

FASTENER VIBRATION LOOSENING & PREVENTION

Why Do Fasteners Loosen?

When a bolted joint is tightened, the bolt stretches like a stiff spring, generating the clamp load that holds the assembly together.

- **The Core Culprit:** Transverse (side-to-side) vibration is the primary driver of joint failure. This cyclic movement causes relative slip between the mating threads and the bearing surface, momentarily dropping friction to near zero.
- **The Mechanics:** Without friction to hold the joint in place, the rotational energy stored in the stretched bolt is released, causing the fastener to back itself out.

Comparison Chart: Prevention Methods & Effectiveness

Locking Method	Effectiveness	Reusability	Cost	Best Used For...
Standard Split Lock Washer	Low	Low	\$	Low-risk, low-vibration assemblies.
Nylon-Insert Lock Nut (Nyloc)	Medium	Low (Single-use ideal)	\$	General industrial manufacturing, automotive interior.
Serrated Flange Nut/Bolt	Medium-High	Medium (Damages surface)	\$\$	Sheet metal, structural framing where surface scratching is acceptable.
All-Metal Top Lock Nut	High	Low-Medium	\$\$	High-temperature environments where nylon would melt.
Wedge-Locking Washers (ie: Nord-Lock)	Very High	High	\$\$\$	Heavy machinery, railway, high-vibration structural joints.
Chemical Threadlockers	Very High	None (Requires reapplication)	\$\$	Permanent assemblies, maintenance & repair (MRO).

Best Practices to Prevent Loosening

- **Ensure Proper Initial Preload:** The best defense against vibration loosening is tightening the fastener correctly in the first place. A properly stretched bolt can absorb significantly more harmonic vibration.
- **Mind the Length-to-Diameter Ratio:** Longer bolts absorb vibration better than short, stubby bolts because they have more elastic stretch capacity.
- **Avoid Stacking Washers:** Stacking flat washers or putting a split lock washer on top of a flat washer introduces more interfaces that can slip, reducing overall joint stability.