Pump and System Curve Operating Point

Flow and head where a pump curve H = H_0 − a Q^2 meets a system curve H = H_s + b Q^2, with the power at that point, from two points of each curve.

Method: Parabolic pump and system curves (Textbook fluid mechanics (White, Fluid Mechanics); Hydraulic Institute)

Input parameters

Unit system: SI

Parameter	Value	Unit
Pump shut-off head	50.000	m
A pump flow on its curve	100.00	m³/h
Pump head at that flow	40.000	m
Static head of the system	15.000	m
A system flow	100.00	m³/h
System head at that flow (static + friction)	30.000	m
Pump efficiency at the duty	75.000	%
Liquid density	998.00	kg/m³

Calculated results

Parameter	Value	Unit
Flow at the operating point	118.32	m³/h
Head at the operating point	36.000	m
Shaft power at the operating point	15.440	kW

Notes for this case

- Both curves approximated by parabolas through the points given; check against the maker's full curve.

Formula and method

$$H_{pump} = H_0 - aQ^2, \quad H_{sys} = H_s + bQ^2, \quad Q^* = \sqrt{\frac{H_0 - H_s}{a + b}}$$

Variables

H_0	Pump shut-off head	m
Q_r	A pump flow on its curve	m³/s
H_r	Pump head at that flow	m
H_s	Static head of the system	m
Q_s	A system flow	m³/s
$H_{s,Q}$	System head at that flow (static + friction)	m
η	Pump efficiency at the duty	-
ρ	Liquid density	kg/m³
Q	Flow at the operating point	m³/s
H	Head at the operating point	m
P	Shaft power at the operating point	W

Method and standards

Intersection of two parabolas.

Assumptions and limits

- Parabolic curve shapes.
- The pump efficiency is a fixed input, not read at the computed operating point: take it from the maker's curve at the flow found and repeat if it differs.

References

- Parabolic pump and system curves (Textbook fluid mechanics (White, Fluid Mechanics); Hydraulic Institute)

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

https://calc.firecad.com/mechanical/pumps/pump-operating-point

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Reopens the calculator with the inputs of this report.