Pump Total Head (Vessel to Vessel)

Total head a pump must develop between a suction and a discharge vessel: pressure, static and friction heads, with the pump suction and discharge pressures.

Method: ANSI/HI 1.6 (total head definition)

Input parameters

Unit system: SI

Parameter	Value	Unit
Pressure in the suction vessel (absolute) Atmospheric for an open tank. Absolute; choose a gauge unit to enter gauge readings.	1.0132	bar
Pressure in the discharge vessel (absolute)	1.0132	bar
Suction liquid level above the pump centreline Negative for a suction lift.	2.0000	m
Discharge point (or liquid level) above the pump centreline	15.000	m
Friction loss in the suction line	0.50000	m
Friction loss in the discharge line, valves and equipment	3.0000	m
Liquid density	998.00	kg/m³

Calculated results

Parameter	Value	Unit
Pump total head	16.500	m
Pressure rise across the pump	161.49	kPa
Pressure at the pump suction (absolute)	1.1601	bar
Pressure at the pump discharge (absolute)	2.7749	bar
Pressure head	0	m
Static head	13.000	m
Friction head	3.5000	m

Formula and method

$$H = \frac{p_d - p_s}{\rho g} + (z_d - z_s) + h_{fs} + h_{fd} = H_p + H_z + H_f \qquad \Delta p = \rho g H$$

$$p_1 = p_s + \rho g (z_s - h_{fs}) \qquad p_2 = p_1 + \rho g H$$

Variables

p_s	pressure in the suction vessel, absolute	Pa
p_d	pressure in the discharge vessel, absolute	Pa
z_s	suction liquid level above the pump centreline	m
z_d	discharge point above the pump centreline	m
h_{fs}	suction line friction loss	m
h_{fd}	discharge line, valve and equipment losses	m
ρ	liquid density	kg/m³
H	pump total head	m
Δp	pressure rise across the pump	Pa
p_1	pressure at the pump suction	Pa

p_2	pressure at the pump discharge	Pa
H_p	pressure head	m
H_z	static head	m
H_f	friction head	m
g	standard gravity, 9.806 65	m/s²

Method and standards

Energy balance between the liquid surfaces of the suction and discharge vessels, with total head as defined in ANSI/HI 1.6.

Assumptions and limits

- Liquid surfaces at rest; for a free discharge to atmosphere add the exit velocity head to the losses.
- Losses at the design flow (use the pipe pressure drop calculator); the head at other flows follows the system curve.
- Constant density.
- Vapour pressure is not checked here: a positive suction pressure does not mean the pump is free of cavitation. Check the margin with the NPSH available calculator.

References

• ANSI/HI 1.6 (total head definition)

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-total-head

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.