Charpy Ductile-Brittle Transition Curve (tanh Fit)

Charpy impact energy at a temperature from a hyperbolic tangent transition curve, and the temperature where the energy reaches a chosen value such as 27 J.

Method: Hyperbolic tangent transition curve

Input parameters

Unit system: SI

Parameter	Value	Unit
Lower shelf energy	0.004000	kJ
Upper shelf energy	0.15000	kJ
Mid-transition temperature	-10.000	°C
Half-width of the transition	20.000	K
Test temperature	-20.000	°C
Target energy	0.027000	kJ

Calculated results

Parameter	Value	Unit
Energy at the temperature	43.265	J
Temperature for the target energy	-26.767	°C
Maximum slope (J/K)	3.6500	
Position in the transition	26.894	%

Notes for this case

• E(T) = A + B·tanh[(T − T_0)/C], A = (US + LS)/2, B = (US − LS)/2: the usual fit to Charpy V-notch data. Inverting gives the temperature for a target energy T = T_0 + C·artanh[(E_t − A)/B], for example T27J. Fit A, B, T_0 and C to test results by least squares; scatter in the transition region is large, so report the fit with the data.

Formula and method

$$E(T) = A + B\tanh\frac{T-T_0}{C}, \quad T_{E_t} = T_0 + C\operatorname{artanh}\frac{E_t - A}{B}$$

Variables

LS	Lower shelf energy	J
US	Upper shelf energy	J
T_0	Mid-transition temperature	K
C	Half-width of the transition	K
T	Test temperature	K
E_t	Target energy	J
$E(T)$	Energy at the temperature	J
T_{E_t}	Temperature for the target energy	K
dE/dT_{max}	Maximum slope (J/K)	-
$(E-LS)/(US-LS)$	Position in the transition	-

Method and standards

Transition curve.

Assumptions and limits

- Symmetric tanh shape; fitted parameters known.

References

Hyperbolic tangent transition curve

Report details

Report reference	FCC-JJKA-CZ31 (the same inputs always give the same reference)
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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/materials/properties/charpy-transition-curve-fit

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.