ASTM Grain Size Number ↔ Grains per mm² and Grain Size

Convert an ASTM E112 grain size number to grains per square millimetre and a mean grain diameter, or the reverse, for use with Hall–Petch.

Method: ASTM E112 definition N = 2^(G−1) grains per in² at 100×; ×15.50 for grains per mm² at 1×

Input parameters

Unit system: SI

Parameter	Value	Unit
Value given	ASTM grain size number G	
ASTM grain size number	8.0000	
Grains per mm² at 1×	1,984.0	

Calculated results

Parameter	Value	Unit
Grain size number	8.0000	
Grains per mm² at 1×	1,984.0	
Grains per square inch at 100×	128.00	
Mean grain diameter 1/√N_A	22.451	µm

Notes for this case

- The mean diameter here is the square root of the mean grain area, one of several conventions.

Formula and method

$$N_{100} = 2^{G-1}, \quad N_A = 15.50 \times 2^{G-1}, \quad \bar{d} = \frac{1}{\sqrt{N_A}}$$

Variables

given	Value given	-
G	ASTM grain size number	-
N_A	Grains per mm² at 1×	-
N_{100}	Grains per square inch at 100×	-
$\bar{d}$	Mean grain diameter 1/√N_A	m

Method and standards

ASTM E112 definition.

Assumptions and limits

- Equiaxed grains.
- The mean diameter is 1/√N_A (about 22.5 µm at G 8); the ASTM E112 mean lineal intercept is smaller (about 20 µm at G 8). Use the convention your Hall–Petch data were fitted with.

References

- ASTM E112 definition N = 2^(G−1) grains per in² at 100×; ×15.50 for grains per mm² at 1×

Report details

Report reference	FCC-36ZE-HB8V (the same inputs always give the same reference)
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Calculator	ASTM Grain Size Number ↔ Grains per mm² and Grain Size
Method last reviewed	12 November 2026
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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/astm-grain-size

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.