Conductor Resistance at Operating Temperature

Resistance of a copper or aluminium conductor at its operating temperature from the value at a reference temperature and the temperature coefficient, with I^2R losses.

Method: $R_2 = R_1 [1 + \alpha (T_2 - T_1)]$

Input parameters

Unit system: SI

Parameter	Value	Unit
Resistance at the reference temperature	0.10000	Ω
Reference temperature	20.000	°C
Operating temperature	90.000	°C
Temperature coefficient of resistance at T_1 (per K) From the conductor maker's data; copper is about 0.0039 per K and aluminium about 0.0040 per K at 20 °C.	0.003930	
Current (for the loss)	100.00	A

Calculated results

Parameter	Value	Unit
Resistance at the operating temperature	0.12751	Ω
Resistance ratio	1.2751	
I^2R loss at the reference temperature	1.0000	kW
I^2R loss at the operating temperature	1.2751	kW

Notes for this case

- DC resistance; AC skin and proximity effects add to it in large conductors.

Formula and method

$$R_2 = R_1[1 + \alpha_1(T_2 - T_1)]$$

$$P = I^2 R$$

Variables

R_1	resistance at the reference temperature	Ω
T_1	reference temperature	K
T_2	operating temperature	K
α_1	temperature coefficient at T_1	1/K
I	current	A
R_2	resistance at the operating temperature	Ω
R_2/R_1	resistance ratio	-
P_1	I^2R loss at T_1	W
P_2	I^2R loss at T_2	W
P	I^2R loss	W

Method and standards

Metal resistance rises almost linearly with temperature; the coefficient α applies at the reference temperature T_1. The conductor maker gives α for the conductor material.

Assumptions and limits

- Linear relation; fine over the normal operating range.
- DC resistance.

- α is the coefficient at the reference temperature T_1; a 20 °C value used with another T_1 is flagged ($\alpha_1 = \alpha_{20}/[1 + \alpha_{20}(T_1 - 20\ °C)]$).

References

- $R_2 = R_1\,[1 + \alpha\,(T_2 - T_1)]$

Report details

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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/electrical/cables/conductor-resistance-temperature

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.