Saturated Water Properties

Saturation pressure, enthalpy, density, specific heat, viscosity, conductivity and Prandtl number of liquid water at a temperature (IAPWS-IF97).

Method: IAPWS R7-97(2012) IF97; IAPWS R12-08 viscosity; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Water temperature	25.000	°C

Calculated results

Parameter	Value	Unit
Saturation pressure	0.031697	bar
Specific enthalpy	104.84	kJ/kg
Specific entropy	0.36726	kJ/(kg·K)
Density	997.00	kg/m³
Specific volume	0.001003	m³/kg
Specific heat capacity	4.1822	kJ/(kg·K)
Dynamic viscosity	8.9004e-04	Pa·s
Kinematic viscosity	8.9271e-07	m²/s
Thermal conductivity	0.60646	W/(m·K)
Prandtl number	6.1377	
Latent heat of vaporisation	2,441.7	kJ/kg

Formula and method

$$p_{sat} = p_s(T)\ \text{(IF97 Eq. 30)} \qquad h_f, s_f, v_f, c_p = f(p_{sat}, T)\ \text{(IF97 region 1)} \qquad h_{fg} = h_g - h_f$$

$$\nu = \frac{\mu}{\rho} \qquad Pr = \frac{c_p\,\mu}{k}$$

Variables

T	water temperature	K
p_{sat}	saturation (boiling) pressure at T	Pa
h_f	specific enthalpy of saturated liquid	J/kg
s_f	specific entropy of saturated liquid	J/(kg·K)
ρ	density	kg/m³
v_f	specific volume	m³/kg
c_p	isobaric specific heat capacity	J/(kg·K)
μ	dynamic viscosity	Pa·s
ν	kinematic viscosity	m²/s
k	thermal conductivity	W/(m·K)
Pr	Prandtl number	–
h_{fg}	latent heat of vaporisation	J/kg

Method and standards

Thermodynamic properties from the IAPWS Industrial Formulation 1997 (region 1 and the region 4 saturation line; region 3 by iteration above 350 °C). Viscosity from the IAPWS 2008 formulation and thermal conductivity from the IAPWS 2011 formulation,

both evaluated at the IF97 density. The code is FireCAD's own implementation, verified against the check values printed in the IAPWS releases.

Assumptions and limits

- 0.01 °C to about 373.85 °C, just below the critical point (373.946 °C), where saturation properties are singular.
- The thermal conductivity omits the critical enhancement term of the IAPWS 2011 formulation: it reads about 0.2 % low for hot liquid near 200 °C and increasingly low towards the critical point. Viscosity near the critical point is also less certain.
- Pure water; dissolved solids change density and boiling point slightly.

References

• IAPWS R7-97(2012) IF97
• IAPWS R12-08 viscosity
• IAPWS R15-11 thermal conductivity

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/steam/water-properties

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Reopens the calculator with the inputs of this report.