Barometric Column Height and Diameter (Hugot)

Height of a barometric tail pipe as static head, velocity head and margin (Hugot eqns 40.19–40.20) and its diameter for the flow (40.22).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Barometric pressure	770.00	mmHg
Condenser pressure (absolute)	3.0000	cmHg
Water temperature in the column	45.000	°C
Vapour condensed	11,000	kg/h
Water per kg vapour	50.000	
Velocity in the column Hugot: 1 m/s in older designs; Webre 2–3 m/s.	1.0000	m/s
Loss coefficient of the column Hugot's table: straight pipe of 50 mm 6.1, 100 mm 2.6, 200 mm 1.2, 400 mm 0.6, 800 mm 0.4.	1.0000	
Margin	0.50000	m

Calculated results

Parameter	Value	Unit
Water density	990.22	kg/m³
Static column for the vacuum	10.160	m
Velocity head with losses	0.10197	m
Column height	10.762	m
Column diameter	447.63	mm

Notes for this case

- Hugot's example: H_0 10.20 m, velocity head 0.10 m and 0.5 m margin give 10.80 m. The well should hold at least 1.5 times the column volume.
- The water is at or above its boiling point at the condenser pressure: it would flash at the top of the column. Check the water temperature and the vacuum.

Formula and method

$$H_0 = \frac{p_a - p}{\rho_w g}, \quad h = (1+\alpha)\frac{V^2}{2g}, \quad H = H_0 + h + s, \quad D = \sqrt{\frac{4Q(W+1)}{\rho_w \pi V}}$$

Variables

p_a	Barometric pressure	Pa
p	Condenser pressure (absolute)	Pa
t_w	Water temperature in the column	K
Q	Vapour condensed	kg/s
W	Water per kg vapour	-
V	Velocity in the column	m/s
α	Loss coefficient of the column	-
s	Margin	m

ρ_w	Water density	kg/m³
H_0	Static column for the vacuum	m
h	Velocity head with losses	m
H	Column height	m
D	Column diameter	m

Method and standards

Hugot's column balance.

Assumptions and limits

- Steady flow; sealed well.
- The water must be below its boiling point at the condenser pressure; a note appears if not.

References

- Hugot
- Handbook of Cane Sugar Engineering
- 3rd ed. (Elsevier, 1986)
- ch. 40
- barometric column
- eqns 40.19–40.23
- pp. 881–883
- Water density from IAPWS-IF97

Report details

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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/barometric-column-hugot

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.