Continuous Casting: Metallurgical Length and Throughput

Time for a strand to solidify through by the square-root law of shell growth, the metallurgical length at a casting speed, and the caster throughput.

Method: Square-root law of shell growth

Input parameters

Unit system: SI

Parameter	Value	Unit
Section thickness	220.00	mm
Section width	1,500.0	mm
Casting speed	1.2000	m/min
Solidification constant (mm/min^½)	27.000	
Number of strands	2.0000	
Steel density (solid)	7,600.0	kg/m³

Calculated results

Parameter	Value	Unit
Solidification time	16.598	min
Metallurgical length	19.918	m
Caster throughput	361.15	t/h

Notes for this case

• Shell thickness s = K√t (K in mm/min^½, about 25–30 for slabs and billets): the strand is solid when s reaches half the thickness, t_s = (d/2K)². The metallurgical length v_c·t_s must lie inside the machine's supported length; casting faster pushes the liquid core further, limited by bulging and soft-reduction position.

Formula and method

$$s = K\sqrt{t}, \quad t_s = \left(\frac{d}{2K}\right)^2, \quad L_m = v_c t_s, \quad \dot{m} = n_s \rho w d v_c$$

Variables

d	Section thickness	m
w	Section width	m
v_c	Casting speed	m/s
K	Solidification constant (mm/min^½)	-
n_s	Number of strands	-
ρ	Steel density (solid)	kg/m³
t_s	Solidification time	s
L_m	Metallurgical length	m
$\dot{m}$	Caster throughput	kg/s

Method and standards

Casting.

Assumptions and limits

- One-dimensional shell growth from both faces; constant K.

References

Square-root law of shell growth

Report details

Report reference	FCC-ZNMA-P3AW (the same inputs always give the same reference)
Generated	23 November 2026, 17:50 UTC
Calculator	Continuous Casting: Metallurgical Length and Throughput
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 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/materials/steelmaking-foundry/continuous-casting-metallurgical-length

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.