Pump Efficiency from a Site Test

Pump total head, hydraulic power and pump and overall efficiency from site readings of flow, suction and discharge pressure and motor input power.

Method: Pump total head from gauge readings (pressure, elevation and velocity heads, the definition used in ISO 9906 acceptance tests); hydraulic power ρ g Q H

Input parameters

Unit system: SI

Parameter	Value	Unit
Measured flow	100.00	m³/h
Discharge pressure	5.0000	bar g
Suction pressure	0.30000	bar g
Height of the discharge gauge above the suction gauge	0.50000	m
Suction pipe inside diameter at the gauge	150.00	mm
Discharge pipe inside diameter at the gauge	100.00	mm
Liquid density	998.00	kg/m³
Motor input power (measured)	22.000	kW
Motor efficiency at this load	92.000	%

Calculated results

Parameter	Value	Unit
Pump total head	49.034	m
Hydraulic power	13.331	kW
Pump shaft power	20.240	kW
Pump efficiency	65.863	%
Overall (wire-to-water) efficiency	60.594	%

Formula and method

$$H = \frac{p_d - p_s}{\rho g} + \Delta z + \frac{v_d^2 - v_s^2}{2g}$$

$$P_h = \rho g Q H, \quad P_{sh} = P_{in}\eta_m$$

$$\eta_p = P_h / P_{sh}, \quad \eta_o = P_h / P_{in}$$

Variables

Q	flow	m³/s
p_d	discharge pressure	Pa
p_s	suction pressure	Pa
Δz	height of discharge gauge above suction gauge	m
D_s	suction pipe diameter	m
D_d	discharge pipe diameter	m
ρ	liquid density	kg/m³
P_{in}	motor input power	W
η_m	motor efficiency	-
v_s	suction velocity	m/s

v_d	discharge velocity	m/s
g	standard gravity	m/s²
H	total head	m
P_h	hydraulic power	W
P_{sh}	shaft power	W
η_p	pump efficiency	-
η_o	overall efficiency	-

Method and standards

Total head is the rise in pressure head plus the gauge height difference and the velocity heads at the gauge points. Hydraulic power over shaft power (motor input times motor efficiency) gives the pump efficiency.

Assumptions and limits

- Steady flow; incompressible liquid; gauges calibrated.

References

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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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Reopens the calculator with the inputs of this report.