Pycnometer Density and Alcoholic Strength

Density of a spirit from pycnometer weighings (empty, with water, with sample) corrected for air buoyancy, and its alcoholic strength by the OIML R 22 formula.

Method: OIML R 22 (1973); Alcoholometry; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Empty pycnometer (weighed in air)	30.000	g
Filled with water	79.900	g
Filled with sample	76.300	g
Temperature of the liquid 0 to 40 °C: the water reference of the R 22 formula is used from 0 °C (the formula itself covers −20 to +40 °C for spirits).	20.000	°C
Air density	1.2000	kg/m³

Calculated results

Parameter	Value	Unit
Water density at t (R 22)	998.20	kg/m³
Sample density at t	926.27	kg/m³
Strength by mass	44.258	%
Strength by volume at 20 °C	51.942	%

Formula and method

$$\rho_s = \frac{m_s - m_0}{m_w - m_0}(\rho_w - \rho_a) + \rho_a, \quad \rho(p,t) = \rho_s$$

Variables

m_0	Empty pycnometer (weighed in air)	kg
m_w	Filled with water	kg
m_s	Filled with sample	kg
t	Temperature of the liquid	K
ρ_a	Air density	kg/m³
ρ_w	Water density at t (R 22)	kg/m³
ρ_s	Sample density at t	kg/m³
p	Strength by mass	-
q	Strength by volume at 20 °C	-

Method and standards

Pycnometer method with R 22 water density and strength inversion.

Assumptions and limits

- Same temperature for water and sample; 0 to 40 °C.

References

- OIML R 22 (1973)
- Alcoholometry
- and International Alcoholometric Tables (1975)
- §5 (pycnometers) and the R 22 formula for water at p = 0
- Pycnometer buoyancy correction: ρs = (ms − m0)/(mw − m0)(ρw − ρa) + ρa

Report details

Report reference	FCC-XS5Y-84WH (the same inputs always give the same reference)
Generated	17 November 2026, 19:49 UTC
Calculator	Pycnometer Density and Alcoholic Strength
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/sugar-ethanol/alcoholometry/pycnometer-alcohol-strength

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.