Gamma Shielding: Attenuation, Buildup and Dose Rate

Uncollided and buildup-corrected gamma flux behind a slab shield from a point source, the absorbed dose rate in tissue and the half- and tenth-value layers.

Method: Point-kernel shielding with buildup

Input parameters

Unit system: SI

Parameter	Value	Unit
Source strength (photons per second)	7.4000e+10	1/s
Photon energy	1.2500	MeV
Distance from source to the point of interest	2.0000	m
Shield thickness	5.0000	cm
Linear attenuation coefficient of the shield	0.66500	1/cm
Buildup factor	Linear B = 1 + μx	
Berger coefficient a	1.0000	
Berger coefficient b	0.030000	
Mass energy-absorption coefficient of tissue	0.029700	cm²/g

Calculated results

Parameter	Value	Unit
Number of mean free paths	3.3250	
Buildup factor	4.3250	
Uncollided flux	5,295.8	1/(cm²·s)
Flux with buildup	22,904	1/(cm²·s)
Absorbed dose rate in tissue	0.49045	mSv/h
Half-value layer	1.0423	cm
Tenth-value layer	3.4625	cm
Transmission B e^(−μx)	15.558	%

Notes for this case

• φ = BSe^(−μx)/(4πr²); absorbed dose rate = φEμ_en/ρ (gray per second, shown in mSv/h for photons, radiation weighting 1). Buildup accounts for scattered photons; take a and b for the shield material and energy from published tables, or use the linear form as a rough estimate.

Formula and method

$$\phi = \frac{BSe^{-\mu x}}{4\pi r^2}, \quad \dot{D} = \phi E \frac{\mu_{en}}{\rho}, \quad HVL = \frac{\ln 2}{\mu}$$

Variables

S	Source strength (photons per second)	1/s
E	Photon energy	J
r	Distance from source to the point of interest	m
x	Shield thickness	m
μ	Linear attenuation coefficient of the shield	1/m
$\mathrm{buildup}$	Buildup factor	-

a	Berger coefficient a	-
b	Berger coefficient b	-
μ_{en}/ρ	Mass energy-absorption coefficient of tissue	m²/kg
μx	Number of mean free paths	-
B	Buildup factor	-
ϕ_0	Uncollided flux	1/(m²·s)
ϕ	Flux with buildup	1/(m²·s)
$\dot{D}$	Absorbed dose rate in tissue	Gy/s
HVL	Half-value layer	m
TVL	Tenth-value layer	m
T	Transmission B e^(−μx)	-

Method and standards

Point-kernel gamma shielding.

Assumptions and limits

- Point isotropic source; slab shield; single energy.

References

Point-kernel shielding with buildup

Report details

Report reference	FCC-E7YW-A3PW (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	Gamma Shielding: Attenuation, Buildup and Dose Rate
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/boilers-power-plant/nuclear-power/gamma-shielding-buildup

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.