Liquid Jet Trajectory: Reach and Height of a Nozzle or Monitor

Exit velocity of a liquid jet from nozzle pressure, and its trajectory without air drag: maximum height, horizontal reach, time of flight and the reach at 45°.

Method: Bernoulli exit velocity and projectile motion without drag (definitions)

Input parameters

Unit system: SI

Parameter	Value	Unit
Pressure at the nozzle	7.0000	bar
Liquid density	998.00	kg/m³
Nozzle velocity coefficient	0.97000	
Elevation angle	30.000	°
Nozzle height above the target level	1.5000	m

Calculated results

Parameter	Value	Unit
Jet exit velocity	36.330	m/s
Maximum height above the nozzle	16.824	m
Time of flight	3.7855	s
Horizontal reach to the target level	119.10	m
Reach at 45° from target level (no drag)	134.59	m

Notes for this case

• Air drag and break-up shorten real reach a great deal: large fire-monitor jets reach roughly half to three-quarters of the no-drag value. Use makers' test data for firefighting design.

Formula and method

$$V_0 = C_v\sqrt{\frac{2\Delta p}{\rho}},\quad t = \frac{V_0\sin\theta + \sqrt{V_0^2\sin^2\theta + 2gh_0}}{g},\quad x = V_0\cos\theta\ t,\quad h_{max} = \frac{V_0^2\sin^2\theta}{2g}$$

Variables

Δp	Pressure at the nozzle	Pa
ρ	Liquid density	kg/m³
C_v	Nozzle velocity coefficient	-
θ	Elevation angle	rad
h_0	Nozzle height above the target level	m
V_0	Jet exit velocity	m/s
h_{max}	Maximum height above the nozzle	m
t	Time of flight	s
x	Horizontal reach to the target level	m
x_{45}	Reach at 45° from target level (no drag)	m

Method and standards

Bernoulli and projectile motion.

Assumptions and limits

- No air drag; jet stays coherent.

References

- Bernoulli exit velocity and projectile motion without drag (definitions)

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/mechanical/fluid-mechanics/liquid-jet-trajectory

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Reopens the calculator with the inputs of this report.