Pump Power (Hydraulic, Shaft and Motor)

Hydraulic power, shaft power and motor input power of a pump from flow, head and liquid density, with the pump and motor efficiencies.

Method: ANSI/HI 1.6 (centrifugal pump tests, power definitions); ISO 9906

Input parameters

Unit system: SI

Parameter	Value	Unit
Flow	60.000	m³/h
Total head	850.00	m
Liquid density at pumping temperature Water: 998 kg/m³ at 20 °C, 955 at 105 °C, 917 at 150 °C.	955.00	kg/m³
Pump efficiency	68.000	%
Motor efficiency	95.000	%

Calculated results

Parameter	Value	Unit
Pump shaft power (brake power)	195.11	kW
Electrical input power	205.38	kW
Hydraulic power	132.68	kW
Pressure rise across the pump	7,960.5	kPa
Mass flow	57,300	kg/h

Formula and method

$$P_h = \rho\, g\, Q\, H \qquad P_s = \frac{P_h}{\eta_p} \qquad P_e = \frac{P_s}{\eta_m} \qquad \Delta p = \rho\, g\, H \qquad \dot{m} = \rho\, Q$$

Variables

Q	flow	m³/s
H	total head	m
ρ	liquid density at pumping temperature	kg/m³
η_p	pump efficiency	–
η_m	motor efficiency	–
P_h	hydraulic power	W
P_s	pump shaft power	W
P_e	electrical input power	W
Δp	pressure rise across the pump	Pa
$\dot{m}$	mass flow	kg/s
g	standard gravity, 9.806 65	m/s²

Method and standards

Power definitions of ANSI/HI 1.6 and ISO 9906: pump output (hydraulic) power is the product of density, gravity, rate of flow and total head; pump efficiency is output power over shaft power.

Assumptions and limits

- Density at the pumping temperature; use the water properties calculator for hot water.
- The pressure rise ρ g H equals the rise in static pressure only when the suction and discharge velocities and gauge heights are equal; otherwise it is the total-head equivalent.

- Coupling and gearbox losses are not included; divide the shaft power by the drive efficiency if there is one.
- Viscous liquids lower the pump efficiency and head (ANSI/HI 9.6.7); enter the corrected efficiency.

References

• ANSI/HI 1.6 (centrifugal pump tests, power definitions)
• ISO 9906

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-power

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Reopens the calculator with the inputs of this report.