Force of a Water Jet on a Plate or Vane

Force of a liquid jet striking a fixed flat plate or a curved vane from the flow, jet velocity and deflection angle, by the momentum equation, with the jet power.

Method: Linear momentum equation for a control volume (Textbook fluid mechanics (White, Fluid Mechanics))

Input parameters

Unit system: SI

Parameter	Value	Unit
Jet flow	36.000	m³/h
Jet diameter	30.000	mm
Deflection of the jet (90° flat plate, 180° full reversal)	90.000	°
Liquid density	998.00	kg/m³

Calculated results

Parameter	Value	Unit
Jet velocity	14.147	m/s
Force on the plate or vane ρ Q v (1 − cos θ)	0.14119	kN
Kinetic power of the jet	0.99870	kW

Notes for this case

- Stationary plate or vane, no friction on the vane, force along the jet direction.

Formula and method

$$F = \rho Q v (1 - \cos\theta), \quad v = \frac{Q}{\pi d^2/4}$$

Variables

Q	Jet flow	m³/s
d	Jet diameter	m
θ	Deflection of the jet (90° flat plate, 180° full reversal)	rad
ρ	Liquid density	kg/m³
v	Jet velocity	m/s
F	Force on the plate or vane ρ Q v (1 − cos θ)	N
P	Kinetic power of the jet	W

Method and standards

Momentum change of the jet.

Assumptions and limits

- Fixed plate, frictionless.

References

- Linear momentum equation for a control volume (Textbook fluid mechanics (White, Fluid Mechanics))

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/jet-impact-force

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Reopens the calculator with the inputs of this report.