Extrusion Pressure and Force (Ideal and Johnson)

Extrusion pressure and ram force from the extrusion ratio and mean flow stress, as ideal work and by Johnson's empirical form with your constants.

Method: Ideal p = σ̄ ln R; Johnson p = σ̄(a + b ln R) (Kalpakjian; Johnson and Mellor)

Input parameters

Unit system: SI

Parameter	Value	Unit
Billet diameter	100.00	mm
Extrudate diameter (equivalent)	30.000	mm
Mean flow stress	50.000	MPa
Johnson constant a From your process data or a forming text; the default pair (0.8, 1.5) is illustrative only.	0.80000	
Johnson constant b From your process data or a forming text; the default pair (0.8, 1.5) is illustrative only.	1.5000	

Calculated results

Parameter	Value	Unit
Extrusion ratio A₀/A_f	11.111	
Ideal pressure σ̄ ln R	120.40	MPa
Johnson pressure σ̄(a + b ln R)	220.60	MPa
Ram force (Johnson)	1,732.6	kN

Notes for this case

- Billet-container friction in direct extrusion adds more at the start of the stroke.

Formula and method

$$R = \frac{A_0}{A_f}, \quad p = \bar{\sigma}(a + b \ln R), \quad F = pA_0$$

Variables

D_0	Billet diameter	m
D_f	Extrudate diameter (equivalent)	m
$\bar{\sigma}$	Mean flow stress	Pa
a	Johnson constant a	-
b	Johnson constant b	-
R	Extrusion ratio A₀/A_f	-
p_i	Ideal pressure σ̄ ln R	Pa
p	Johnson pressure σ̄(a + b ln R)	Pa
F	Ram force (Johnson)	N

Method and standards

Ideal work plus empirical terms.

Assumptions and limits

- Steady extrusion.
- The Johnson constants a and b depend on the process and die; the defaults are illustrative, not a sourced pair: take yours from process data or a forming text.

References

- Ideal p = σ̄ ln R; Johnson p = σ̄(a + b ln R) (Kalpakjian; Johnson and Mellor)

Report details

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

This calculator online

https://calc.firecad.com/mechanical/manufacturing/extrusion-pressure

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.