Condenser Air In-Leakage from a Vacuum Rate-of-Rise Test

Air leaking into an isolated condenser or vacuum system from the rate of pressure rise, the system volume and temperature (ideal gas).

Method: Ideal-gas law applied to a vacuum rate-of-rise test; dry-air molar mass from the US Standard Atmosphere composition

Input parameters

Unit system: SI

Parameter	Value	Unit
Steam-space volume under vacuum	120.00	m³
Pressure rise during the test	2.0000	kPa
Test duration	10.000	min
Gas temperature in the condenser	40.000	°C

Calculated results

Parameter	Value	Unit
Rate of rise (pressure per minute)	0.20000	kPa
Air in-leakage	16.020	kg/h

Notes for this case

- Rate of rise is shown per minute. Vapour flashing from a hot hotwell also raises the pressure; test with the hotwell cooled or allow for it.

Formula and method

$$\dot{m}_a = \frac{V}{RT} M \frac{\Delta p}{\Delta t}$$

Variables

V	Steam-space volume under vacuum	m³
Δp	Pressure rise during the test	Pa
Δt	Test duration	s
T	Gas temperature in the condenser	K
$\dot{p}$	Rate of rise, pressure per minute	Pa/min
M	molar mass of dry air, 28.96	kg/kmol
R	universal gas constant, 8314.46	J/(kmol·K)
$\dot{m}_a$	Air in-leakage	kg/s

Method and standards

Ideal-gas law: the air entering an isolated volume raises its pressure at the rate $\Delta p/\Delta t$. Plant and condenser maker practice sets the acceptance limit; no test code value is reproduced here.

Assumptions and limits

- All the pressure rise is attributed to dry air. The water-vapour partial pressure also changes with temperature during the test and vapour flashes from a hot hotwell; neither is corrected, so the leakage may be overstated. Test with the hotwell and shell temperature steady.

References

- Ideal-gas law applied to a vacuum rate-of-rise test; dry-air molar mass from the US Standard Atmosphere composition

Report details

Report reference	FCC-RJMN-RKKK (the same inputs always give the same reference)
Generated	17 November 2026, 19:37 UTC
Calculator	Condenser Air In-Leakage from a Vacuum Rate-of-Rise Test
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 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/boilers-power-plant/condensers-cooling/condenser-air-leak-rate-of-rise

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.