# Creep Activation Energy from Two Temperatures

Apparent activation energy for creep from steady-state creep rates at two temperatures under the same stress, and the creep rate predicted at a third temperature.

**Method:** Arrhenius analysis of steady-state creep

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Creep rate at $T_1$ (1/s) | 2.0000e-09 | |
| Temperature 1 | 550.00 | °C |
| Creep rate at $T_2$ (1/s) | 3.5000e-08 | |
| Temperature 2 | 600.00 | °C |
| Temperature to predict | 575.00 | °C |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Activation energy for creep | 342.08 | kJ/mol |
| Predicted creep rate at $T_3$ (1/s) | 8.7271e-09 | |
| Rate ratio | 17.500 | |
| Temperature rise that doubles the rate near $T_1$ | 11.576 | K |

### Notes for this case

• Steady-state creep follows $\dot{\varepsilon} = A\sigma^n \exp(-Q_c/RT)$. At constant stress two temperatures give $Q_c = R \cdot \ln(\dot{\varepsilon}_2/\dot{\varepsilon}_1)/(1/T_1 - 1/T_2)$. Above about half the melting point $Q_c$ is close to the activation energy for self-diffusion (dislocation climb), which supports extrapolation within one mechanism; a change in mechanism makes extrapolation unsafe.

## Formula and method

$$Q_c = \frac{R \ln(\dot{\varepsilon}_2/\dot{\varepsilon}_1)}{1/T_1 - 1/T_2}, \quad \dot{\varepsilon}_3 = \dot{\varepsilon}_1 \exp\left[-\frac{Q_c}{R}\left(\frac{1}{T_3} - \frac{1}{T_1}\right)\right]$$

### Variables

| | | |
|---|---|---|
| $\dot{\varepsilon}_1$ | Creep rate at $T_1$ (1/s) | - |
| $T_1$ | Temperature 1 | K |
| $\dot{\varepsilon}_2$ | Creep rate at $T_2$ (1/s) | - |
| $T_2$ | Temperature 2 | K |
| $T_3$ | Temperature to predict | K |
| $Q_c$ | Activation energy for creep | J/mol |
| $\dot{\varepsilon}_3$ | Predicted creep rate at $T_3$ (1/s) | - |
| $\dot{\varepsilon}_2/\dot{\varepsilon}_1$ | Rate ratio | - |
| $\Delta T_{\times 2}$ | Temperature rise that doubles the rate near $T_1$ | K |

### Method and standards

Creep activation energy.

### Assumptions and limits

- Same stress and mechanism; steady-state creep.

### References

Arrhenius analysis of steady-state creep

## Report details

| | |
|---|---|
| Report reference | FCC-JV60-G9D9 (the same inputs always give the same reference) |
| Generated | 23 November 2026, 17:50 UTC |
| Calculator | Creep Activation Energy from Two Temperatures |
| 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/materials/properties/creep-activation-energy

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.