Boiler Heat Duty Split (Economiser, Evaporator, SH, RH)

How a boiler's heat duty splits between economiser, evaporator, superheater and reheater, from the steam, feedwater and reheat conditions (IAPWS-IF97).

Method: IAPWS R7-97 IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Main steam flow	640,000	kg/h
Main steam (drum) pressure (absolute)	150.00	bar
Main steam temperature	540.00	°C
Feedwater temperature at economiser inlet	245.00	°C
Water temperature leaving the economiser	300.00	°C
Reheat steam flow (0 = no reheat)	560,000	kg/h
Reheat pressure (absolute)	40.000	bar
Cold reheat temperature	340.00	°C
Hot reheat temperature	540.00	°C

Calculated results

Parameter	Value	Unit
Total heat to water and steam	492.67	MW
Economiser	48.992	MW
Evaporator (furnace walls)	226.28	MW
Superheater	144.42	MW
Reheater	72.986	MW

Notes for this case

- One pressure is used for economiser, drum and superheater; pressure drops, blowdown and attemperator spray are not included.

Formula and method

$$\dot{Q}_{eco} = \dot{m}(h_{eco} - h_{fw}) \qquad \dot{Q}_{ev} = \dot{m}(h_g - h_{eco}) \qquad \dot{Q}_{sh} = \dot{m}(h_{ms} - h_g) \qquad \dot{Q}_{rh} = \dot{m}_{rh}(h_{hrh} - h_{crh})$$

Variables

$\dot{m}_{ms}$	main steam flow	kg/s
p	main steam pressure	Pa
T_{ms}	main steam temperature	K
T_{fw}	feedwater temperature	K
T_{eco}	economiser outlet temperature	K
$\dot{m}_{rh}$	reheat flow	kg/s
p_{rh}	reheat pressure	Pa
T_{crh}	cold reheat temperature	K
T_{hrh}	hot reheat temperature	K
$\dot{Q}$	total duty	W
$\dot{Q}_{eco}$	economiser	W
$\dot{Q}_{ev}$	evaporator	W

$\dot{Q}_{sh}$	superheater	W
$\dot{Q}_{rh}$	reheater	W
$\dot{m}$	main steam flow	kg/s
h	enthalpies (IF97)	J/kg

Method and standards

Enthalpy differences from FireCAD's IAPWS-IF97 at one pressure for economiser, drum and superheater.

Assumptions and limits

- One pressure for economiser, drum and superheater; no blowdown or spray. The real drum runs above the main steam pressure, which moves a little duty from the evaporator to the superheater.
- The hot reheat must be hotter than the cold reheat.

References

- IAPWS R7-97 IF97

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/boilers/utility-boiler-heat-duty

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.