Thermal expansion report

Sample document with complete example values. It shows the report the purchased export produces for YOUR input - it is not itself a report for any part.

Project: Sample project | Part/Position: no real part | Prepared by: Sample, not released

Overall assessment: not OK - the clearance is used up at the final temperature, the parts seize.

Task

Calculated	Two parts: clearance over temperature

Outer part (bore, guide)

Material	S235JR
Expansion coefficient α_o	12 10^{-6}/K
Outer nominal size L_o	80 mm

Inner part (shaft, carriage)

Material	POM-C
Inner expansion coefficient α_i	110 10^{-6}/K
Inner nominal size L_i	79.95 mm

Temperature

Initial temperature T_0	20 °C
Final temperature T_1	120 °C
Temperature difference ΔT	100 K

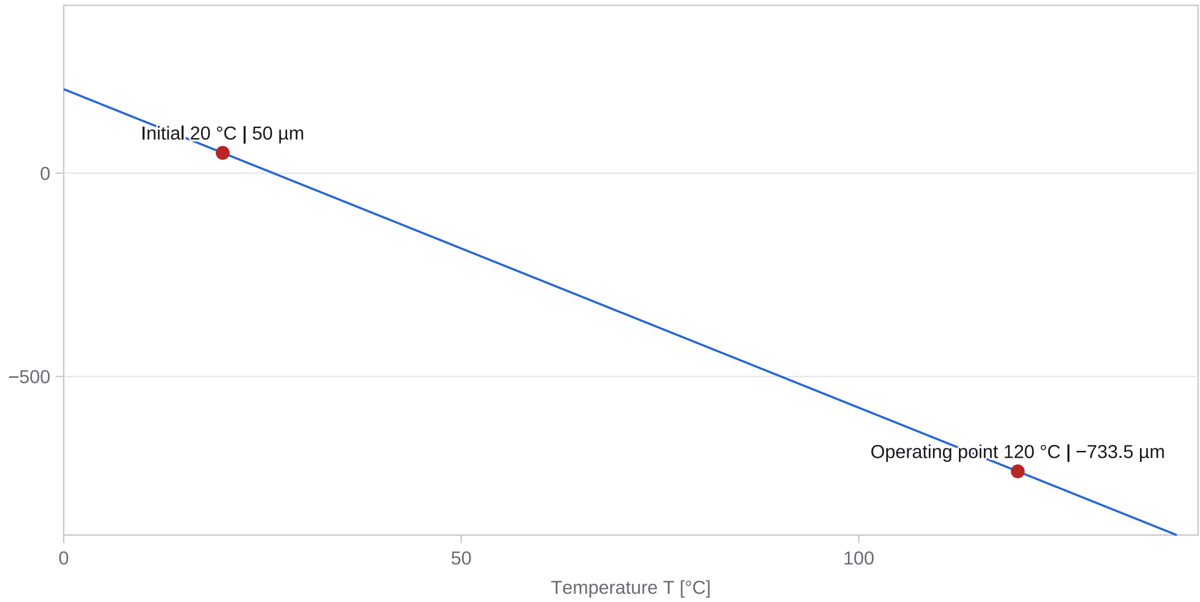
Results

Outer length change ΔL_o	0.096 mm
Inner length change ΔL_i	0.8795 mm
Clearance at T_0	50 µm
Clearance at T_1	−733.5 µm
Change of clearance	−783.5 µm
Clearance used up at	26.4 °C

Verification

Criterion	Value	Limit	Status
Clearance at T_1 stays positive	−733.5 µm	> 0 µm	● not OK

Clearance s(T) [µm]



Below the zero line the clearance is used up and the pair seizes. The curve is extended beyond the range considered so that its direction stays visible.

Notes

A temperature lies outside the range for which the tabulated coefficient applies (−50 to 200 °C, for plastics up to 100 °C). α changes with temperature; enter a suitable value for the range considered as a free input.

The clearance is used up at the final temperature: the parts seize or sit with interference. Change the material pairing, the fit or the temperature range.

Basis of calculation

Free thermal expansion from ΔL = α·L·ΔT with ΔT = $T_1 - T_0$. Area and volume change are formed exactly from the length ratio, that is ΔA/A = (1+α·ΔT)² − 1 and ΔV/V = (1+α·ΔT)³ − 1, and not through the common approximations 2·α·ΔT and 3·α·ΔT. For a pair the clearance follows from s(T) = s_0 + (α_o·L_o − α_i·L_i)·(T − T_0), and the temperature at which it is used up from T = T_0 − s_0/(α_o·L_o − α_i·L_i). If that lies below absolute zero the case does not occur. The calculation assumes an expansion coefficient held constant over the temperature range, unrestrained expansion and a temperature constant across the section. No stress therefore arises - if the expansion is restrained, σ_th = −E·α·ΔT applies and the verification belongs to the axial bar calculator. Residual stress, creep and phase changes are not considered; the tabulated coefficients are mean values for the range around room temperature.

About this sample

All values on these pages come from a freely chosen example calculation and belong to no real part. The purchased export contains the same sections with your input, your header data (project, part, prepared by) and as searchable text. Pricing and scope: maschinenbaurechner.de/en/pricing