Falling-Ball Viscometer: Viscosity by Stokes' Law

Dynamic viscosity of a liquid from the terminal fall time of a ball over a distance by Stokes' law, with the Faxén wall correction and a Reynolds number check.

Method: Stokes' law with Faxén's wall correction

Input parameters

Unit system: SI

Parameter	Value	Unit
Ball diameter	2.0000	mm
Ball density	7,800.0	kg/m³
Liquid density	1,260.0	kg/m³
Timed fall distance	200.00	mm
Fall time	14.000	s
Tube inside diameter	50.000	mm

Calculated results

Parameter	Value	Unit
Measured fall velocity	14.286	mm/s
Viscosity, Stokes (no wall correction)	0.99766	Pa·s
Faxén wall factor	0.91597	
Viscosity with wall correction	0.91383	Pa·s
Ball Reynolds number	0.039394	

Notes for this case

• At terminal velocity, drag 3πμdv balances buoyant weight (π/6)d³(ρ_s − ρ_f)g, so μ = d²(ρ_s − ρ_f)g/(18v). The tube wall slows the ball; the Faxén factor f_w = 1 − 2.104(d/D) + 2.09(d/D)³ − 0.95(d/D)⁵ (for d/D up to about 0.3) corrects the result. Stokes' law requires Re below about 0.1; time the ball only after it has reached terminal speed, away from the ends.

Formula and method

$$\mu = \frac{d^2(\rho_s - \rho_f)g}{18v} f_w, \quad f_w = 1 - 2.104\frac{d}{D} + 2.09\left(\frac{d}{D}\right)^3 - 0.95\left(\frac{d}{D}\right)^5$$

Variables

d	Ball diameter	m
ρ_s	Ball density	kg/m³
ρ_f	Liquid density	kg/m³
L	Timed fall distance	m
t	Fall time	s
D_t	Tube inside diameter	m
v	Measured fall velocity	m/s
μ_S	Viscosity, Stokes (no wall correction)	Pa·s
f_w	Faxén wall factor	-
μ	Viscosity with wall correction	Pa·s
Re	Ball Reynolds number	-

Method and standards

Falling ball.

Assumptions and limits

- Newtonian liquid; Re < 0.1; ball on the tube axis.

References

Stokes' law with Faxén's wall correction

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

https://calc.firecad.com/chemical/physical-properties/falling-ball-viscometer

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Reopens the calculator with the inputs of this report.