Fire-Tube Boiler Heating Surface and Evaporation Rate

Heating surface of a fire-tube (smoke-tube) boiler from its tubes and furnace, and the evaporation per square metre of heating surface for a steam output.

Method: Fire-side area of tubes and furnace (geometry)

Input parameters

Unit system: SI

Parameter	Value	Unit
Number of smoke tubes	120.00	
Tube inside diameter (fire side)	57.000	mm
Tube length	4.5000	m
Furnace inside diameter	900.00	mm
Furnace length	4.5000	m
Other heated surface (reversal chamber, tube plates)	3.0000	m²
Steam output	5,000.0	kg/h

Calculated results

Parameter	Value	Unit
Tube heating surface n π d_t L_t	96.698	m²
Furnace heating surface π D_f L_f	12.723	m²
Total heating surface	112.42	m²
Evaporation per m² of heating surface	0.012354	kg/(m²·s)

Formula and method

$$A = n\,\pi\,d_t\,L_t + \pi\,D_f\,L_f + A_x$$

$$e = \frac{\dot{m}_s}{A}$$

Variables

n	Number of smoke tubes	-
d_t	Tube inside diameter (fire side)	m
L_t	Tube length	m
D_f	Furnace inside diameter	m
L_f	Furnace length	m
A_x	Other heated surface (reversal chamber, tube plates)	m²
$\dot{m}_s$	Steam output	kg/s
A_t	Tube heating surface n π d_t L_t	m²
A_f	Furnace heating surface π D_f L_f	m²
A	Total heating surface	m²
e	Evaporation per m² of heating surface	kg/(m²·s)

Method and standards

Geometric area of the heated surfaces on the gas side.

Assumptions and limits

- Plain tubes; corrugated furnaces counted by their mean diameter.

- Other surfaces entered by the user.
- Heating surface measured on the side touched by the hot gas: inside the smoke tubes and inside the furnace.

References

- Fire-side area of tubes and furnace (geometry)

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/boilers-power-plant/boilers/fire-tube-heating-surface

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.