Saturation Magnetisation from Bohr Magnetons

Saturation magnetisation and saturation flux density of a ferromagnetic or ferrimagnetic material from its net Bohr magnetons per atom (or formula unit) and density.

Method: Saturation magnetisation from atomic moments

Input parameters

Unit system: SI

Parameter	Value	Unit
Density	8,900.0	kg/m³
Molar mass of the atom or formula unit	58.690	kg/kmol
Net Bohr magnetons per atom or formula unit	0.60000	

Calculated results

Parameter	Value	Unit
Atoms (formula units) per cubic metre	9.1322e+28	
Saturation magnetisation	508,154	A/m
Saturation flux density μ₀M_s	0.63857	T

Notes for this case

• M_s = N·n_B·μ_B, N the atoms (or formula units) per m³ = ρN_A/A and μ_B = 9.274 × 10⁻²⁴ A·m² the Bohr magneton. Measured n_B is non-integer for metals (Fe 2.22, Co 1.72, Ni 0.60 at 0 K); in ferrites the antiparallel sublattices cancel partly (Fe_3O_4: 4 per formula unit). B_s = μ₀M_s near saturation, where M ≈ H. Values fall with temperature to zero at the Curie point.

Formula and method

$$N = \frac{\rho N_A}{A}, \quad M_s = N n_B \mu_B, \quad B_s = \mu_0 M_s$$

Variables

ρ	Density	kg/m³
A	Molar mass of the atom or formula unit	kg/kmol
n_B	Net Bohr magnetons per atom or formula unit	-
N	Atoms (formula units) per cubic metre	-
M_s	Saturation magnetisation	A/m
B_s	Saturation flux density μ₀M_s	T

Method and standards

Saturation magnetisation.

Assumptions and limits

- 0 K moments; full alignment.

References

Saturation magnetisation from atomic moments

Report details

Report reference	FCC-TB8H-CF9M (the same inputs always give the same reference)
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Calculator	Saturation Magnetisation from Bohr Magnetons
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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/properties/saturation-magnetisation

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.