# Gear 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

Spur gear pair: geometry and load capacity quick check

Overall assessment: OK

## Inputs

| | |
|---|---|
| Normal module mn | 3 mm |
| Number of teeth z1 / z2 | 20 / 60 |
| Profile shift x1 / x2 | 0 / 0 |
| Helix angle β | 0 ° |
| Face width b | 40 mm |
| Load | P = 7.5 kW |
| Pinion speed n1 | 1,450 $min^{-1}$ |
| Application factor KA | 1.25 |
| Gear quality | 7-8 |
| Material, gear 1 | 16MnCr5 / 18CrNiMo7-6 |
| Material, gear 2 | 16MnCr5 / 18CrNiMo7-6 |
| Minimum safety factors SFmin / SHmin | 1.5 / 1.2 |

## Geometry per gear

| Quantity | Gear 1 | Gear 2 |
|---|---|---|
| Pitch diameter d in mm | 60 | 180 |
| Base diameter db in mm | 56.3816 | 169.1447 |
| Tip diameter da in mm | 66 | 186 |
| Root diameter df in mm | 52.5 | 172.5 |
| Working pitch diameter dw in mm | 60 | 180 |
| Profile shift x | 0 | 0 |
| Equivalent number of teeth zn | 20 | 60 |
| Tip tooth thickness s_an in mm | 2.085 | 2.357 |
| Minimum profile shift x_min | −0.1698 | −2.5093 |
| Root form circle d_Ff in mm | 56.4602 | 174.7793 |
| Root usable circle d_Nf in mm | 56.5784 | 175.7624 |
| Radial reserve (d_Nf - d_Ff)/2 in µm | 59.1 | 491.6 |
| Reserve Δ_ξ along the line of action in mm | 0.8681 | 1.8771 |

## Gear pair

| | |
|---|---|
| Operating center distance a | 120 mm |
| Reference center distance ad | 120 mm |
| Transverse module mt | 3 mm |
| Operating pressure angle α_wt | 20 ° |
| Transverse contact ratio ε_α | 1.6708 |
| Overlap ratio ε_β | 0 |
| Total contact ratio ε_γ | 1.6708 |
| Gear ratio i | 3 |
| Tip clearance c | 0.75 mm |
| Tip shortening factor k (info) | 0 |
| Limiting number of teeth zg | 17.1 |

## Tooth forces and load factors

| | |
|---|---|
| Pinion torque T1 | 49.39 Nm |
| Tangential force Ft | 1,646.4 N |
| Radial force Fr | 599.3 N |
| Axial force Fa | 0 N |
| Pitch line velocity v | 4.56 m/s |
| Factors KA / KV / KH_β / KF_β | 1.25 / 1.2 / 1.5 / 1.25 |

## Tooth root load capacity

| Quantity | Gear 1 | Gear 2 |
|---|---|---|
| Tooth form factor YFa | 2.8 | 2.2863 |
| Stress correction factor YSa | 1.5525 | 1.7286 |
| Contact ratio factor Y_ε | 0.6989 | 0.6989 |
| Helix angle factor Y_β | 1 | 1 |
| σ_F0 in N/mm² | 41.68 | 37.9 |
| σ_F in N/mm² | 78.16 | 71.05 |
| σ_Flim in N/mm² | 430 | 430 |
| Safety factor SF | 11 | 12.1 |

## Flank load capacity

| | |
|---|---|
| Zone factor ZH | 2.4946 |
| Elasticity factor ZE | 189.8 √(N/mm²) |
| Contact ratio factor Z_ε | 0.8811 |
| Helix angle factor Z_β | 1 |
| σ_H0 | 399.02 N/mm² |
| σ_H | 598.54 N/mm² |
| Safety factor SH (min) | 2.46 |

## Assessment criteria

| Criterion | Value | Limit | Status |
|---|---|---|---|
| Transverse contact ratio ε_α | 1.6708 | >= 1.1 | ● OK |
| Root interference, gear 1 (Δ_ξ >= g_min) | 0.8681 mm | 0.06 mm | ● OK |
| Root interference, gear 2 (Δ_ξ >= g_min) | 1.8771 mm | 0.06 mm | ● OK |
| Undercut, gear 1 (x >= x_min) | 0 | - | ● OK |
| Pointed tip limit, gear 1 (s_an >= 0.2 mn) | 2.085 mm | 0.6 mm | ● OK |
| Undercut, gear 2 (x >= x_min) | 0 | - | ● OK |
| Pointed tip limit, gear 2 (s_an >= 0.2 mn) | 2.357 mm | 0.6 mm | ● OK |
| Tooth root safety factor SF, gear 1 | 11 | 1.5 | ● OK |
| Tooth root safety factor SF, gear 2 | 12.1 | 1.5 | ● OK |
| Flank safety factor SH, gear 1 | 2.46 | 1.2 | ● OK |
| Flank safety factor SH, gear 2 | 2.46 | 1.2 | ● OK |

## Calculation basis

Gear geometry of the involute gearing with reference profile per DIN 867 (tip circles unshortened, tip shortening factor shown for reference only). The load capacity quick check follows DIN 3990 and ISO 6336: tooth root stress with load application at the tooth tip (YFa/YSa, Method C) and contact ratio factor Y_ε, flank pressure at the pitch point. Simplifications: KV taken as a flat 1.2, KH_β/KF_β from the quality table, KH_α = KF_α = 1, endurance strength without life factor, lubricant factor or size factor. The result is a reference-value check, not a complete standard verification.

Root interference (tip corner meshing): the flank is a usable involute only between the root form circle d_Ff and the tip circle, yet the mesh already starts at the root usable circle d_Nf set by the tip circle of the mating gear. Required is d_Nf >= d_Ff on both gears (Dubbel, G 8.1.7). The root form circle follows from the usable tool addendum hN = mn·(hfP* - rhoFP*·(1 - sin α_n)). Assessed is the reserve Δ_ξ along the line of action against g_min = max(0.02·mn; 0.05 mm), because the radial difference becomes insensitive near the base circle; the radial difference is reported in addition. Limits: nominal geometry without

tolerances, root side only (tip chamfers and tip relief not modelled), external gearing only, hobbing with a rack type tool without protuberance and without grinding stock only; for helical gears the transverse section approximation per ISO 21771 applies. With pronounced undercut d_Ff cannot be determined in closed form and the criterion counts as not verified: ε_α,nutz is then only a lower bound, so the geometric contact ratio is assessed instead and no not-OK verdict is derived from the uncertain figure. One bound still holds, because the usable involute can start no lower than the base circle: if even that upper bound of the reserve is negative, the interference is certain and is rated not OK, only its magnitude stays open. If interference occurs, SF and SH are void because they assume undisturbed involute meshing.

## About this sample

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