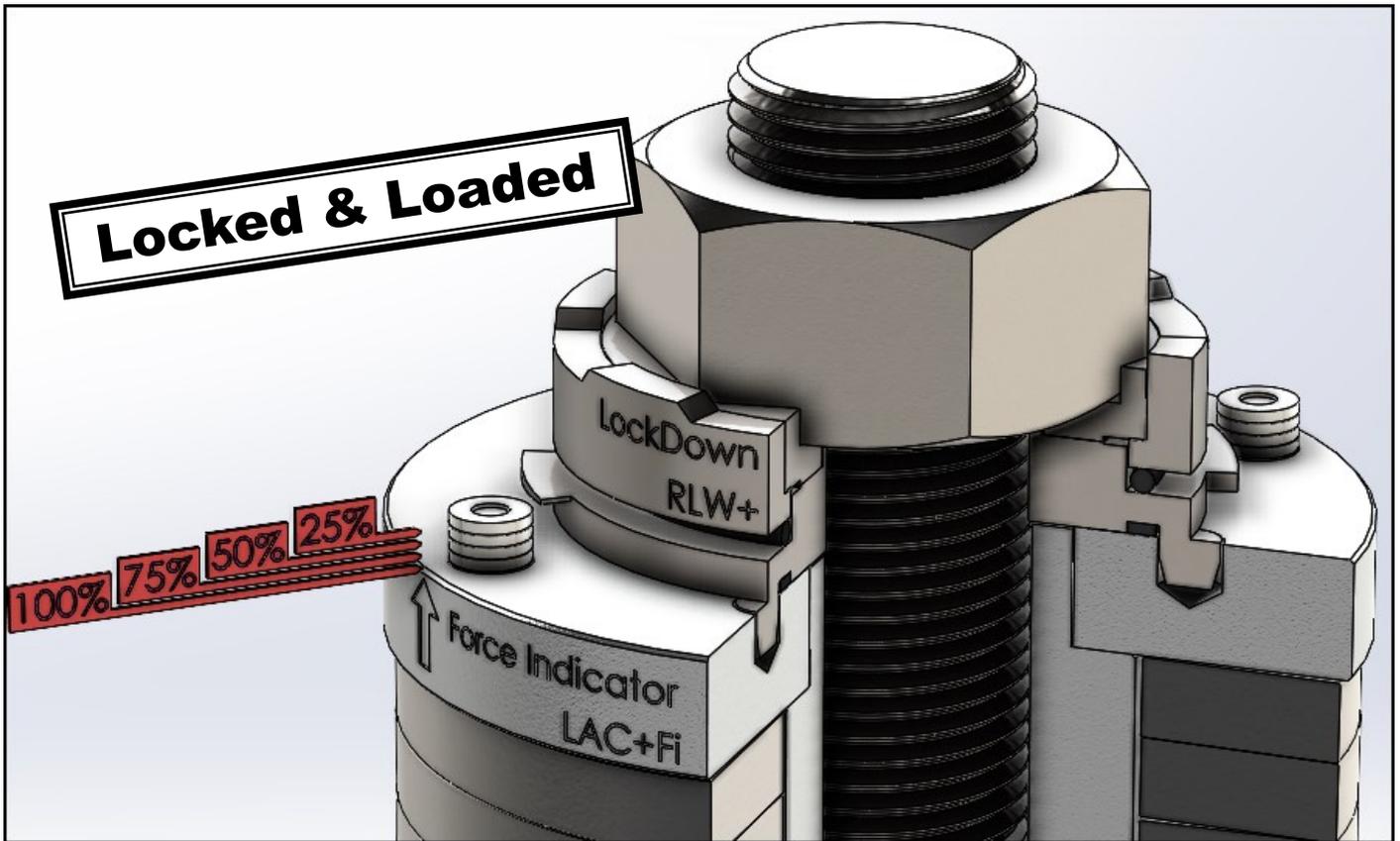
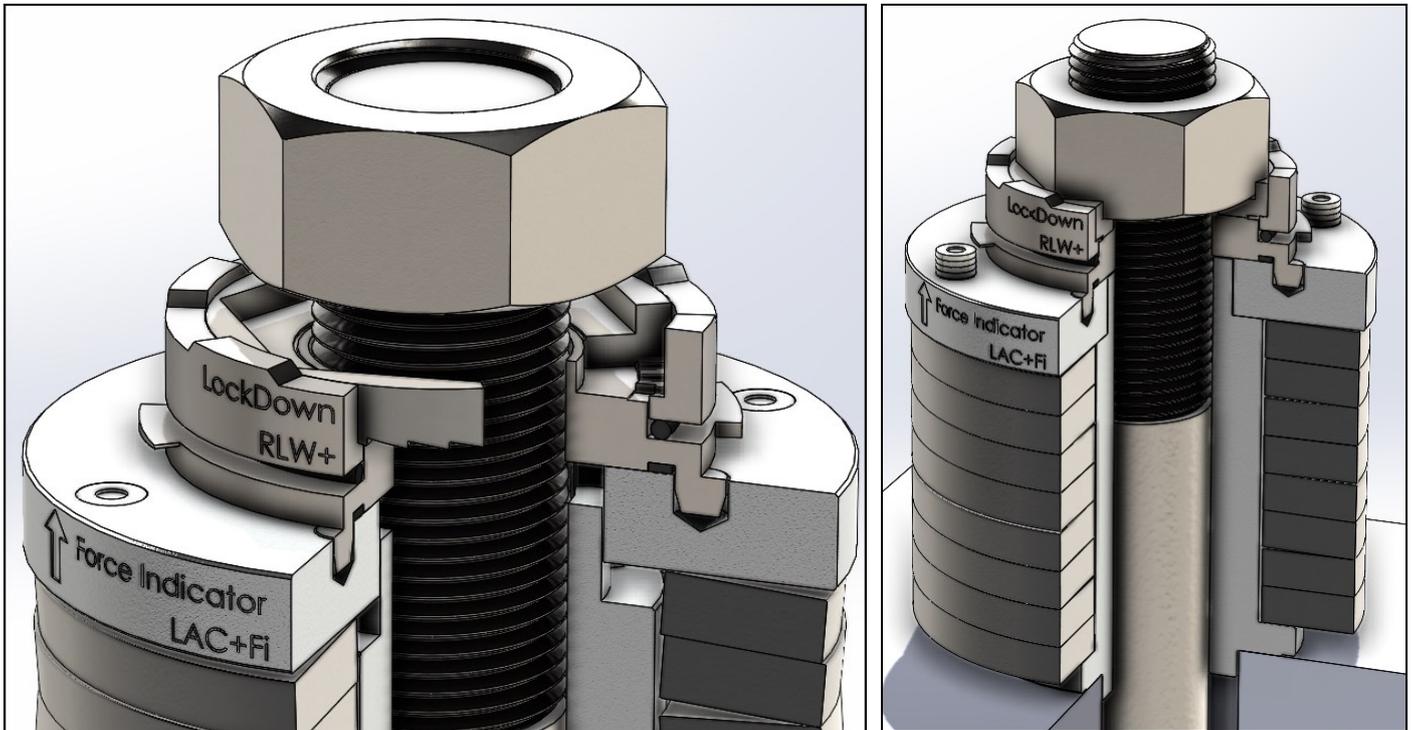


LockDown Active System with Force Indicator

.....RLW+ Optimising Preload Retention in Dynamic and Relaxing Joints



Automatically compensates for **settlement, creep, and thermal changes**,
Reduces **maintenance needs** and extends **service life**.....Read this Technical Brief



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1. Why Compliance (Elasticity) Helps Maintain Preload in Dynamic Environments

All bolted joints relax over time—especially under dynamic loads, wear, or thermal cycling. Introducing **compliance (elasticity)** into the **fastener system** (e.g., by integrating disc springs in series with the bolt) improves preload retention by allowing the assembly to better accommodate joint relaxation. This preserves clamp load longer and increases joint reliability.

More preload retention = higher joint integrity as the joint relaxes.

Many industrial assemblies suffer preload loss due to two mechanisms:

Spontaneous Loosening (Rotational Self-Loosening):

- Shock and impact loading
 - Machine-induced vibration
 - Dynamic loading from movement or flow
- These can cause nuts or bolts to rotate loose without mechanical locking.

Joint Relaxation:

- Material embedment or settlement
 - Creep (permanent deformation)
 - Microstructural **relaxation**
 - Thermal cycling (expansion/contraction)
- All contribute to joint **relaxation** and preload loss, even when the torque is correct

2. How LockDown Active System (LAS+) Enhances Bolt Reliability in Relaxing Assemblies

Mechanical Anti-Rotation Locking:

The **Ratchet-LockWasher (RLW+)** features a positive ratchet mechanism that physically prevents rotation, even under reduced preload. It ensures mechanical lock integrity throughout the joint's service life.

Active-Loading with Belleville Disc Springs (Calibrated System):

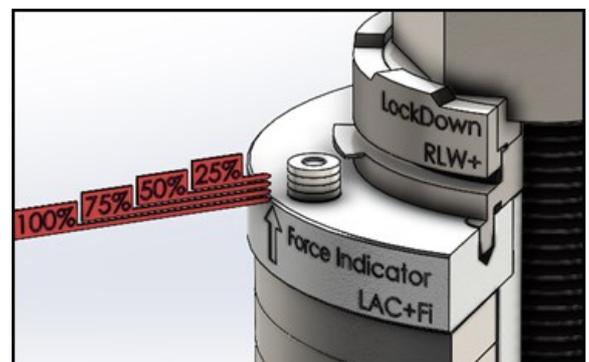
LAS+ integrates calibrated disc springs that are precisely matched to the joint geometry. This ensures:

- **Controlled and measurable deflection** under tension
 - **Over-compression protection** to avoid spring damage or preload distortion
 - **Uniform load distribution** across the joint face, minimizing localized stress
- This calibrated system actively maintains clamping force as the joint **relaxes**, ideal for dynamic and long-service applications.

3. Integrated Monitoring with a Force Indicator (LAS+Fi)

The **LAS+ system** can incorporate a **Force Indicator**, a visual indicator for clamp force-tension verification and condition monitoring:

- Real-time visual confirmation of preload
- Verifies tension accuracy during installation
- Enables ongoing monitoring for predictive maintenance
- Supports QA with visible clamp assurance



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4. Technical Insight: The Role of Joint and System Stiffness

A high-strength bolt stretched within its elastic range applies a proportional clamp force. As the joint relaxes, this force decreases in relation to the **overall system stiffness**. The **LAS+ system** reduces the effective stiffness of the fastener stack by introducing compliance—**not by changing the joint stiffness**—while also providing mechanical locking and preload compensation.

Example:

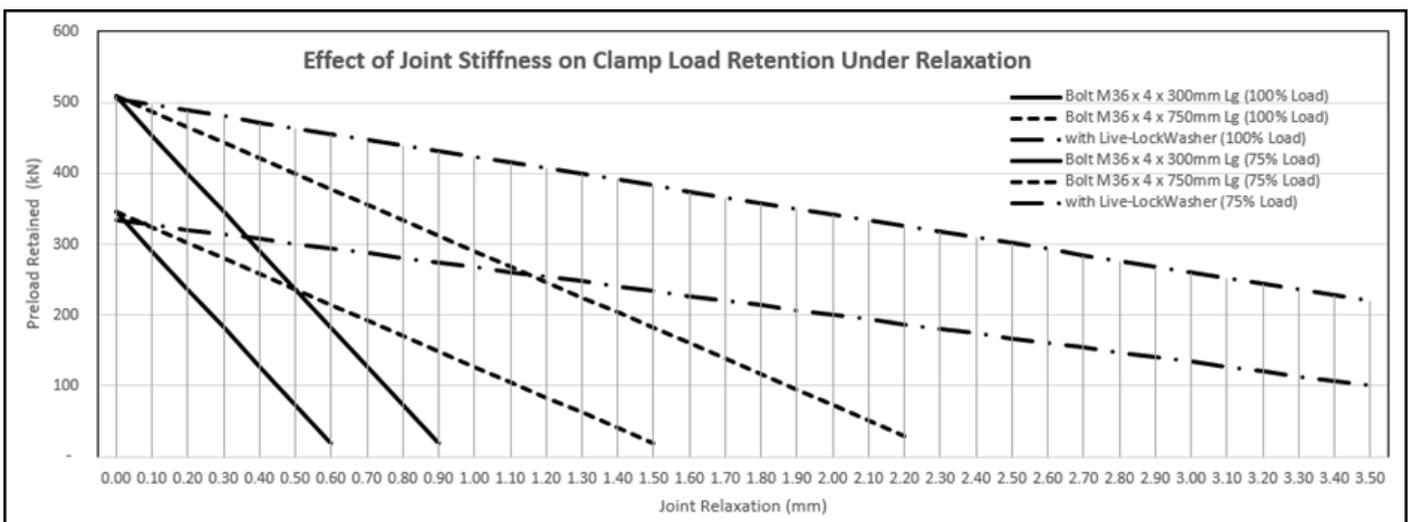
An M36 × 4 × 300 mm bolt tensioned to 500 kN, after 0.5 mm of **relaxation**, retains only **236 kN**. With LAS+ and disc springs, **preload retention** improves to **464 kN**—nearly double.

The preload graph (see below) illustrates:

- **Longer bolts** improve fatigue resistance, reduce stress variation and preload retention during joint relaxation, but only when the joint is stiff.
- **Where bolt length can't be increased**, LAS+ adds **compliance** compactly, improving preload retention and joint durability.

5. Technical Point – Optimizing Bolt Load with System Compliance

By introducing **compliance** into the fastener system (via LAS+), you don't need to maximize bolt preload at installation. Starting at a moderate load (e.g., 75% of bolt yield) still preserves clamp force after joint relaxation while reducing stress concentration on the bolt. This provides better tolerance to dynamic tension spikes and improves fatigue performance.



Summary of Benefits

- Superior **preload retention** under joint **relaxation**
- Protects against vibration-induced loosening and fatigue
- Automatically compensates for settlement, creep, and thermal changes
- Reduces maintenance needs and extends service life
- Visual **Force Indicator** for real-time tension and performance monitoring

Additional Value from the RLW+:

- Accurate preload control with 10° ratchet-lock increments
- Tactile feedback during tightening enhances installation reliability
- Independent mechanical lock only releases through intentional action
- Efficient torque-to-tension conversion
- Reduced friction and improved bolt stress profile
- Quick installation with low overall cost

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