Steam Turbine Exhaust Dryness and Wetness

Dryness fraction and moisture of steam leaving a turbine from the inlet conditions, exhaust pressure and isentropic efficiency, actual and isentropic (IAPWS-IF97).

Method: IAPWS R7-97(2012) IF97

Input parameters

Unit system: SI

Parameter	Value	Unit
Inlet steam pressure (absolute)	66.000	bar
Inlet steam condition	Superheated at the temperature below	
Inlet steam temperature (superheated only)	485.00	°C
Exhaust pressure (absolute)	10.000	kPa
Turbine isentropic efficiency	82.000	%

Calculated results

Parameter	Value	Unit
Exhaust dryness fraction (1 = dry or superheated)	91.067	%
Exhaust moisture (wetness)	8.9328	%
Dryness after isentropic expansion	81.803	%
Exhaust temperature	45.808	°C
Exhaust enthalpy	2,370.2	kJ/kg

Formula and method

$$h_2 = h_1 - \eta_i \left[h_1 - h(p_2, s_1)\right] \qquad x_2 = \frac{h_2 - h_f}{h_g - h_f} \qquad y_2 = 1 - x_2 \qquad x_{2s} = \frac{s_1 - s_f}{s_g - s_f}$$

Variables

p_1	inlet pressure, absolute	Pa
state	dry saturated or superheated inlet	–
T_1	inlet temperature (superheated)	K
p_2	exhaust pressure, absolute	Pa
η_i	turbine isentropic efficiency	–
x_2	exhaust dryness fraction	–
y_2	exhaust moisture	–
x_{2s}	dryness after isentropic expansion	–
T_2	exhaust temperature	K
h_2	exhaust enthalpy	J/kg
$h_1\$, \$s_1$	inlet enthalpy and entropy	J/kg, J/(kg·K)
$h_f\$, \$h_g\$, \$s_f\$, \$s_g$	saturated liquid and vapour enthalpy and entropy at p_2	J/kg, J/(kg·K)

Method and standards

Exhaust state from the isentropic-efficiency expansion; dryness from saturation properties at the exhaust pressure, all by FireCAD's IAPWS-IF97. A superheated exhaust shows dryness 1.

Assumptions and limits

- One expansion with constant efficiency; equilibrium wet steam (no supercooling).

References

• IAPWS R7-97(2012) 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/turbines-cycles/turbine-exhaust-wetness

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.