Compound Parabolic Concentrator Concentration and Acceptance

Ideal concentration ratio of a two- or three-dimensional compound parabolic concentrator from its acceptance half-angle, with the sun's limiting concentration.

Method: Ideal non-imaging concentration

Input parameters

Unit system: SI

Parameter	Value	Unit
Acceptance half-angle	20.000	°
Aperture width (2D) or diameter (3D)	0.20000	m

Calculated results

Parameter	Value	Unit
Ideal 2D (trough) concentration 1/sin θ	2.9238	
Ideal 3D (cone) concentration 1/sin²θ	8.5486	
Absorber width for 2D	68.404	mm
Hours per day a fixed east-west trough sees the sun (2θ/15°)	2.6667	
Limit for the sun's disc (2D)	214.59	

Notes for this case

• Thermodynamic limit: C = 1/sin θ_a (2D) and 1/sin²θ_a (3D); the sun's half-angle of 0.267° caps them at about 215 and 46,000. Wide acceptance angles allow fixed or seasonally adjusted collectors; in practice CPCs are truncated, lowering C slightly.

Formula and method

$$C_{2D} = \frac{1}{\sin\theta_a}, \quad C_{3D} = \frac{1}{\sin^2\theta_a}$$

Variables

θ_a	Acceptance half-angle	rad
W	Aperture width (2D) or diameter (3D)	m
C_{2D}	Ideal 2D (trough) concentration 1/sin θ	-
C_{3D}	Ideal 3D (cone) concentration 1/sin²θ	-
w	Absorber width for 2D	m
Δt	Hours per day a fixed east-west trough sees the sun (2θ/15°)	-
$C_{max,2D}$	Limit for the sun's disc (2D)	-

Method and standards

Non-imaging concentration.

Assumptions and limits

- Ideal untruncated concentrator.

References

Ideal non-imaging concentration

Report details

Report reference	FCC-A7G2-SGWA (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	Compound Parabolic Concentrator Concentration and Acceptance
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/environmental/solar-thermal/cpc-concentration-acceptance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.