Compressibility Factor by the Pitzer Virial Correlation (Abbott)

Compressibility factor Z and gas density of a pure gas from reduced temperature and pressure by the Pitzer generalised second-virial correlation (Abbott).

Method: Pitzer generalised second-virial correlation with the Abbott equations (Smith, Van Ness and Abbott, Introduction to Chemical Engineering Thermodynamics)

Input parameters

Unit system: SI

Parameter	Value	Unit
Temperature	126.85	°C
Pressure (absolute)	20.000	bar
Critical temperature From a property table for the gas.	96.650	°C
Critical pressure	42.480	bar
Acentric factor	0.15200	
Molar mass	44.097	kg/kmol

Calculated results

Parameter	Value	Unit
Reduced temperature	1.0817	
Reduced pressure	0.47081	
B^0 = 0.083 − 0.422/T_r^1.6	-0.28919	
B^1 = 0.139 − 0.172/T_r^4.2	0.015309	
Compressibility factor	0.87514	
Density	30.302	kg/m³

Formula and method

$$Z = 1 + (B^0 + \omega B^1)\frac{p_r}{T_r}, \quad B^0 = 0.083 - \frac{0.422}{T_r^{1.6}}, \quad B^1 = 0.139 - \frac{0.172}{T_r^{4.2}}$$

Variables

T	Temperature	K
p	Pressure (absolute)	Pa
T_c	Critical temperature	K
p_c	Critical pressure	Pa
ω	Acentric factor	-
M	Molar mass	kg/kmol
T_r	Reduced temperature	-
p_r	Reduced pressure	-
B^0	B^0 = 0.083 − 0.422/T_r^1.6	-
B^1	B^1 = 0.139 − 0.172/T_r^4.2	-
Z	Compressibility factor	-
ρ	Density	kg/m³

Method and standards

Pitzer–Abbott.

Assumptions and limits

- Non-polar or slightly polar gases.
- Gas phase only. No phase check is made: below the critical temperature make sure the pressure is below the vapour pressure, or the result is meaningless.

References

• Pitzer generalised second-virial correlation with the Abbott equations (Smith, Van Ness and Abbott, Introduction to Chemical Engineering Thermodynamics)

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/chemical/gas-mixtures/compressibility-pitzer-virial

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.