Draft Tube Efficiency and Pressure at the Runner Outlet

Pressure head at the draft tube inlet below the runner, draft tube efficiency and the margin above vapour pressure from velocities, setting height and losses.

Input parameters

Unit system: SI

Parameter	Value	Unit
Velocity at the draft tube inlet	6.0000	m/s
Velocity at the draft tube outlet	1.5000	m/s
Height of the inlet above the tailrace	3.0000	m
Draft tube loss as a share of the inlet velocity head	10.000	%
Atmospheric pressure	101.33	kPa
Vapour pressure of water	2.3400	kPa
Water density	1,000.0	kg/m³

Calculated results

Parameter	Value	Unit
Velocity head recovered (ideal)	1.7208	m
Loss in the draft tube	0.18355	m
Absolute pressure head at the inlet	5.7951	m
Absolute pressure at the inlet	56.830	kPa
Vacuum below atmospheric	4.5372	m
Margin above vapour pressure	5.5564	m
Draft tube efficiency	83.750	%

Notes for this case

- Bernoulli between the draft tube inlet and the tailrace, the outlet at tailrace level. The setting height must also satisfy the Thoma cavitation criterion for the runner.

Formula and method

$$\frac{p_2}{\rho g} = \frac{p_a}{\rho g} - H_s - \frac{V_2^2 - V_3^2}{2g} + h_f$$

$$\eta_d = \frac{\frac{V_2^2 - V_3^2}{2g} - h_f}{\frac{V_2^2}{2g}}$$

Variables

V_2	Velocity at the draft tube inlet	m/s
V_3	Velocity at the draft tube outlet	m/s
H_s	Height of the inlet above the tailrace	m
k_d	Draft tube loss as a share of the inlet velocity head	-
p_a	Atmospheric pressure	Pa
p_v	Vapour pressure of water	Pa
ρ	Water density	kg/m³

$(V_2^2 - V_3^2)/2g$	Velocity head recovered (ideal)	m
h_f	Loss in the draft tube	m
$p_2/\rho g$	Absolute pressure head at the inlet	m
p_2	Absolute pressure at the inlet	Pa
$(p_a - p_2)/\rho g$	Vacuum below atmospheric	m
$(p_2 - p_v)/\rho g$	Margin above vapour pressure	m
η_d	Draft tube efficiency	-

Method and standards

Energy equation through the draft tube.

Assumptions and limits

- One-dimensional steady flow; outlet at tailrace level.

Report details

Report reference	FCC-PTB7-5BTH (the same inputs always give the same reference)
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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/boilers-power-plant/hydro-power/draft-tube-efficiency-pressure

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.