Borewell Submersible Pump Head and Power

Total head and motor power of a borewell submersible pump from water level, drawdown, delivery height, pipe size and length, and flow, with Hazen–Williams friction.

Method: Hazen–Williams formula (SI form)

Input parameters

Unit system: SI

Parameter	Value	Unit
Flow	6.0000	m³/h
Static water level below ground	60.000	m
Drawdown while pumping	15.000	m
Delivery height above ground (tank inlet)	12.000	m
Total pipe length (column pipe plus delivery)	110.00	m
Pipe inside diameter	38.100	mm
Hazen–Williams coefficient	140.00	
Fittings and residual head	3.0000	m
Pump and motor efficiency	45.000	%

Calculated results

Parameter	Value	Unit
Pipe friction head	7.2653	m
Total head	97.265	m
Pipe velocity	1.4619	m/s
Motor input power	3.5257	kW
Motor power in horsepower	4.7280	hp

Notes for this case

• A submersible pump lifts water from the pumping water level (static level plus drawdown) to the delivery point, and overcomes friction in the column and delivery pipes. Friction uses the Hazen–Williams formula h_f = 10.67 L Q^1.852/(C^1.852 d^4.87) with C about 140 for HDPE or PVC and 100–120 for old steel. Choose a pump whose curve passes through this flow and head, and check the borewell's yield: if drawdown keeps increasing, the flow is too high for the well.

Formula and method

$$H = h_s + h_d + h_t + h_f + h_m, \quad h_f = \frac{10.67\, L\, \dot{V}^{1.852}}{C^{1.852} d^{4.87}}, \quad P = \frac{\rho g \dot{V} H}{\eta}$$

Variables

$\dot{V}$	Flow	m³/s
h_s	Static water level below ground	m
h_d	Drawdown while pumping	m
h_t	Delivery height above ground (tank inlet)	m
L	Total pipe length (column pipe plus delivery)	m
d	Pipe inside diameter	m
C	Hazen–Williams coefficient	-
h_m	Fittings and residual head	m

η	Pump and motor efficiency	-
h_f	Pipe friction head	m
H	Total head	m
v	Pipe velocity	m/s
P	Motor input power	W
P_{hp}	Motor power in horsepower	W

Method and standards

Borewell pump.

Assumptions and limits

- Water at about 20 °C; steady pumping level.

References

Hazen–Williams formula (SI form)

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.