Strainlabs System

Condition monitoring of bolted joints

Problem description

Uncontrolled bolted joint conditions threaten asset lifespan, uptime and safety

In railway infrastructure, bolted joint integrity is critical. Vibrations, thermal expansion, and relaxation can cause loosening, often missed by manual, time-consuming inspections. This raises the risk of failures, downtime, and accidents.

Without real-time insight, maintenance is often inefficient and reactive. Predictive, condition-based maintenance is key to improving reliability and reducing costs. Continuous remote preload monitoring enables early fault detection, data-driven decisions, and compliance – with a patented solution ready for global deployment.

Solution description

Condition monitoring of bolted joints

Strainlabs introduces e-Bolts equipped with embedded sensors to monitor preload in real time. Each e-Bolt includes a miniaturized optoelectronic system that captures mechanical strain and transmits data wirelessly. The system provides alerts on preload loss, supporting Predictive Maintenance and reducing the need for manual inspections. Data is visualized on a dashboard, highlighting critical joints and maintenance needs.

They are built for Harsh Environments, with long battery life and robust wireless communication.

A globally patented system ensures unique technological value, enabling early risk detection, repair verification, and optimized maintenance – especially in Industrial and Railway applications.

How it works

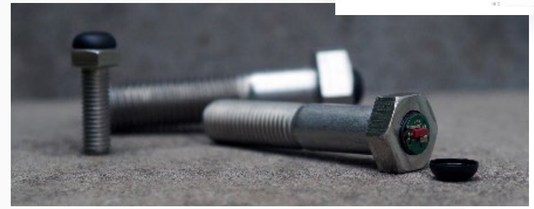
Main Features

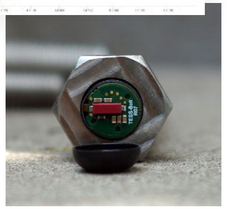
- Wireless e-Bolts with embedded strain and temperature sensors
- Preload loss detection with real-time alerts for maintenance
- Visual dashboards highlighting critical risks and interventions
- Predictive maintenance alerts from continuous monitoring data
- Long battery life with configurable measurement frequency
- Proprietary protocol ensuring secured, compliant, and certified communication

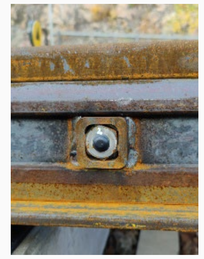
Product description

Strainlabs' solution embeds a miniaturized optoelectronic sensor that continuously measures mechanical strain to determine preload. The system integrates an LED-sensor, microcontroller, and wireless transmitter, with data sent periodically to an internet gateway for cloud analysis. The optoelectronic design offers superior mechanical and thermal resistance, minimal EMI sensitivity, and stable measurements without recalibration. The design is mechanically passive, ensuring that the bolt retains its full structural function without interference from the sensor.

The system operates on a battery that lasts over 5 years at default settings which can be extended by adjusting the measurement frequency. They are CE-marked, demonstrating compliance with industrial standards for electromagnetic compatibility, electrical safety, and controlled wireless transmission power, while guaranteeing robustness and endurance in Industrial and Railway environments.







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Additional Features

- 24/7 continuous monitoring of bolted joints
- Early detection of preload loss risks
- Scalable predictive maintenance planning for large infrastructures
- Retrofit-friendly: fits standard bolt dimensions
- Post-maintenance verification of assembly integrity
- Cloud dashboard with real-time data visualization
- Secured, compliant data access via Strainlabs gateway

Bolts
Unlimited
IoT bolts

Routers
Pre-configured routers
for data exchange

Analytics
Remote monitoring
with data insights

Additional Highlights

- Scalable deployment: from pilots to industrial fleet integration
- Real-time preload alerts ensuring installation accuracy
- Actionable insights to maximize uptime and operational safety
- Industry 4.0 solution with certified compliance and cost efficiency

e-BOLTS

CE-marked	with Intertek
Standard sizes	M10, M12, M16, M20, M22, M24, M27, M33, M36
Length	30-200 mm
Steel classes	Steel 8.8, 10.9 or 12.9
Stainless steel	A4-70, A4-80 or Bumax® 88, 109
Special alloys	Yes
Type	Hex head, fully or partially threaded ISO 4014/ISO4017
Operating Conditions	› Minimum clamp length: 10 mm › Temp range -30°C / +70°C
Preload Monitoring	› Tightening mode: Direct feedback › Active mode: Every 10 minutes (reduced interval when below -0°C) › Pre-calibrated alert levels, adaptable
Additional IOT Features	› Temperature data & thermal compensation › Micro controller / Smart battery management › Unique ID, position & time tracking › Band with ISM 2,4 GHz › Proprietary protocol
Battery Lifetime	Simulated to 5 years in environment (extendable if lower sampling frequency <1ms/10min)

ROUTERS

Type	Industrial IoT router from Multitech®
Software updates	Automatic & remote
Communication	Ethernet/LAN, Wi-Fi, 4G LTE, 5G
Range	Stable up to 90 meters (extended via antennas/amplifiers, free space)
Power Connection	100–240 V, includes EU & UK adapter
Antenna	RangeAnt MAX +3dBi Omnidirectional

Analytics

Installation	Agnostic – in the cloud or installed locally
Monitoring	Site-level overview, scalable down to specific bolts
Functionality	Visualizes measurement data, tracks bolt IDs, routers, locations, and preload alert levels
Value	Aggregated data supports asset planning and product development
Potential	Enables future analysis with AI & Machine Learning

e-BOLT

ROUTER