Saturated Liquid Density by the Rackett Equation

Saturated liquid molar volume and density from critical temperature, pressure and the Rackett parameter Z_RA, by the Rackett equation (Perry's sec. 2).

Method: Perry's Chemical Engineers' Handbook; 9th ed. (McGraw-Hill, 2019); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Temperature	25.000	°C
Critical temperature	288.90	°C
Critical pressure	48.950	bar
Rackett parameter (or Z_c)	0.26980	
Molar mass	78.114	kg/kmol

Calculated results

Parameter	Value	Unit
Reduced temperature	0.53047	
Saturated liquid molar volume	89.634	cm³/mol
Saturated liquid density	871.48	kg/m³

Formula and method

$$V_s = \frac{RT_c}{p_c} Z_{RA}^{1+(1-T_r)^{2/7}}, \quad \rho = \frac{M}{V_s}$$

Variables

T	Temperature	K
T_c	Critical temperature	K
p_c	Critical pressure	Pa
Z_{RA}	Rackett parameter (or Z_c)	-
M	Molar mass	kg/kmol
T_r	Reduced temperature	-
V_s	Saturated liquid molar volume	m³/mol
ρ	Saturated liquid density	kg/m³

Method and standards

Rackett equation (Spencer–Danner form).

Assumptions and limits

- Saturated liquid; non-polar and slightly polar compounds.

References

- Perry's Chemical Engineers' Handbook
- 9th ed. (McGraw-Hill, 2019)
- sec. 2 (physical properties): Rackett equation with the Spencer–Danner parameter Z_RA

Report details

Report reference	FCC-ES2K-2GMB (the same inputs always give the same reference)
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Calculator	Saturated Liquid Density by the Rackett Equation
Method last reviewed	13 November 2026
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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/chemical/unit-operations/rackett-liquid-density

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.