Economiser Heat Balance (Water Outlet Temperature)

Economiser duty and feedwater outlet temperature from the flue gas flow and temperatures and the water flow, with the approach to saturation (IAPWS-IF97).

Method: IAPWS R7-97(2012) IF97; first law heat balance

Input parameters

Unit system: SI

Parameter	Value	Unit
Flue gas flow	133,200	kg/h
Mean specific heat of the flue gas Between the two gas temperatures; the gas properties calculator gives it.	1.0800	kJ/(kg·K)
Gas temperature in	350.00	°C
Gas temperature out	180.00	°C
Feedwater flow	51,120	kg/h
Feedwater pressure (absolute)	70.000	bar
Feedwater temperature in	150.00	°C

Calculated results

Parameter	Value	Unit
Feedwater temperature out	255.98	°C
Economiser duty	6,793.2	kW
Approach to saturation (steaming margin)	29.851	K
Feedwater temperature rise	105.98	K
Feedwater enthalpy out	1,114.7	kJ/kg

Formula and method

$$\dot{Q} = \dot{m}_g c_{p,g} (T_{g,1} - T_{g,2}) \qquad h_{w,2} = h_{w,1} + \frac{\dot{Q}}{\dot{m}_w} \qquad T_{w,2} = T(p_w, h_{w,2})$$

$$\Delta T_w = T_{w,2} - T_{w,1} \qquad \Delta T_{sat} = T_{sat}(p_w) - T_{w,2}$$

Variables

$\dot{m}_g$	flue gas flow	kg/s
$c_{p,g}$	mean specific heat of flue gas	J/(kg·K)
$T_{g,1}$	gas temperature in	K
$T_{g,2}$	gas temperature out	K
$\dot{m}_w$	feedwater flow	kg/s
p_w	feedwater pressure, absolute	Pa
$T_{w,1}$	feedwater temperature in	K
$T_{w,2}$	feedwater temperature out	K
$\dot{Q}$	economiser duty	W
ΔT_{sat}	approach to saturation	K
ΔT_w	feedwater temperature rise	K
$h_{w,1}$	feedwater enthalpy in	J/kg
$h_{w,2}$	feedwater enthalpy out	J/kg

T_{sat}	saturation temperature at feedwater pressure	K

Method and standards

A first-law balance across the economiser: gas-side duty from flow, mean specific heat and temperature drop; water-side outlet enthalpy and temperature by FireCAD's IAPWS-IF97 (backward equation T(p,h)). Heat loss from the economiser casing is neglected.

Assumptions and limits

- No heat loss from the casing; steady flow.
- Water side single-phase; a warning is given if it reaches saturation, and for a temperature cross at either end.
- The water-side pressure drop is neglected: the outlet saturation temperature is taken at the inlet pressure, which slightly overstates the approach.
- At or above the critical pressure (220.64 bar) there is no saturation temperature, so the approach is not shown.

References

- IAPWS R7-97(2012) IF97
- first law heat balance

Report details

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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/furnace-heating-surfaces/economiser-heat-balance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.