Zener–Hollomon Parameter and Hot Working Flow Stress

Zener–Hollomon parameter from strain rate and temperature, and steady hot working flow stress by the Sellars–Tegart hyperbolic sine law.

Method: Sellars–Tegart constitutive law

Input parameters

Unit system: SI

Parameter	Value	Unit
Strain rate	1.0000	1/s
Deformation temperature	1,000.0	°C
Activation energy for deformation	312.00	kJ/mol
Constant A (1/s)	1.0000e+11	
Stress multiplier (1/MPa)	0.012000	
Stress exponent	5.0000	

Calculated results

Parameter	Value	Unit
Zener–Hollomon parameter (1/s)	6.3161e+12	
ln Z	29.474	
Steady flow stress	130.57	MPa

Notes for this case

• Z = ε̇·exp(Q/RT); σ = (1/α)·asinh((Z/A)^(1/n)). A, α, n and Q are fitted to hot compression or torsion tests for each alloy; the defaults are illustrative for a carbon-manganese steel in austenite.

Formula and method

$$Z = \dot{\varepsilon}\exp\frac{Q}{RT}, \quad \sigma = \frac{1}{\alpha}\sinh^{-1}\left[\left(\frac{Z}{A}\right)^{1/n}\right]$$

Variables

$\dot{\varepsilon}$	Strain rate	1/s
T	Deformation temperature	K
Q	Activation energy for deformation	J/mol
A	Constant A (1/s)	-
α	Stress multiplier (1/MPa)	-
n	Stress exponent	-
Z	Zener–Hollomon parameter (1/s)	-
$\ln Z$	ln Z	-
σ	Steady flow stress	Pa

Method and standards

Hot working law.

Assumptions and limits

- Steady-state flow; constant structure.

References

Sellars–Tegart constitutive law

Report details

Report reference	FCC-3DKP-KWE0 (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/heat-treatment/zener-hollomon-flow-stress

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.