Steam, Feedwater and Fuel Flow Reconciliation

Cross-check of steam flow against feedwater minus blowdown and against fuel heat times efficiency (IF97 enthalpies), showing which meter disagrees and by how much.

Method: Mass balance and energy balance with IAPWS-IF97 enthalpies

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam flow (meter)	60.000	t/h
Feedwater flow (meter)	62.500	t/h
Blowdown	1.5000	t/h
Fuel flow	27.000	t/h
Fuel GCV	9,600.0	kJ/kg
Boiler efficiency (GCV)	70.000	%
Steam pressure (absolute)	46.000	bar
Steam temperature	440.00	°C
Feedwater temperature	105.00	°C

Calculated results

Parameter	Value	Unit
Steam from feedwater − blowdown	61.000	t/h
Steam from fuel heat × efficiency	63.178	t/h
Steam meter vs water balance	-1.6393	%
Steam meter vs fuel balance	-5.0301	%

Notes for this case

- If the steam meter disagrees with both balances in the same direction, suspect the steam meter (density compensation, DP span).

Formula and method

$$\dot{m}_{s,1} = \dot{m}_{fw} - \dot{m}_{bd}, \quad \dot{m}_{s,2} = \frac{\dot{m}_{fuel} GCV \eta - \dot{m}_{bd}(h_f - h_{fw})}{h_s - h_{fw}}$$

Variables

$\dot{m}_s$	Steam flow (meter)	kg/s
$\dot{m}_{fw}$	Feedwater flow (meter)	kg/s
$\dot{m}_{bd}$	Blowdown	kg/s
$\dot{m}_{fuel}$	Fuel flow	kg/s
GCV	Fuel GCV	J/kg
η	Boiler efficiency (GCV)	-
p	Steam pressure (absolute)	Pa
T_s	Steam temperature	K
T_{fw}	Feedwater temperature	K
$\dot{m}_{s,1}$	Steam from feedwater − blowdown	kg/s
$\dot{m}_{s,2}$	Steam from fuel heat × efficiency	kg/s
ϵ_1	Steam meter vs water balance	-

ϵ_2	Steam meter vs fuel balance	-

Method and standards

Mass balance (steam = feedwater − blowdown) and energy balance (fuel heat × efficiency, less the heat to the blowdown as saturated water, over the heat per kg of steam), with IAPWS-IF97 enthalpies.

Assumptions and limits

- Steady load.
- Attemperator spray taken from the feedwater after its meter, vents, drains and soot-blowing steam taken before the steam meter are not in the balance; allow for them when comparing.
- Feedwater liquid at the steam pressure; feedwater flow above the blowdown; fuel flow above zero.

References

- Mass balance and energy balance with IAPWS-IF97 enthalpies

Report details

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Release checks	2 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/plant-performance/steam-feed-fuel-reconciliation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.