Juice Heating by Vapour Bleeding: Three Stages

Vapour bled from evaporator effects to heat juice in three stages, from juice flow, specific heat, stage temperatures and IF97 latent heats (Hugot p. 589).

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

Input parameters

Unit system: SI

Parameter	Value	Unit
Juice flow	100.00	t/h
Juice specific heat	3.7681	kJ/(kg·K)
Heater efficiency	95.000	%
Juice in	30.000	°C
After stage 1	65.000	°C
After stage 2	85.000	°C
After stage 3	103.00	°C
Vapour temperature, stage 1	85.000	°C
Vapour temperature, stage 2	100.00	°C
Vapour temperature, stage 3	111.00	°C

Calculated results

Parameter	Value	Unit
Vapour for stage 1	6,048.0	kg/h
Vapour for stage 2	3,515.6	kg/h
Vapour for stage 3	3,205.9	kg/h
Total vapour	12,770	kg/h
Smallest margin vapour to juice outlet	8.0000	K

Notes for this case

- Hugot's margins between vapour and juice outlet: 5–8 °C on exhaust, 10–12 °C on first-effect vapour, 15–20 °C on later vapours.

Formula and method

$$P_i = \frac{\dot{m}_j c (t_i - t_{i-1})}{h_{fg}(T_i)\,\eta}$$

Variables

$\dot{m}_j$	Juice flow	kg/s
c	Juice specific heat	J/(kg·K)
η	Heater efficiency	-
t_0	Juice in	K
t_1	After stage 1	K
t_2	After stage 2	K
t_3	After stage 3	K
T_1	Vapour temperature, stage 1	K
T_2	Vapour temperature, stage 2	K

T_3	Vapour temperature, stage 3	K
P_1	Vapour for stage 1	kg/s
P_2	Vapour for stage 2	kg/s
P_3	Vapour for stage 3	kg/s
$\sum P$	Total vapour	kg/s
$T_i - t_i$	Smallest margin vapour to juice outlet	K

Method and standards

Heat balance per heater with IF97 latent heat.

Assumptions and limits

- Condensate leaves saturated.
- A note appears when the smallest vapour-to-juice margin is below 5 K.

References

• Hugot
• Handbook of Cane Sugar Engineering
• 3rd ed. (Elsevier, 1986)
• ch. 30 (Table 30.1 margins) and ch. 32 example
• p. 589
• Latent heat from IAPWS-IF97

Report details

Report reference	FCC-0GDR-VQRV (the same inputs always give the same reference)
Generated	17 November 2026, 19:46 UTC
Calculator	Juice Heating by Vapour Bleeding: Three Stages
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/sugar-ethanol/clarification/juice-heater-vapour-bleed

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.