Vacuum Pump-Down Time

Time to evacuate a vessel from one pressure to another with a vacuum pump of constant effective pumping speed, and the speed needed for a target time.

Method: Pump-down equation for constant pumping speed (vacuum technology texts)

Input parameters

Unit system: SI

Parameter	Value	Unit
Volume of the vessel and piping	5.0000	m³
Effective pumping speed at the vessel	250.00	m³/h
Starting pressure (absolute)	1,013.2	mbar
Target pressure (absolute)	10.000	mbar
Time wanted (for the speed needed)	10.000	min

Calculated results

Parameter	Value	Unit
Pump-down time (V/S) ln(p₁/p₂)	5.5420	min
Pumping speed needed for the time wanted	138.55	m³/h

Notes for this case

- Constant speed and no leaks or outgassing: valid in the rough vacuum range. Pumping speed falls near the pump's ultimate pressure, and piping lowers the effective speed.

Formula and method

$$t = \frac{V}{S} \ln \frac{p_1}{p_2}$$

Variables

V	Volume of the vessel and piping	m³
S	Effective pumping speed at the vessel	m³/s
p_1	Starting pressure (absolute)	Pa
p_2	Target pressure (absolute)	Pa
t_w	Time wanted (for the speed needed)	s
t	Pump-down time (V/S) ln(p₁/p₂)	s
S_{req}	Pumping speed needed for the time wanted	m³/s

Method and standards

Mass balance with constant volumetric speed.

Assumptions and limits

- Valid in the rough vacuum range (down to about 1 mbar); the page warns for lower targets, where outgassing and leakage set the time.
- Rough vacuum, no gas load.

References

- Pump-down equation for constant pumping speed (vacuum technology texts)

Report details

Report reference	FCC-VP92-XDGV (the same inputs always give the same reference)
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Calculator	Vacuum Pump-Down Time
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Software release	FireCAD Calc, release of 17 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/compressors/vacuum-pump-down-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.