# Thermal Shock Resistance Parameters of a Brittle Material

Critical quench temperature difference R and heat-flow parameter R′ of a brittle material from strength, modulus, expansion and conductivity.

**Method:** Kingery (1955) thermal stress resistance parameters R = σ_f(1 − ν)/(Eα); R′ = kR

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Fracture (flexural) strength | 300.00 | MPa |
| Poisson's ratio | 0.22000 | |
| Elastic modulus | 300.00 | GPa |
| Thermal expansion coefficient | 8.0000 | µm/(m·K) |
| Thermal conductivity | 20.000 | W/(m·K) |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Critical quench ΔT (parameter R) | 97.500 | K |
| Heat-flow parameter R′ = kR | 1,950.0 | W/m |

**Notes for this case**

• R is the ΔT that cracks a fully constrained surface on an instant quench (infinite Biot number); R′ governs at moderate heat transfer. Materials with low expansion and high conductivity (silicon carbide, silica glass) resist shock best.

## Formula and method

$$R = \frac{\sigma_f(1-\nu)}{E\alpha}, \quad R' = kR$$

### Variables

| | | |
|---|---|---|
| $\sigma_f$ | Fracture (flexural) strength | Pa |
| $\nu$ | Poisson's ratio | - |
| $E$ | Elastic modulus | Pa |
| $\alpha$ | Thermal expansion coefficient | 1/K |
| $k$ | Thermal conductivity | W/(m·K) |
| $R$ | Critical quench ΔT (parameter R) | K |
| $R'$ | Heat-flow parameter R′ = kR | W/m |

### Method and standards

Kingery's parameters.

### Assumptions and limits

- Linear elastic, brittle.

### References

• Kingery (1955) thermal stress resistance parameters R = σ_f(1 − ν)/(Eα)
• R′ = kR

## Report details

| | |
|---|---|
| Report reference | FCC-JTX1-JQNE (the same inputs always give the same reference) |
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| Release checks | 2 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/thermal-shock-resistance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.