Solar Glazing Transmittance and (τα) Product for N Covers

Reflection and absorption losses of one to four solar collector covers at any incidence angle, diffuse reflectance and the transmittance-absorptance product.

Input parameters

Unit system: SI

Parameter	Value	Unit
Angle of incidence	0	°
Refractive index of the cover (glass 1.526)	1.5260	
Number of covers	1.0000	
Extinction coefficient times thickness, per cover (glass 2.3 mm: 0.037 to 0.074)	0.012000	
Absorptance of the absorber plate	95.000	%

Calculated results

Parameter	Value	Unit
Refraction angle	0	°
Interface reflectance, perpendicular	0.043362	
Interface reflectance, parallel	0.043362	
Transmittance for reflection losses	0.91688	
Transmittance for absorption losses	0.98807	
Cover system transmittance	0.90594	
Diffuse reflectance of the covers (at 60°)	0.15562	
Transmittance-absorptance product	0.86740	

Notes for this case

• τ ≈ τ_r τ_a for identical covers; the diffuse reflectance is taken at the 60° effective angle for radiation reflected back from the plate. (τα) ≈ 1.01 τα is a good check.

Formula and method

$$r_\perp = \frac{\sin^2(\theta_2-\theta_1)}{\sin^2(\theta_2+\theta_1)},\quad r_\parallel = \frac{\tan^2(\theta_2-\theta_1)}{\tan^2(\theta_2+\theta_1)},\quad n = \frac{\sin\theta_1}{\sin\theta_2}$$

$$\tau_r = \frac{1}{2}\left[\frac{1-r_\parallel}{1+(2N-1)r_\parallel}+\frac{1-r_\perp}{1+(2N-1)r_\perp}\right],\quad \tau_a = e^{-NKL/\cos\theta_2},\quad (\tau\alpha) = \frac{\tau\alpha}{1-(1-\alpha)\rho_d}$$

Variables

θ_1	Angle of incidence	rad
n	Refractive index of the cover (glass 1.526)	-
N	Number of covers	-
KL	Extinction coefficient times thickness, per cover (glass 2.3 mm: 0.037 to 0.074)	-
α	Absorptance of the absorber plate	-
θ_2	Refraction angle	rad
$r_\perp$	Interface reflectance, perpendicular	-
$r_\parallel$	Interface reflectance, parallel	-

τ_r	Transmittance for reflection losses	-
τ_a	Transmittance for absorption losses	-
τ	Cover system transmittance	-
ρ_d	Diffuse reflectance of the covers (at 60°)	-
$(\tau\alpha)$	Transmittance-absorptance product	-

Method and standards

Fresnel reflection, Bouguer absorption and multiple reflection between plate and covers.

Assumptions and limits

- Specular, non-scattering covers of equal properties; solar-spectrum average index.

Report details

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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/glazing-cover-transmittance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.