Tensile Strength and Endurance Limit from Brinell Hardness

Approximate ultimate tensile strength of steel from Brinell hardness, and the unnotched rotating-bending endurance limit estimate from it.

Method: S_u ≈ 3.45 HB MPa (steels; Shigley's Mechanical Engineering Design, ch. 2) and S_e' = 0.5S_u up to 700 MPa (ch. 6)

Input parameters

Unit system: SI

Parameter	Value	Unit
Brinell hardness	200.00	
Strength factor (MPa per HB)	3.4500	

Calculated results

Parameter	Value	Unit
Estimated tensile strength	690.00	MPa
Estimated endurance limit	345.00	MPa

Notes for this case

- S_u ≈ 3.45HB MPa for carbon and low-alloy steels (±10 %); not for cast iron, stainless steels or non-ferrous metals. The endurance limit estimate is for polished specimens; apply surface, size and reliability factors.

Formula and method

$$S_u \approx 3.45\,HB \text{ MPa}, \quad S_e{}' = \min(0.5 S_u, 700 \text{ MPa})$$

Variables

HB	Brinell hardness	-
k	Strength factor (MPa per HB)	-
S_u	Estimated tensile strength	Pa
$S_e{}'$	Estimated endurance limit	Pa

Method and standards

Empirical correlations.

Assumptions and limits

- Steels (carbon and low-alloy). Above about 450 HB the relation is less reliable and is flagged.

References

- S_u ≈ 3.45 HB MPa (steels; Shigley's Mechanical Engineering Design, ch. 2) and S_e' = 0.5S_u up to 700 MPa (ch. 6)

Report details

Report reference	FCC-28HQ-TFRX (the same inputs always give the same reference)
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Calculator	Tensile Strength and Endurance Limit from Brinell Hardness
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Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 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/tensile-strength-from-hardness

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.