Surface Roughness in Turning: Ra from Feed and Nose Radius

Theoretical surface roughness (Ra and peak-to-valley Rt) of a turned surface from the feed and the tool nose radius, and the feed for a target Ra.

Method: Geometric roughness R_t = f²/(8r); R_a ≈ f²/(32r) (Kalpakjian; Sandvik turning formulas)

Input parameters

Unit system: SI

Parameter	Value	Unit
Feed per revolution	0.20000	mm
Tool nose radius	0.80000	mm
Target Ra	1.6000	µm

Calculated results

Parameter	Value	Unit
Theoretical Ra f²/(32r)	1.5625	µm
Peak-to-valley f²/(8r)	6.2500	µm
Feed for the target Ra	0.20239	mm

Notes for this case

- Geometric value; real roughness is higher due to built-up edge, vibration and tool wear.

Formula and method

$$R_a \approx \frac{f^2}{32 r_\varepsilon}, \quad R_t = \frac{f^2}{8 r_\varepsilon}$$

Variables

f	Feed per revolution	m
r_ε	Tool nose radius	m
$R_{a,t}$	Target Ra	m
R_a	Theoretical Ra f²/(32r)	m
R_t	Peak-to-valley f²/(8r)	m
f_t	Feed for the target Ra	m

Method and standards

Geometry.

Assumptions and limits

- R_a = f²/(32 r) is the usual approximation (R_a = R_t/4). The exact mean deviation of a circular-arc cusp is f²/(18√3 r) = f²/(31.2 r), about 2.6 % higher; the difference is far smaller than the effect of wear and vibration.
- Valid when the feed is well below the nose radius; the page warns when f exceeds r and when f reaches 2r, where the nose arc no longer forms the whole cusp.
- Sharp tool, no vibration.

References

- Geometric roughness R_t = f²/(8r)
- R_a ≈ f²/(32r) (Kalpakjian; Sandvik turning formulas)

Report details

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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/mechanical/manufacturing/surface-roughness-turning

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Reopens the calculator with the inputs of this report.