Pelton Wheel: Jet Velocity, Wheel and Jet Diameter, Buckets and Power

Jet velocity, bucket speed, pitch diameter, jet diameter, jet ratio, number of buckets, hydraulic efficiency and power of a Pelton wheel from head, flow and speed.

Input parameters

Unit system: SI

Parameter	Value	Unit
Net head at the nozzle	400.00	m
Flow	7,200.0	m^3/h
Speed	500.00	rpm
Number of jets	2.0000	
Nozzle velocity coefficient	98.000	%
Speed ratio u/√(2gH)	46.000	%
Relative velocity ratio at exit (bucket friction)	90.000	%
Bucket deflection angle	165.00	°
Mechanical efficiency	97.000	%
Water density	1,000.0	kg/m^3

Calculated results

Parameter	Value	Unit
Jet velocity	86.802	m/s
Bucket speed	40.744	m/s
Pitch circle diameter	1.5563	m
Jet diameter	121.11	mm
Jet ratio	12.850	
Number of buckets (15 + m/2)	22.000	
Hydraulic efficiency	89.429	%
Power developed by the runner	7,016.0	kW
Shaft power	6,805.5	kW
Specific speed per jet (rpm, kW, m)	16.305	

Notes for this case

- Hydraulic efficiency is on the net head at the nozzle (it includes the nozzle loss). Jet ratios of 10–24 are usual; below about 10 the buckets become too large for the wheel.

Formula and method

$$V_1 = C_v\sqrt{2gH}, \quad u = \phi\sqrt{2gH} = \frac{\pi D N}{60}, \quad d = \sqrt{\frac{4Q}{n_j \pi V_1}}$$

$$\eta_h = \frac{u(V_1 - u)(1 - k\cos\theta)}{gH}, \quad z = 15 + \frac{D}{2d}$$

Variables

H	Net head at the nozzle	m
Q	Flow	m^3/s
N	Speed	rad/s
n_j	Number of jets	-
C_v	Nozzle velocity coefficient	-
ϕ	Speed ratio u/√(2gH)	-
k	Relative velocity ratio at exit (bucket friction)	-
θ	Bucket deflection angle	rad
η_m	Mechanical efficiency	-
ρ	Water density	kg/m^3
V_1	Jet velocity	m/s
u	Bucket speed	m/s
D	Pitch circle diameter	m
d	Jet diameter	m
$m = D/d$	Jet ratio	-
z	Number of buckets (15 + m/2)	-
η_h	Hydraulic efficiency	-
P_h	Power developed by the runner	W
P	Shaft power	W
N_s	Specific speed per jet (rpm, kW, m)	-

Method and standards

Impulse turbine velocity triangles.

Assumptions and limits

- Free-jet impulse turbine; one-dimensional velocity triangles.

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

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