Service Life at Another Temperature (Arrhenius Ageing)

Life of insulation, elastomers or lubricants at a new temperature from a known life and activation energy, with the acceleration factor.

Method: Arrhenius ageing L ? exp(E_a/RT) (IEC 60216 principle; Montsinger's 10 K rule as a special case)

Input parameters

Unit system: SI

Parameter	Value	Unit
Known life	20,000	h
Temperature for the known life	90.000	°C
New temperature	110.00	°C
Activation energy	80.000	kJ/mol

Calculated results

Parameter	Value	Unit
Life at the new temperature	5,016.4	h
Acceleration factor L_1/L_2	3.9870	
Temperature rise that halves life near T_1	9.5004	K

Notes for this case

- Single-mechanism Arrhenius model. The familiar 'life halves every 10 K' for insulation corresponds to E_a ≈ 80 kJ/mol near 100 °C. Do not extrapolate across a change of mechanism (melting, glass transition).

Formula and method

$$L_2 = L_1 \exp\left[\frac{E_a}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)\right], \quad \Delta T_{1/2} \approx \frac{R T_1^2 \ln 2}{E_a}$$

Variables

L_1	Known life	s
T_1	Temperature for the known life	K
T_2	New temperature	K
E_a	Activation energy	J/mol
L_2	Life at the new temperature	s
AF	Acceleration factor L_1/L_2	-
$\Delta T_{1/2}$	Temperature rise that halves life near T_1	K

Method and standards

Arrhenius relation.

Assumptions and limits

- Single thermally activated mechanism.

References

• Arrhenius ageing L ? exp(E_a/RT) (IEC 60216 principle; Montsinger's 10 K rule as a special case)

Report details

Report reference	FCC-AMSB-W8FX (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/arrhenius-ageing-life

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.