Equivalent Evaporation (From and At 100 °C)

Boiler output expressed as water evaporated from and at 100 °C: factor of evaporation, equivalent evaporation and evaporation ratio per kg of fuel.

Method: IAPWS R7-97(2012) IF97; BS 845-1:1987 (boiler thermal performance, concise procedure)

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam generated	10,000	kg/h
Steam pressure (absolute) At the boiler outlet. Absolute; choose a gauge unit to enter gauge readings.	10.500	bar
Steam condition	Dry saturated	
Steam temperature (superheated only)	250.00	°C
Feedwater temperature	105.00	°C
Fuel burnt (optional) Enter 0 to skip the evaporation ratios.	1,600.0	kg/h

Calculated results

Parameter	Value	Unit
Equivalent evaporation from and at 100 °C	10,362	kg/h
Factor of evaporation	1.0362	
Actual evaporation ratio	6.2500	kg/kg
Equivalent evaporation ratio	6.4760	kg/kg
Steam enthalpy	2,779.0	kJ/kg
Feedwater enthalpy	440.90	kJ/kg
Latent heat at 100 °C	2,256.5	kJ/kg

Formula and method

$$F = \frac{h_s - h_{fw}}{h_{fg,100}} \qquad \dot{m}_e = F\,\dot{m}_s$$

$$\text{actual evaporation ratio} = \frac{\dot{m}_s}{\dot{m}_f} \qquad \text{equivalent evaporation ratio} = \frac{\dot{m}_e}{\dot{m}_f}$$

Variables

$\dot{m}_s$	steam generated	kg/s
p	steam absolute pressure at the boiler outlet	Pa
state	dry saturated, or superheated at T_s	–
T_s	steam temperature when superheated	K
T_{fw}	feedwater temperature	K
$\dot{m}_f$	fuel burnt (optional)	kg/s
$\dot{m}_e$	equivalent evaporation from and at 100 °C	kg/s
F	factor of evaporation	–
$\dot{m}_s/\dot{m}_f$	actual evaporation ratio	kg/kg
$\dot{m}_e/\dot{m}_f$	equivalent evaporation ratio	kg/kg

h_s	steam enthalpy	J/kg
h_{fw}	feedwater enthalpy	J/kg
$h_{fg,100}$	latent heat of vaporisation at 100 °C	J/kg

Method and standards

The "from and at 100 °C" rating convention used for shell boilers (BS 845-1 and boiler-maker practice). All enthalpies come from FireCAD's IAPWS-IF97 implementation; $h_{fg,100}$ is evaluated on the saturation line at 373.15 K.

Assumptions and limits

- Feedwater enthalpy is taken at the steam pressure (the difference to the feed pump outlet pressure is negligible here).
- Wet steam and blowdown are not included; for boiler efficiency use the PTC 4 calculators.

References

• IAPWS R7-97(2012) IF97
• BS 845-1:1987 (boiler thermal performance, concise procedure)

Report details

Report reference	FCC-QMX2-0N91 (the same inputs always give the same reference)
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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/boilers-power-plant/boilers/equivalent-evaporation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.