Sour Gas Z-Factor: Wichert–Aziz and Carr–Kobayashi–Burrows

Pseudo-critical properties of a sour natural gas corrected for CO_2, H_2S and N_2 by Wichert–Aziz and Carr–Kobayashi–Burrows, with Z and gas density.

Input parameters

Unit system: SI

Parameter	Value	Unit
Gas gravity (air = 1)	0.85000	
CO_2 mole fraction	20.000	%
H_2S mole fraction	2.0000	%
N_2 mole fraction	3.0000	%
Gas type (for Standing's pseudo-critical properties)	Natural gas	
Pressure (absolute)	2,000.0	psi
Temperature	200.00	°F

Calculated results

Parameter	Value	Unit
Pseudo-critical temperature, uncorrected	-24.451	°F
Pseudo-critical pressure, uncorrected	662.66	psi
Wichert–Aziz adjustment	22.194	°F
Corrected T_pc (Wichert–Aziz)	-46.646	°F
Corrected p_pc (Wichert–Aziz)	628.24	psi
Z factor (Wichert–Aziz, Hall–Yarborough)	0.82136	
Gas density (Wichert–Aziz)	8.4669	lb/ft³
Corrected T_pc (Carr–Kobayashi–Burrows)	-45.351	°F
Corrected p_pc (Carr–Kobayashi–Burrows)	757.56	psi
Z factor (Carr–Kobayashi–Burrows, Hall–Yarborough)	0.83168	
Gas density (Carr–Kobayashi–Burrows)	8.3618	lb/ft³

Notes for this case

- Wichert–Aziz needs only CO_2 and H_2S and is the usual choice; Carr–Kobayashi–Burrows also corrects for nitrogen and needs no composition beyond the three mole fractions. Z is solved by Hall–Yarborough with the corrected properties.

Formula and method

$$\varepsilon = 120(A^{0.9} - A^{1.6}) + 15(B^{0.5} - B^4), \quad T'_{pc} = T_{pc} - \varepsilon, \quad p'_{pc} = \frac{p_{pc} T'_{pc}}{T_{pc} + B(1-B)\varepsilon}, \quad A = y_{H_2S} + y_{CO_2}, \quad B = y_{H_2S}$$

Variables

γ_g	Gas gravity (air = 1)	-
y_{CO_2}	CO_2 mole fraction	-
y_{H_2S}	H_2S mole fraction	-
y_{N_2}	N_2 mole fraction	-
type	Gas type (for Standing's pseudo-critical properties)	-
p	Pressure (absolute)	Pa

T	Temperature	K
T_{pc}	Pseudo-critical temperature, uncorrected	K
p_{pc}	Pseudo-critical pressure, uncorrected	Pa
ε	Wichert–Aziz adjustment	K
T'_{pc}	Corrected T_pc (Wichert–Aziz)	K
p'_{pc}	Corrected p_pc (Wichert–Aziz)	Pa
Z_{WA}	Z factor (Wichert–Aziz, Hall–Yarborough)	-
ρ_{WA}	Gas density (Wichert–Aziz)	kg/m³
$T'_{pc,CKB}$	Corrected T_pc (Carr–Kobayashi–Burrows)	K
$p'_{pc,CKB}$	Corrected p_pc (Carr–Kobayashi–Burrows)	Pa
Z_{CKB}	Z factor (Carr–Kobayashi–Burrows, Hall–Yarborough)	-
ρ_{CKB}	Gas density (Carr–Kobayashi–Burrows)	kg/m³

Method and standards

Wichert–Aziz and Carr–Kobayashi–Burrows corrections (°R, psia).

Assumptions and limits

- Hall–Yarborough range 1.05 ≤ T_pr ≤ 3.

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

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Reopens the calculator with the inputs of this report.