Finned Tube Fin Efficiency and Effective Area

Fin efficiency of annular (circular) fins by Schmidt's approximation, the overall surface efficiency and the effective area per metre of finned tube.

Method: T.E. Schmidt (1949) approximation for annular fins

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas-side heat transfer coefficient	60.000	W/(m²·K)
Fin thermal conductivity	45.000	W/(m·K)
Fin thickness	1.2000	mm
Tube outside diameter	50.800	mm
Fin outside diameter	88.900	mm
Fin pitch (centre to centre)	4.0000	mm

Calculated results

Parameter	Value	Unit
Fin efficiency	72.368	%
Overall surface efficiency	73.719	%
Total outside area per metre of tube	2.2857	m²
Effective area per metre of tube	1.6850	m²
Area ratio to the bare tube	14.322	

Formula and method

$$m = \sqrt{\frac{2h}{kt}} \qquad \phi = \left(\frac{r_{ec}}{r_b} - 1\right)\left(1 + 0.35\ln\frac{r_{ec}}{r_b}\right) \qquad \eta_f = \frac{\tanh(m r_b \phi)}{m r_b \phi}$$

$$\eta_o = 1 - \frac{A_f}{A}(1 - \eta_f) \qquad A = A_f + A_b$$

Variables

h	gas-side coefficient	W/(m²·K)
k	fin conductivity	W/(m·K)
t	fin thickness	m
d_o	tube outside diameter	m
d_f	fin outside diameter	m
S	fin pitch	m
η_f	fin efficiency	–
η_o	overall surface efficiency	–
A	total area per metre	m²
$\eta_o A$	effective area per metre	m²
A/A_b	area ratio to bare tube	–
r_b	fin root radius	m
r_{ec}	fin tip radius plus half thickness	m
A_f	fin area per metre	m²

A_b	exposed tube area per metre	m²
m	fin parameter	1/m
ϕ	Schmidt geometry factor	–

Method and standards

Schmidt's approximation for annular fins of constant thickness with the tip loss included by extending the radius by half the thickness; areas per metre of tube.

Assumptions and limits

- Solid annular fins of uniform thickness; uniform h; no contact resistance at the fin root.
- Serrated (segmented) fins, common in HRSGs, have a different efficiency and are not covered.

References

• T.E. Schmidt (1949) approximation for annular fins

Report details

Report reference	FCC-MP31-FRBG (the same inputs always give the same reference)
Generated	17 November 2026, 19:45 UTC
Calculator	Finned Tube Fin Efficiency and Effective Area
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/finned-tube-efficiency

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.