Fast Neutron Shielding with Removal Cross-Sections

Fast neutron flux behind two shield layers from a point source using removal cross-sections, with the attenuation factor and tenth-value thicknesses.

Method: Removal cross-section method for fast neutron shielding

Input parameters

Unit system: SI

Parameter	Value	Unit
Fast neutron source strength (neutrons per second)	1.0000e+12	1/s
Distance from source to the point of interest	3.0000	m
First layer thickness	50.000	cm
First layer removal cross-section (water about 0.10 /cm)	0.10300	1/cm
Second layer thickness	60.000	cm
Second layer removal cross-section (ordinary concrete about 0.09 /cm)	0.089000	1/cm

Calculated results

Parameter	Value	Unit
Flux with no shield	884,194	1/(cm²·s)
Flux behind the shield	24.592	1/(cm²·s)
Attenuation factor	2.7813e-05	
Tenth-value thickness of layer 1	22.355	cm
Tenth-value thickness of layer 2	25.872	cm

Notes for this case

- Removal theory: fast flux falls as e^(−Σ_R x) in hydrogenous shields, because one collision with hydrogen removes a fast neutron from the penetrating group. Valid for thick shields containing hydrogen; slowed-down neutrons and capture gammas need separate treatment.

Formula and method

$$\phi = \frac{S}{4\pi r^2} e^{-\Sigma_{R,1} x_1 - \Sigma_{R,2} x_2}, \quad TVL = \frac{\ln 10}{\Sigma_R}$$

Variables

S	Fast neutron source strength (neutrons per second)	1/s
r	Distance from source to the point of interest	m
x_1	First layer thickness	m
$\Sigma_{R,1}$	First layer removal cross-section (water about 0.10 /cm)	1/m
x_2	Second layer thickness	m
$\Sigma_{R,2}$	Second layer removal cross-section (ordinary concrete about 0.09 /cm)	1/m
ϕ_0	Flux with no shield	1/(m²·s)
ϕ	Flux behind the shield	1/(m²·s)
ϕ/ϕ_0	Attenuation factor	-
TVL_1	Tenth-value thickness of layer 1	m
TVL_2	Tenth-value thickness of layer 2	m

Method and standards

Removal shielding.

Assumptions and limits

- Point source; thick hydrogenous shield; fast group only.

References

Removal cross-section method for fast neutron shielding

Report details

Report reference	FCC-CCXA-K6BS (the same inputs always give the same reference)
Generated	23 November 2026, 17:35 UTC
Calculator	Fast Neutron Shielding with Removal Cross-Sections
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/fast-neutron-removal-shielding

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.