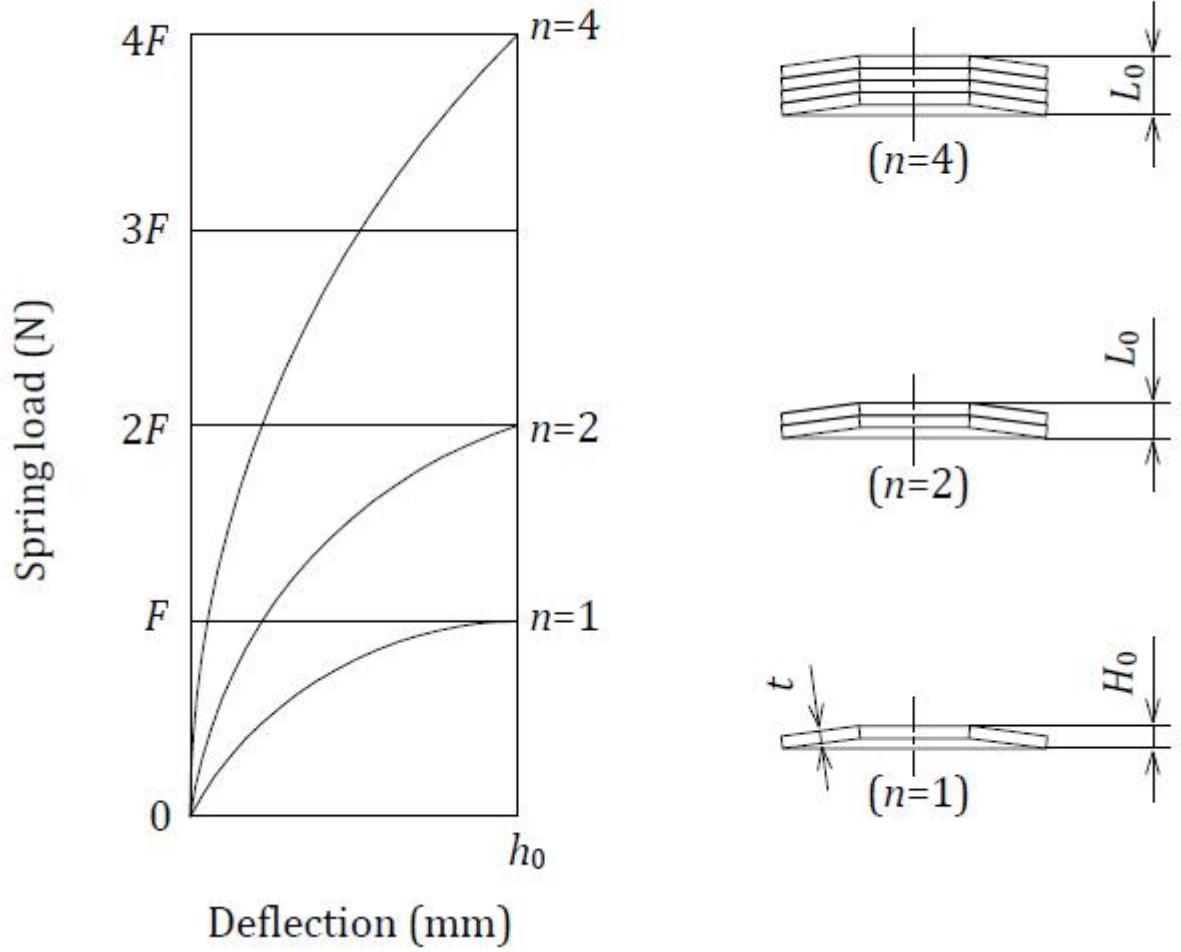


Figure 3 - Stacking in series

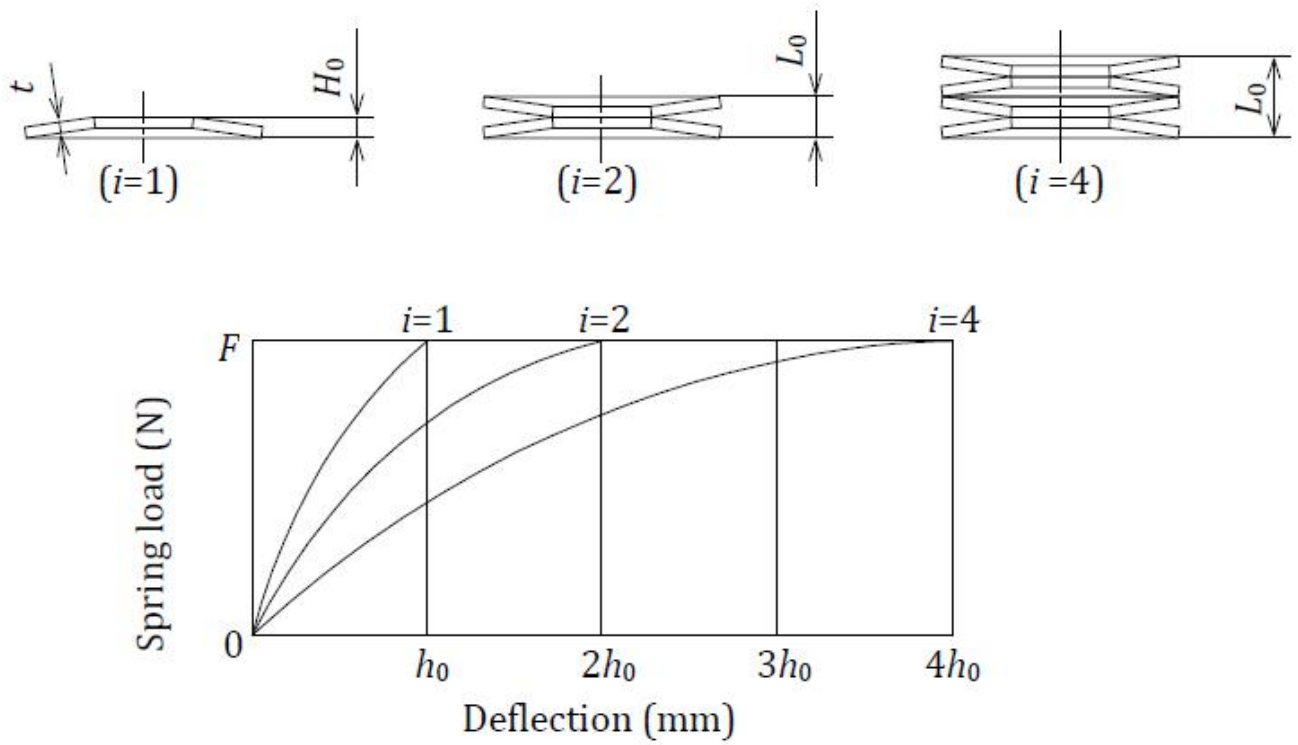


Figure 3 - Stacking in parallel and series:

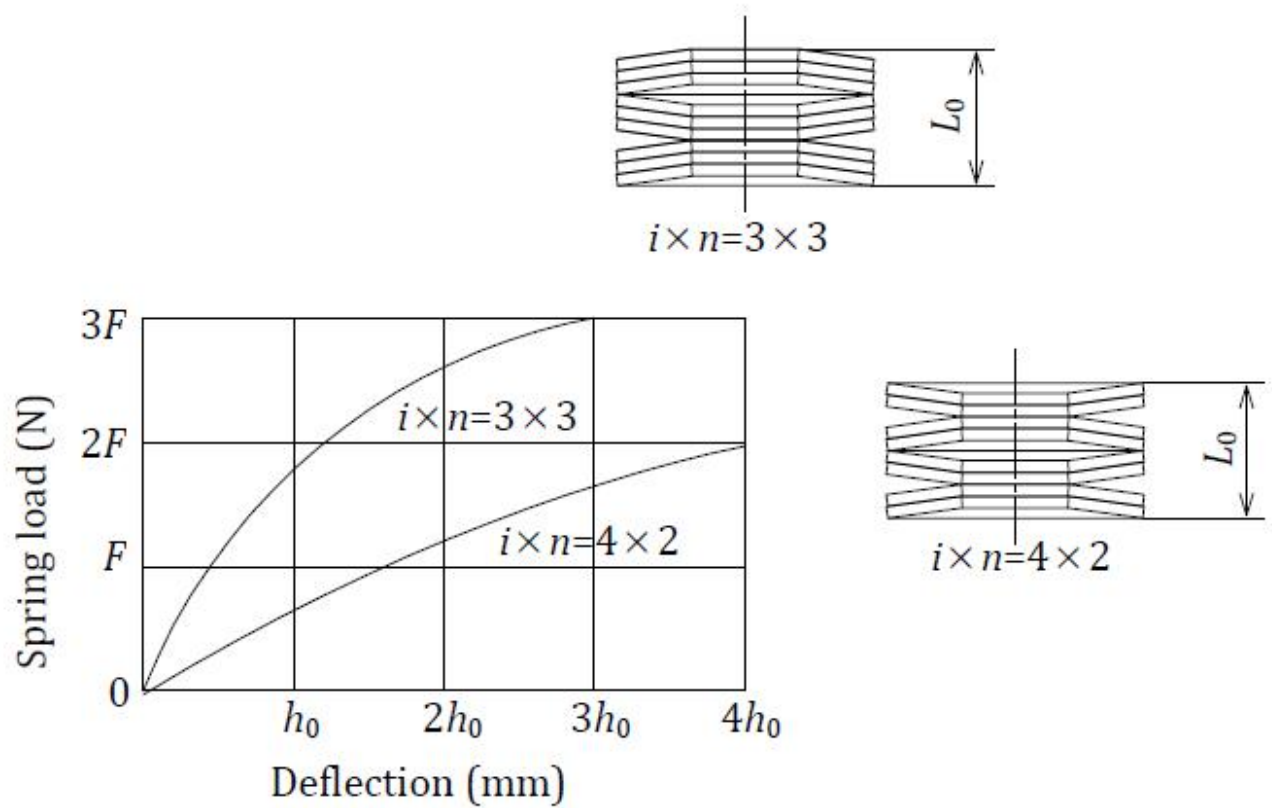


Figure 3 – Various disc spring stacking