Powder Compaction: Heckel Plot from Two Pressing Tests

Heckel constants from the relative density of a powder compact at two pressures, the mean yield pressure, and the density predicted at a third pressure.

Input parameters

Unit system: SI

Parameter	Value	Unit
First pressure	50.000	MPa
Relative density at P_1	55.000	%
Second pressure	150.00	MPa
Relative density at P_2	68.000	%
Pressure to predict	100.00	MPa

Calculated results

Parameter	Value	Unit
Mean yield pressure 1/K	293.32	MPa
Heckel intercept	0.62804	
Relative density at the intercept	46.637	%
Relative density at P_3	62.053	%

Notes for this case

• Heckel's equation ln[1/(1 − D)] = K·P + A treats pore removal during pressing as first order in pressure. The slope K gives the mean yield pressure P_y = 1/K: low values mean plastic deformation, high values brittle fragmentation. The intercept A reflects die filling and particle rearrangement. Two tests in the linear range fix the line; real plots curve at low pressure, so use pressures where the plot is straight.

Formula and method

$$\ln\frac{1}{1-D} = KP + A, \quad P_y = \frac{1}{K}$$

Variables

P_1	First pressure	Pa
D_1	Relative density at P_1	-
P_2	Second pressure	Pa
D_2	Relative density at P_2	-
P_3	Pressure to predict	Pa
P_y	Mean yield pressure 1/K	Pa
A	Heckel intercept	-
D_A	Relative density at the intercept	-
D_3	Relative density at P_3	-

Method and standards

Heckel.

Assumptions and limits

- Linear Heckel region.

Report details

Report reference	FCC-5EQJ-1AD0 (the same inputs always give the same reference)
Generated	23 November 2026, 17:35 UTC
Calculator	Powder Compaction: Heckel Plot from Two Pressing Tests
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/chemical/ceramics-glass/ceramic-heckel-compaction

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.