Vapour Pressure by Riedel and Ambrose–Walton

Vapour pressure of an organic liquid from its normal boiling point and critical constants by the Riedel method, and from the acentric factor by Ambrose–Walton.

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Temperature	226.85	°C
Normal boiling point	131.72	°C
Critical temperature	359.20	°C
Critical pressure	45.191	bar
Acentric factor (Ambrose–Walton)	0.24986	

Calculated results

Parameter	Value	Unit
Vapour pressure, Riedel	7.7352	bar
Vapour pressure, Ambrose–Walton	7.6671	bar
Reduced temperature	0.79070	

Notes for this case

- Perry's: about 1 % above the normal boiling point, 5–30 % near the triple point. Estimate for design; use measured data where they exist.

Formula and method

$$\ln p_r = A - \frac{B}{T_r} + C\ln T_r + DT_r^6, \quad \psi = -35 + \frac{36}{T_{br}} + 42\ln T_{br} - T_{br}^6, \quad \alpha_c = \frac{3.758K\psi + \ln(p_c/1.01325\ \text{bar})}{K\psi - \ln T_{br}}$$

$$\ln p_r = f^{(0)} + \omega f^{(1)} + \omega^2 f^{(2)}, \quad f^{(0)} = \frac{-5.97616\tau + 1.29874\tau^{1.5} - 0.60394\tau^{2.5} - 1.06841\tau^5}{T_r}, \ \tau = 1 - T_r$$

$$f^{(1)} = \frac{-5.03365\tau + 1.11505\tau^{1.5} - 5.41217\tau^{2.5} - 7.46628\tau^5}{T_r}, \quad f^{(2)} = \frac{-0.64771\tau + 2.41539\tau^{1.5} - 4.26979\tau^{2.5} + 3.25259\tau^5}{T_r}$$

Variables

T	Temperature	K
T_b	Normal boiling point	K
T_c	Critical temperature	K
p_c	Critical pressure	Pa
ω	Acentric factor (Ambrose–Walton)	-
p_{Riedel}	Vapour pressure, Riedel	Pa
p_{AW}	Vapour pressure, Ambrose–Walton	Pa
T_r	Reduced temperature	-

Method and standards

Riedel's equation with K = 0.0838; Ambrose–Walton corresponding states.

Assumptions and limits

- Organic compounds; poorer near the triple point.
- T_b feeds Riedel and ω feeds Ambrose–Walton; they are entered separately, so a difference above 10 % between the two results is flagged as a sign of inconsistent data.

References

- Perry's Chemical Engineers' Handbook
- 9th ed. (McGraw-Hill, 2019)
- sec. 2
- Eqs. (2-28)
- (2-28a) (Riedel) and (2-29) (Ambrose–Walton, Lee–Kesler form)
- with the chlorobenzene example

Report details

Report reference	FCC-QRGF-29KG (the same inputs always give the same reference)
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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/chemical/physical-properties/riedel-vapour-pressure

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.