# Refractory Wall Heat Loss and Surface Temperature

Heat loss through a furnace or duct wall of up to three refractory and insulation layers, the interface and outer surface temperatures and the total loss.

**Method:** One-dimensional conduction through plane layers in series with a surface coefficient

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Hot face temperature | 1,100.0 | °C |
| Thickness | 115.00 | mm |
| Thermal conductivity at its mean temperature | 1.2000 | W/(m·K) |
| Thickness (0 = none) | 115.00 | mm |
| Thermal conductivity | 0.30000 | W/(m·K) |
| Thickness (0 = none) | 75.000 | mm |
| Thermal conductivity | 0.080000 | W/(m·K) |
| Ambient temperature | 30.000 | °C |
| Outer surface coefficient (convection + radiation)<br>About 8–15 W/(m²·K) for painted casing in still air; more in wind. | 12.000 | W/(m²·K) |
| Wall area | 50.000 | m² |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Heat loss per m² | 713.33 | W/m² |
| Outer surface temperature | 89.444 | °C |
| Total heat loss | 35.667 | kW |
| Interface temperature, layer 1 to 2 | 1,031.6 | °C |
| Interface temperature, layer 2 to 3 | 758.19 | °C |

**Notes for this case**

- Surface above 60 °C: a burn hazard where people can touch it; add insulation or guarding.
- Check each interface temperature against the service limit of the next layer's material.

## Formula and method

$$q = \frac{T_h - T_a}{\frac{t_1}{k_1} + \frac{t_2}{k_2} + \frac{t_3}{k_3} + \frac{1}{h_s}} \qquad T_{12} = T_h - q\frac{t_1}{k_1} \qquad T_{23} = T_{12} - q\frac{t_2}{k_2} \qquad T_s = T_a + \frac{q}{h_s}$$

### Variables

| | | |
|---|---|---|
| $T_h$ | hot face temperature | K |
| $t_1$ | layer 1 thickness | m |
| $k_1$ | layer 1 conductivity | W/(m·K) |
| $t_2$ | layer 2 thickness | m |
| $k_2$ | layer 2 conductivity | W/(m·K) |
| $t_3$ | layer 3 thickness | m |
| $k_3$ | layer 3 conductivity | W/(m·K) |
| $T_a$ | ambient temperature | K |

| | | |
|---|---|---|
| $h_s$ | outer surface coefficient | W/(m²·K) |
| $A$ | wall area | m² |
| $q$ | heat loss per m² | W/m² |
| $T_s$ | outer surface temperature | K |
| $\dot{Q}$ | total heat loss | W |
| $T_{12}$ | interface 1–2 | K |
| $T_{23}$ | interface 2–3 | K |

### Method and standards

Steady one-dimensional conduction through plane layers in series and a combined convection–radiation coefficient at the casing.

### Assumptions and limits

- Plane wall; constant conductivities; no heat bridges.
- One pass with fixed k and h_s. Refractory conductivity varies with temperature and the casing coefficient rises with casing temperature (radiation), so recheck each k at the computed layer mean temperature and h_s at the computed T_s, and recalculate if they differ.

### References

- One-dimensional conduction through plane layers in series with a surface coefficient

## Report details

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|---|---|
| Report reference | FCC-HP0Z-5BB9 (the same inputs always give the same reference) |
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| Calculator | Refractory Wall Heat Loss and Surface Temperature |
| Method last reviewed | 11 November 2026 |
| Software release | FireCAD Calc, release of 17 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/mechanical/heat-transfer/refractory-heat-loss

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.