Gas Viscosity at High Pressure (Jossi–Stiel–Thodos)

Viscosity of a nonpolar gas at high pressure from its low-pressure viscosity and reduced density by the Jossi–Stiel–Thodos residual correlation (Perry Eq. 2-88).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Temperature	76.850	°C
Pressure	200.00	bar
Compressibility factor at T and p	0.49830	
Critical temperature	31.060	°C
Critical pressure	73.830	bar
Critical compressibility factor	0.27400	
Molar mass	44.010	kg/kmol
Low-pressure viscosity at T	0.017400	cP

Calculated results

Parameter	Value	Unit
Reduced density	1.2947	
Viscosity-reducing parameter (1/(mPa·s))	224.08	
Viscosity at T and p	0.048854	cP
Pressure correction factor	2.8077	

Notes for this case

- Nonpolar gases; Perry's quotes about 9 %. Estimate for design; use measured data where they exist.

Formula and method

$$[(\eta-\eta^\circ)\xi+1]^{1/4} = 1.0230 + 0.23364\rho_r + 0.58533\rho_r^2 - 0.40758\rho_r^3 + 0.093324\rho_r^4$$

$$\xi = 2173.4\,T_c^{1/6} M^{-1/2} p_c^{-2/3} \quad (T_c \text{ K},\ p_c \text{ MPa}), \quad \rho_r = \frac{pZ_cT_c}{ZTp_c}$$

Variables

T	Temperature	K
p	Pressure	Pa
Z	Compressibility factor at T and p	-
T_c	Critical temperature	K
p_c	Critical pressure	Pa
Z_c	Critical compressibility factor	-
M	Molar mass	kg/kmol
η°	Low-pressure viscosity at T	Pa·s
ρ_r	Reduced density	-
ξ	Viscosity-reducing parameter (1/(mPa·s))	-
η	Viscosity at T and p	Pa·s
η/η°	Pressure correction factor	-

Method and standards

Residual viscosity correlation.

Assumptions and limits

- Nonpolar gases; 0.1 < ρ_r < 3.
- Z and the low-pressure viscosity are inputs and are not checked against T and p: Z must come from an equation of state at the same T and p (Z = 1 at high pressure gives a wrong reduced density), and the low-pressure viscosity must be at the same T.

References

- Perry's Chemical Engineers' Handbook
- 9th ed. (McGraw-Hill, 2019)
- sec. 2
- Eqs. (2-88) and (2-93) (Jossi, Stiel and Thodos) with the CO_2 example

Report details

Report reference	FCC-0NM1-DVBV (the same inputs always give the same reference)
Generated	17 November 2026, 19:37 UTC
Calculator	Gas Viscosity at High Pressure (Jossi–Stiel–Thodos)
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
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/physical-properties/dense-gas-viscosity-jossi-stiel-thodos

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.