Belleville (Disc) Spring Load and Stress: Almen–László

Load, stiffness and the compressive stress at the inner edge of a Belleville disc spring at a deflection, from its diameters, thickness, cone height and material.

Method: Almen–László disc spring theory

Input parameters

Unit system: SI

Parameter	Value	Unit
Outside diameter	50.000	mm
Inside diameter	25.400	mm
Thickness	2.0000	mm
Free cone height (inner height minus thickness)	1.6000	mm
Deflection	1.2000	mm
Elastic modulus	206.00	GPa
Poisson's ratio	0.30000	

Calculated results

Parameter	Value	Unit
Spring load at the deflection	5,560.9	N
Load when pressed flat (s = h_0)	6,740.5	N
Stiffness at the deflection	3,117.5	N/mm
Compressive stress at the inner upper edge	-2,492.1	MPa
Cone height ratio (above 1.414 the curve has a falling region)	0.80000	
Diameter-ratio factor	0.68780	

Notes for this case

- Almen–László theory for a disc of uniform thickness without flats; contact friction and stacking change the real characteristic.

Formula and method

$$F = \frac{4E}{1-\nu^2}\frac{t^4}{K_1 D_e^2}\frac{s}{t}\left[\left(\frac{h_0}{t}-\frac{s}{t}\right)\left(\frac{h_0}{t}-\frac{s}{2t}\right)+1\right]$$

$$K_1 = \frac{1}{\pi}\frac{\left(\frac{\delta-1}{\delta}\right)^2}{\frac{\delta+1}{\delta-1}-\frac{2}{\ln\delta}}, \quad \delta = \frac{D_e}{D_i}$$

Variables

D_e	Outside diameter	m
D_i	Inside diameter	m
t	Thickness	m
h_0	Free cone height (inner height minus thickness)	m
s	Deflection	m
E	Elastic modulus	Pa
ν	Poisson's ratio	-
F	Spring load at the deflection	N

F_{flat}	Load when pressed flat (s = h_0)	N
dF/ds	Stiffness at the deflection	N/m
σ_I	Compressive stress at the inner upper edge	Pa
h_0/t	Cone height ratio (above 1.414 the curve has a falling region)	-
K_1	Diameter-ratio factor	-

Method and standards

Almen–László disc spring equations.

Assumptions and limits

- Uniform thickness, no contact flats, elastic material.

References

Almen–László disc spring theory

Report details

Report reference	FCC-R6K5-NKSQ (the same inputs always give the same reference)
Generated	23 November 2026, 18:24 UTC
Calculator	Belleville (Disc) Spring Load and Stress: Almen–László
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/machine-design/belleville-disc-spring

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.