Fracture Toughness from Charpy Energy (Barsom–Rolfe)

Upper-shelf plane-strain fracture toughness of a steel from its Charpy V-notch energy and yield strength (Barsom–Rolfe), and the critical crack size.

Method: Barsom–Rolfe upper-shelf correlation

Input parameters

Unit system: SI

Parameter	Value	Unit
Charpy V-notch energy (upper shelf)	0.080000	kJ
Yield strength	800.00	MPa
Applied stress	400.00	MPa
Crack geometry factor	1.1200	

Calculated results

Parameter	Value	Unit
Estimated fracture toughness (MPa·m^½)	193.05	
Toughness-to-yield ratio (√m)	0.24132	
Critical crack size	59.108	mm

Notes for this case

• Barsom–Rolfe: (K_Ic/σ_y)² = 5(CVN/σ_y − 0.05) in ksi√in, ft·lb and ksi, for upper-shelf behaviour of steels with yield 760–1,700 MPa. Outside that range or in the transition region use other correlations or direct tests; a_c = (K_Ic/Yσ)²/π.

Formula and method

$$\left(\frac{K_{Ic}}{\sigma_y}\right)^2 = 5\left(\frac{CVN}{\sigma_y} - 0.05\right), \quad a_c = \frac{1}{\pi}\left(\frac{K_{Ic}}{Y\sigma}\right)^2$$

Variables

CVN	Charpy V-notch energy (upper shelf)	J
σ_y	Yield strength	Pa
σ	Applied stress	Pa
Y	Crack geometry factor	-
K_{Ic}	Estimated fracture toughness (MPa·m^½)	-
K_{Ic}/σ_y	Toughness-to-yield ratio (√m)	-
a_c	Critical crack size	m

Method and standards

Barsom–Rolfe.

Assumptions and limits

- Upper-shelf behaviour; medium- and high-strength steels.

References

Barsom–Rolfe upper-shelf correlation

Report details

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Release checks	4 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/materials/properties/barsom-rolfe-charpy-toughness

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.