

Shaft Verification

Sample document with complete example values. It shows the report the purchased export produces for YOUR input - it is not itself a report for any part.

Project: Sample project

Part/Position: no real part

Prepared by: Sample, not released

Overall result: OK - S_D and S_F both reach the required minimum safety factor $S_{min} = 1.2$.

Notch and options

Notch case	Shaft shoulder
Diameter d	40 mm
Diameter D	50 mm
Notch radius r	3 mm
Load case	1
Surface roughness R_z	5 μm
Hardening factor KV	1
Effective diameter d_{eff}	50 mm
Required minimum safety factor S_{min}	1.2

Material (properties at $d_B = 16$ mm)

Material	36CrNiMo4 +QT
Group	Quenched and tempered steel
Tensile strength σ_B	1,100 N/mm ²
Yield strength σ_S	900 N/mm ²
Tension/compression fatigue strength σ_{zdW}	440 N/mm ²
Bending fatigue strength σ_{bW}	550 N/mm ²
Torsional fatigue strength τ_{tW}	330 N/mm ²

Loading (mean value $\pm$ amplitude)

Tension/compression force F_{zd}	251,327.41 $\pm$ 62,831.85 N
Bending moment M_b	1,884.96 $\pm$ 376.99 Nm
Torsional moment M_t	1,256.64 $\pm$ 502.65 Nm

Safety factors

Criterion	Value	Limit	Status
Safety factor against fatigue fracture S_D	1.25	1.2	● borderline
Safety factor against yielding S_F	1.28	1.2	● borderline

Cross-section and global values

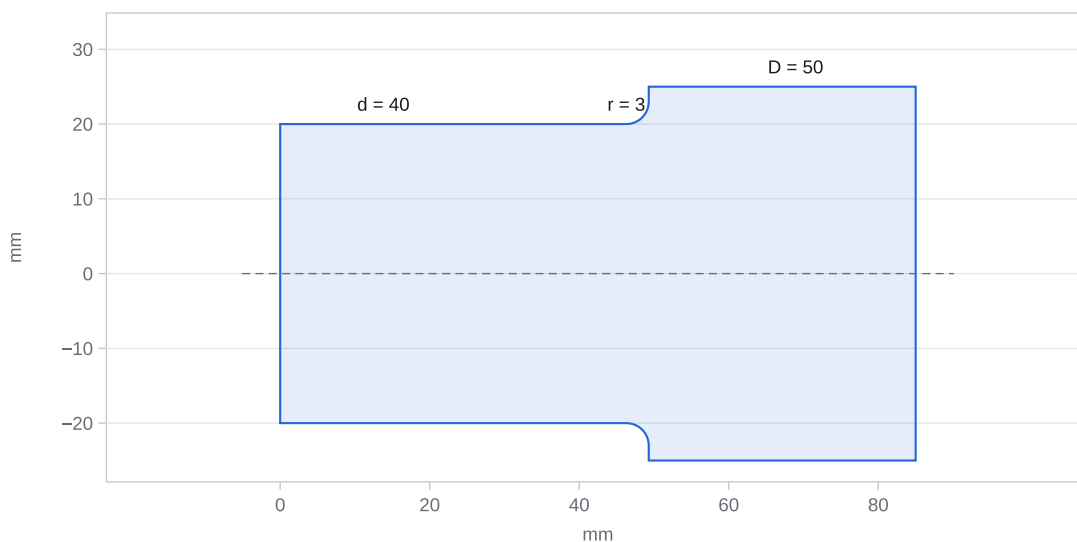
Technological size factor $K1(B)$	0.871
Technological size factor $K1(S)$	0.797
Tensile strength of the component $\sigma_B(d)$	958.5 N/mm ²
Yield strength of the component $\sigma_S(d)$	717.4 N/mm ²
Equivalent mean stress σ_{mv}	529.2 N/mm ²
Equivalent mean stress τ_{mv}	305.5 N/mm ²
Cross-sectional area A	1,257 mm ²
Section modulus W_b	6,283 mm ³
Section modulus W_t	12,566 mm ³

Intermediate values by load direction

Quantity	Tension/compression	Bending	Torsion
Mean stress in N/mm ²	200	300	100

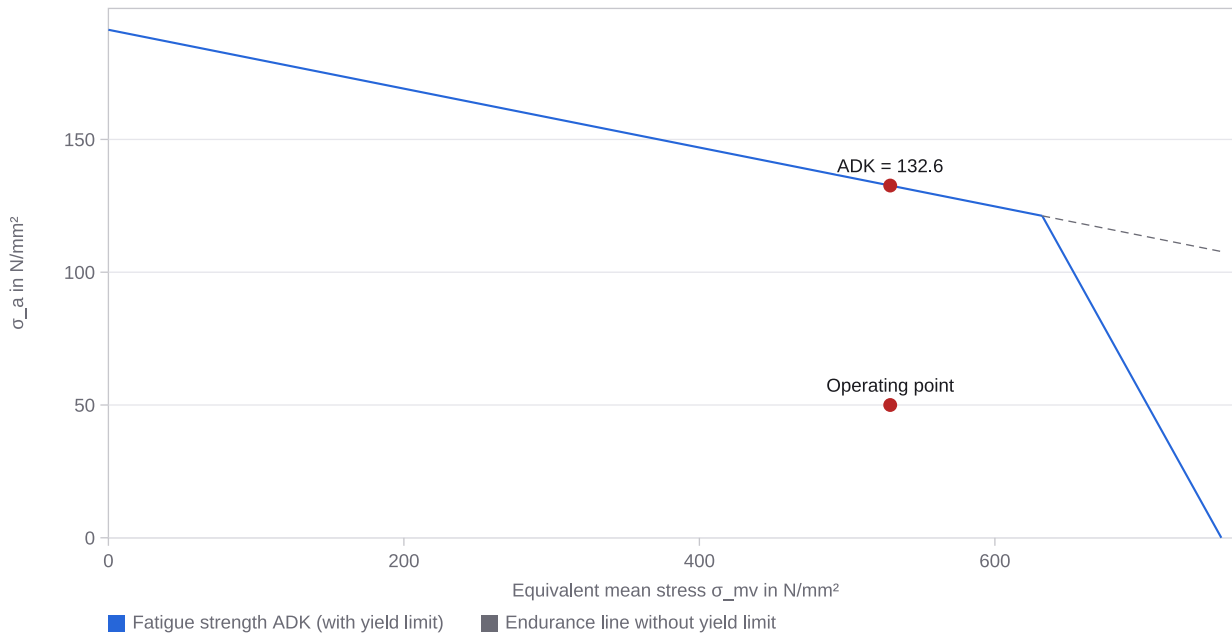
Stress amplitude in N/mm ²	50	60	40
Maximum stress in N/mm ²	250	360	140
Stress concentration factor α	1.968	1.801	1.405
Relative stress gradient G' in 1/mm	0.874	0.874	0.383
Support factor n	1.043	1.043	1.028
Fatigue notch factor β	1.887	1.727	1.366
Size factor K ₂	1	0.888	0.888
Surface factor K _F	0.895	0.895	0.94
Total influence factor K	2.004	2.061	1.602
Component fatigue strength WK in N/mm ²	191.3	232.5	179.5
Mean stress sensitivity ψ	0.111	0.138	0.103
Static support effect K _{2F}	1	1.2	1.2
Increase factor γ_F	1.05	1.05	1
Component yield limit FK in N/mm ²	753.3	903.9	497
Component fatigue strength ADK in N/mm ²	132.6	159.5	147.9

Notch case in longitudinal section (dimensions in mm)



Shoulder with fillet, drawn to scale: notch root diameter d , large diameter D and notch radius r as entered.

Haigh diagram tension/compression: tolerable amplitude in N/mm²



Fatigue limit diagram of the governing direction (highest amplitude utilisation): solid line is the fatigue strength limit ADK including the yield limit, dashed line the endurance line without yield limitation. The distance between the operating point and the limit line is the reserve against fatigue failure; for loading case 2 the evaluation follows the ray through the origin.

Calculation basis

Strength verification for shafts and axles per DIN 743: from the nominal stresses at the notch cross-section, the fatigue notch factor (form factor and support factor, or experimental values), the geometric and technological size factor, and the surface and hardening factor are combined into the total influence factor K for each load direction. From this follow the component fatigue strength and, with the mean stress sensitivity ψ , the component fatigue strength ADK as well as the component yield limit FK. The safety factor against fatigue fracture S_D is derived from the stress amplitudes, the safety factor against permanent deformation S_F from the maximum stresses. An * next to the component fatigue strength indicates that it is limited by the yield limit; in the Haigh diagram this is the kink where the yield line $FK - \sigma_m$ drops below the endurance line $\sigma_{WK} - \psi \cdot \sigma_m$. The rating is against the selected minimum safety factor S_{min} : if S_D or S_F falls below it, the check is not satisfied - even when the factor is still above 1.0.

About this sample

All values on these pages come from a freely chosen example calculation and belong to no real part. The purchased export contains the same sections with your input, your header data (project, part, prepared by) and as searchable text. Pricing and scope: maschinenbaurechner.de/en/pricing

Note: The results are design and orientation aids. They do not replace independent verification, calculation and approval by a qualified person. The terms of use at maschinenbaurechner.de apply.