Hydrostatic Head and Boiling Temperature in the Tubes

Rise of boiling temperature at the mean depth of juice in evaporator tubes from tube length, juice level and density, with IF97 saturation (Hugot ch. 32).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Pressure in the vapour space (absolute)	16.000	kPa
Tube length	2.2500	m
Juice level as a share of tube height Hugot: optimum 30–40 % of tube height; Kestner about 20 %.	33.000	%
Juice density	1,250.0	kg/m³

Calculated results

Parameter	Value	Unit
Mean depth	0.37125	m
Pressure at the mean depth	20.551	kPa
Rise of boiling temperature	5.3333	K

Notes for this case

- The rise is small in the first effect and several degrees in the last, where the pressure is low and the syrup dense.

Formula and method

$$z = \frac{\ell L}{2}, \quad p_m = p + \rho g z, \quad \Delta T_h = T_s(p_m) - T_s(p)$$

Variables

p	Pressure in the vapour space (absolute)	Pa
L	Tube length	m
ℓ	Juice level as a share of tube height	-
ρ	Juice density	kg/m³
z	Mean depth	m
p_m	Pressure at the mean depth	Pa
ΔT_h	Rise of boiling temperature	K
g	Standard gravity, 9.806 65	m/s²
T_s	Saturation temperature of water (IAPWS-IF97)	K

Method and standards

Hydrostatics with IF97 saturation.

Assumptions and limits

- Liquid column without bubbles (conservative).

References

- Hugot
- Handbook of Cane Sugar Engineering
- 3rd ed. (Elsevier, 1986)
- ch. 32
- hydrostatic pressure
- pp. 497–504

- Saturation temperature from IAPWS-IF97

Report details

Report reference	FCC-R9W0-3SKB (the same inputs always give the same reference)
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Calculator	Hydrostatic Head and Boiling Temperature in the Tubes
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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/sugar-ethanol/evaporation/evaporator-hydrostatic-head

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.