Headbox Jet Velocity, Flow and Jet-to-Wire Ratio

Slice jet velocity from headbox head by Bernoulli (v = √2gh), jet flow with a contraction coefficient, and the jet-to-wire ratio with rush or drag.

Method: Smook; Handbook for Pulp & Paper Technologists; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Total head at the slice (as stock)	18.000	m
Slice opening	12.000	mm
Jet contraction coefficient	65.000	%
Slice width	9.0000	m
Wire speed	1,200.0	m/min
Headbox consistency	0.60000	%

Calculated results

Parameter	Value	Unit
Jet velocity	1,127.4	m/min
Jet-to-wire ratio	0.93947	
Rush (+) or drag (−)	-72.639	m/min
Headbox flow	4,748.4	m³/h
Fibre in the jet	28.491	t/h

Notes for this case

- A jet-to-wire ratio a little off 1 (rush or drag) sets fibre orientation and formation; it is a key tuning variable.

Formula and method

$$v_j = \sqrt{2gh}, \quad Q = v_j\, b\, C_c\, W, \quad \frac{v_j}{v_w}$$

Variables

h	Total head at the slice (as stock)	m
b	Slice opening	m
C_c	Jet contraction coefficient	-
W	Slice width	m
v_w	Wire speed	m/s
C	Headbox consistency	-
v_j	Jet velocity	m/s
v_j/v_w	Jet-to-wire ratio	-
$v_j - v_w$	Rush (+) or drag (−)	m/s
Q	Headbox flow	m³/s
$\dot{m}_{OD}$	Fibre in the jet	kg/s

Method and standards

Bernoulli jet as given by Smook.

Assumptions and limits

- No losses in the slice; stock density about 1 000 kg/m³. Real jets run about 1–3 % slower than √(2gh) because of a velocity

coefficient that is not applied here; since the jet-to-wire ratio is tuned within a few per cent of 1, calibrate against a measured jet speed.

References

- Smook
- Handbook for Pulp & Paper Technologists
- 3rd ed. (Angus Wilde, 2002)
- ch. 16.3 (headbox: jet speed from Bernoulli, v = √(2gh); jet contraction)

Report details

Report reference	FCC-50W0-KSCY (the same inputs always give the same reference)
Generated	17 November 2026, 19:45 UTC
Calculator	Headbox Jet Velocity, Flow and Jet-to-Wire Ratio
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/chemical/pulp-paper/headbox-jet-velocity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.