Cantilever Snap-Fit: Allowable Deflection and Assembly Force

Allowable deflection, deflection force and mating (push-in) force of a rectangular cantilever snap-fit hook from its size, permissible strain and friction.

Method: Cantilever beam snap-fit design

Input parameters

Unit system: SI

Parameter	Value	Unit
Arm length	15.000	mm
Arm thickness at the root	1.5000	mm
Arm width	6.0000	mm
Permissible strain (once or repeated)	2.0000	%
Secant modulus at that strain	2.0000	GPa
Coefficient of friction	0.50000	
Lead-in (mating) angle	30.000	°
Undercut (actual deflection)	1.0000	mm

Calculated results

Parameter	Value	Unit
Allowable deflection 0.67 ε l²/h	2.0000	mm
Deflection force at the undercut	3.0000	N
Mating (push-in) force	4.5437	N
Strain at the actual undercut	1.0000	%
Use of the allowable deflection	0.50000	

Notes for this case

- Constant-section rectangular cantilever, deflection at the hook tip: ε = 1.5hy/l². Taper the arm (thinner at the tip) to spread the strain and allow more deflection.

Formula and method

$$y_{allow} = 0.67\frac{\varepsilon l^2}{h}, \quad P = \frac{bh^2}{6}\frac{E_s\varepsilon}{l}, \quad W = P\frac{\mu + \tan\alpha}{1 - \mu\tan\alpha}$$

Variables

l	Arm length	m
h	Arm thickness at the root	m
b	Arm width	m
ε	Permissible strain (once or repeated)	-
E_s	Secant modulus at that strain	Pa
μ	Coefficient of friction	-
α	Lead-in (mating) angle	rad
y	Undercut (actual deflection)	m
y_{allow}	Allowable deflection 0.67 ε l²/h	m
P	Deflection force at the undercut	N
W	Mating (push-in) force	N
ε_y	Strain at the actual undercut	-

y/y_{allow}	Use of the allowable deflection	-

Method and standards

Beam theory for snap fits.

Assumptions and limits

- Rectangular constant section, small deflections, rigid mating part.

References

Cantilever beam snap-fit design

Report details

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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/snap-fit-cantilever

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.