Pump as Turbine (PAT): Pump Duty for a Hydro Site

Best-efficiency duty of a standard pump to run in reverse as a small hydro turbine for a site flow and head, by the Sharma conversion, with the power.

Method: Sharma conversion of pump best-efficiency point to turbine mode

Input parameters

Unit system: SI

Parameter	Value	Unit
Site flow available to the turbine	180.00	m³/h
Net head at the turbine	40.000	m
Best efficiency of the pump (taken also as turbine efficiency)	75.000	%
Water density	998.00	kg/m³

Calculated results

Parameter	Value	Unit
Pump best-efficiency flow to look for	143.00	m³/h
Pump best-efficiency head to look for	28.323	m
Turbine shaft power	14.681	kW
Flow ratio turbine/pump	1.2588	
Head ratio turbine/pump	1.4123	

Notes for this case

• A centrifugal pump run backwards works as a turbine at a higher flow and head than its pump duty. Sharma's conversion estimates the turbine best-efficiency point from the pump's: Q_t = Q_p/η^0.8 and H_t = H_p/η^1.2, so the pump to choose has its best-efficiency point at Q_t η^0.8 and H_t η^1.2. The estimate is within about ±20 %: confirm with the maker's turbine-mode test or a margin on head. Turbine efficiency is taken equal to the pump's best efficiency.

Formula and method

$$Q_p = Q_t\,\eta^{0.8}, \quad H_p = H_t\,\eta^{1.2}, \quad P = \rho g Q_t H_t \eta$$

Variables

Q_t	Site flow available to the turbine	m³/s
H_t	Net head at the turbine	m
η_p	Best efficiency of the pump (taken also as turbine efficiency)	-
ρ	Water density	kg/m³
Q_p	Pump best-efficiency flow to look for	m³/s
H_p	Pump best-efficiency head to look for	m
P	Turbine shaft power	W
Q_t/Q_p	Flow ratio turbine/pump	-
H_t/H_p	Head ratio turbine/pump	-

Method and standards

Pump as turbine.

Assumptions and limits

- Sharma's empirical conversion; turbine efficiency equal to pump efficiency.

References

Sharma conversion of pump best-efficiency point to turbine mode

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/pumps/pump-as-turbine-selection

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.