Hydropneumatic (Pressure) Tank Sizing

Drawdown volume and total size of a precharged pressure tank for a water pump from cut-in and cut-out pressures, precharge, pump flow and maximum starts per hour.

Method: Boyle's law drawdown and pump-cycling criterion

Input parameters

Unit system: SI

Parameter	Value	Unit
Pump flow	60.000	L/min
Maximum pump starts per hour	15.000	
Cut-in pressure (gauge)	2.0000	bar
Cut-out pressure (gauge)	3.5000	bar
Precharge pressure (gauge, empty tank)	1.8000	bar
Atmospheric pressure	1.0132	bar

Calculated results

Parameter	Value	Unit
Drawdown volume needed	60.000	L
Drawdown factor (share of tank volume)	31.030	%
Total tank volume	193.36	L
Minimum cycle time	4.0000	min

Notes for this case

• The pump fills the tank between cut-in and cut-out; the air (or nitrogen behind a bladder) compresses by Boyle's law, so a tank of volume V precharged to p_0 holds $V\,p_0(1/p_1 - 1/p_2)$ of usable water between the two pressures (absolute). Pump cycling is worst when demand is half the pump flow, giving a cycle time of 4V_d/Q, so V_d = Q/(4N) limits starts to N per hour. Set the precharge about 0.2 bar below the cut-in pressure.

Formula and method

$$V_d = \frac{\dot{V}}{4N}, \quad f_d = p_0\left(\frac{1}{p_{on}} - \frac{1}{p_{off}}\right), \quad V = \frac{V_d}{f_d}$$

Variables

$\dot{V}$	Pump flow	m³/s
N	Maximum pump starts per hour	-
p_{on}	Cut-in pressure (gauge)	Pa
p_{off}	Cut-out pressure (gauge)	Pa
p_0	Precharge pressure (gauge, empty tank)	Pa
p_a	Atmospheric pressure	Pa
V_d	Drawdown volume needed	m³
f_d	Drawdown factor (share of tank volume)	-
V	Total tank volume	m³
t_c	Minimum cycle time	s

Method and standards

Pressure tank.

Assumptions and limits

- Isothermal gas; bladder tank.

References

Boyle's law drawdown and pump-cycling criterion

Report details

Report reference	FCC-C7AJ-JF9B (the same inputs always give the same reference)
Generated	23 November 2026, 18:00 UTC
Calculator	Hydropneumatic (Pressure) Tank Sizing
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/hydropneumatic-tank-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.