

Car Wind Noise Cheat Sheet

Aeroacoustics, noise sources, wind throb and fixes

ENGINEERING
CHEAT SHEET

Key equations

Quantity	Equation	Notes
Sound pressure level	$SPL = 20 \log_{10}(p / p_0)$	$p_0 = 20 \mu Pa$. Doubling pressure adds about 6 dB
Aerodynamic drag	$F_d = \frac{1}{2} \rho C_d A v^2$	Shapes that add drag often add wind noise too
Aero noise vs. speed	Noise power rises steeply with v	Textbook dipole scaling is about v^6 : small speed gains give big noise gains
Wind throb frequency	$f \approx (c / 2\pi) \sqrt{(A / (V L))}$	Helmholtz resonance of the cabin. A = opening area, V = cabin volume, L = effective neck length
Wind throb range	10-50 Hz	Low-frequency pulsing with one window or sunroof partly open
Noise thresholds (guide)	80 dB unpleasant; city ~70 dB; highway up to ~100 dB	Long exposure above 80 dB can cause harm

Key takeaways

- Wind noise is turbulent airflow plus air leaking through gaps. It is loudest where flow separates: mirror backs, A-pillars, rear edges.
- **Quality issue:** uneven gaps or bad seals along the door, hood, tailgate seal lines. **Design issue:** mirrors, roof racks, door handles.
- Four sources: pressure fluctuation on the side glass, at the mirror, at the A-pillar, and eddies (negligible at normal speeds).
- Find the source on a quiet drive with the music off and a passenger helping. Check door and window weatherstripping first.
- Fixes: replace crushed seals, mirror covers or gaskets, remove or streamline roof racks, repair body damage, glass chips and rust.
- CFD alone predicts wind noise poorly, so teams rely on wind tunnel testing. Sound-deadening material is heavy and only covers some frequencies.
- Wind throb stops when the window closes or a second window opens.