Vacuum Leak Test: Air Entering a Vessel

Air leaking into an evaporator or pan from the fall in vacuum over a time, its volume and temperatures (Hugot's leak test, p. 880).

Method: Hugot; Handbook of Cane Sugar Engineering; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Vessel volume	50.000	m³
Absolute pressure at the start	21.378	kPa
Absolute pressure at the end	34.716	kPa
Temperature at the start	20.000	°C
Temperature at the end	25.000	°C
Duration	36.000	min
Water vapour in the vessel	Dry vessel (Hugot's test)	

Calculated results

Parameter	Value	Unit
Air at the start	12.703	kg
Air at the end	20.282	kg
Air leakage	12.632	kg/h

Notes for this case

• Hugot's example: 50 m³ falling from 60 to 50 cm vacuum in 36 min (20 → 25 °C) admits about 12.7 kg of air per hour. Test with the vessel closed and empty; start above 36 cm vacuum so the flow through leaks stays critical.

Formula and method

$$m_i = \frac{p_{a,i} V}{R_a T_i}, \quad \dot{m}_L = \frac{m_2 - m_1}{t}$$

Variables

V	Vessel volume	m³
p_1	Absolute pressure at the start	Pa
p_2	Absolute pressure at the end	Pa
T_1	Temperature at the start	K
T_2	Temperature at the end	K
t	Duration	s
vapour	Water vapour in the vessel	-
m_1	Air at the start	kg
m_2	Air at the end	kg
$\dot{m}_L$	Air leakage	kg/s

Method and standards

Ideal-gas balance of the air in the vessel.

Assumptions and limits

- Uniform temperature in the vessel.
- The leak flow is critical only while the vessel is below about 0.53 atm absolute (above about 36 cm vacuum); a test that ends above it is flagged, because the average rate is then understated.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 40
• leak test (eqn 40.16 and example)
• pp. 879–880
• Ideal-gas law for air

Report details

Report reference	FCC-K09Z-21QV (the same inputs always give the same reference)
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Calculator	Vacuum Leak Test: Air Entering a Vessel
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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/sugar-ethanol/vacuum-water/vacuum-leak-test

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.