

## The Ratchet-LockWasher Advantage: True Mechanical Locking Without Preload Dependence

*Eliminates self-loosening under vibration, shock, and preload loss — enhancing safety, extending maintenance intervals, and keeping operations running.*

### Key Benefit of Eliminating Self-Loosening in Bolted Joints (Beyond Preload and Slip Resistance Considerations)

In high-preload bolted joints designed in accordance with recognized structural engineering guidelines, two major factors ensure joint integrity:

1. **Preload Requirements** → Ensuring sufficient bolt tension to prevent fatigue failure.
2. **Slip Resistance** → Relying on friction between connected surfaces to resist movement.

While these are essential in friction-based designs, they do not directly eliminate self-loosening, which remains a major failure mode in dynamic applications. The key benefit of the Ratchet-LockWasher (RLW) is its ability to eliminate self-loosening, even when preload loss or slip occurs, thereby acting as a secondary safeguard to maintain joint integrity.

### Why Eliminating Self-Loosening is Critical

#### ⇒ Prevents Catastrophic Failure

- Even in cases where preload loss occurs due to relaxation, temperature fluctuations, or differential material expansion, RLW prevents full detachment of the bolt or nut.
- This is crucial in applications such as steel structures, offshore platforms, wind turbines, and railway infrastructure, where joint failure can be disastrous.

#### ⇒ Maintains Structural Stability

- In bearing-type connections, where the joint is designed to transfer loads via direct bolt contact rather than friction, self-loosening can still cause movement and failure even if slip resistance is not the primary concern.
- RLW acts as a locking mechanism to ensure joint stability over time.

#### ⇒ Reduces Maintenance and Inspection Costs

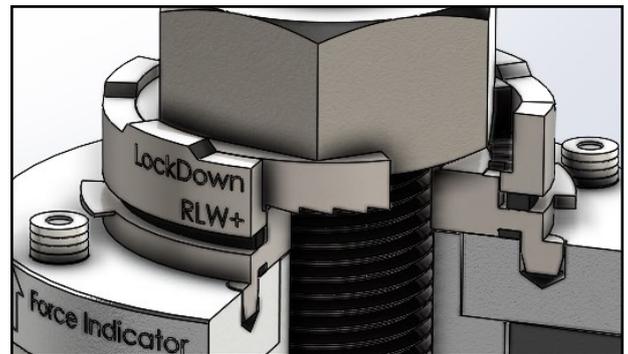
- Traditional high-preload bolted joints require regular retightening to compensate for relaxation, creep and potential loosening.
- By eliminating the root cause of rotational loosening, RLW significantly reduces the need for frequent maintenance, saving time and costs in industries with thousands of bolted connections (e.g., bridges, cranes, industrial machinery).

#### ⇒ Enhances Safety Under Dynamic Loads

- Even in applications where slip resistance is sufficient, external vibrations, cyclic loading, and impact forces can still lead to gradual rotation of nuts or bolts.
- RLW provides an additional level of security, ensuring that bolted joints remain intact despite environmental stresses.

#### ⇒ Improves Preload Control and Load Transfer Efficiency

- The RLW's low-friction, hardened contact surface promotes smooth, predictable torque-to-tension conversion.
- By reducing bearing friction and microscopic embedment, the RLW enables more accurate preload application and improved long-term tension retention.
- Unlike traditional serrated lock washers such as the Nord-Lock, which rely on a minimum preload to engage their wedge effect, the RLW provides consistent locking **even in low or degraded tension conditions**, making it more reliable in preload-loss scenarios.



### Conclusion

While preload and slip resistance are fundamental in friction-based designs, self-loosening remains a separate failure mode that can still compromise joint integrity. The Ratchet-LockWasher (RLW) directly addresses this issue, providing a fail-safe mechanism against rotational loosening **while also enhancing preload control and long-term joint stability**. Its ability to function independently of minimum tension requirements makes it a robust alternative to conventional locking washers, especially in dynamic, safety-critical environments where preload cannot always be guaranteed.