Bolt Tensile Stress Area (ISO Metric Thread)

Tensile stress area of a metric bolt or stud from its nominal diameter and pitch, with the pitch and minor diameters of the ISO thread profile.

Method: ISO 898-1 stress area definition; ISO 68-1 / ISO 724 thread profile

Input parameters

Unit system: SI

Parameter	Value	Unit
Nominal (major) diameter	20.000	mm
Thread pitch The distance between threads, as in M20 × 2.5. Read it from the bolt's designation or measure it with a thread gauge.	2.5000	mm

Calculated results

Parameter	Value	Unit
Tensile stress area	244.79	mm²
Pitch diameter	18.376	mm
Minor diameter of the bolt thread	16.933	mm
Stress diameter $(d_2 + d_3)/2$	17.655	mm
Area at the minor diameter	225.19	mm²

Formula and method

$$A_s = \frac{\pi}{4}\left(\frac{d_2 + d_3}{2}\right)^2 = \frac{\pi}{4}\,(d - 0.938\,194\,P)^2$$

$$d_2 = d - \frac{3\sqrt{3}}{8}P, \quad d_3 = d - \frac{17\sqrt{3}}{24}P$$

$$A_3 = \frac{\pi}{4}d_3^2$$

Variables

d	nominal (major) diameter	m
P	thread pitch	m
d_2	pitch diameter	m
d_3	minor diameter of the bolt (external) thread	m
d_s	stress diameter, mean of d_2 and d_3	m
A_s	tensile stress area	m²
A_3	area at the minor diameter	m²

Method and standards

The ISO metric thread is built on a triangle of height H = (√3/2) P (ISO 68-1). The pitch diameter is d − 2·(3/8)H and the minor diameter of the bolt thread is d − 2·(17/24)H (ISO 724). ISO 898-1 defines the tensile stress area as the circle on the mean of these two diameters. The proof load of a bolt is its proof stress times this area; continue to the bolt torque calculator for preload and torque.

Assumptions and limits

- ISO metric (60°) threads only, coarse or fine pitch.
- Basic dimensions; manufacturing tolerances on the thread are not included.
- Gives the area only; the bolt's proof and tensile strengths come from its property class.

References

- ISO 898-1 stress area definition
- ISO 68-1 / ISO 724 thread profile

Report details

Report reference	FCC-8Y98-DKX9 (the same inputs always give the same reference)
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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/mechanical/machine-design/bolt-stress-area

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.