



# Introducing Bolt iQ

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# Challenges with Bolt Maintenance



The proper installation and maintenance of bolted joints is crucial, but also a common pain point. Traditional bolt testing methodologies have significant drawbacks in terms of efficiency and accuracy. Bolt iQ is the next generation technology for tension measurement



**Traditional retorquing as a method for checking bolt tension is slow, inaccurate, and can disturb or damage bolts unnecessarily**

- Traditional re-torquing is imprecise due to the numerous factors (such as variations in friction factor) that can impact the accuracy of torque as a proxy for tension
- Retorquing every bolt during maintenance inspections is time consuming, requires heavy equipment, and can disturb or damage bolts unnecessarily



**Elongation-based methods require numerous calibrations and baseline bolt measurements, meaning they cannot be used on in-situ bolts without loosening and replacing them**

- Elongation-based methods require baseline measurements of every bolt before they are under load, which add cost to new bolts and means that in-situ bolts must be loosened, measured and then replaced
- The devices used to measure elongation also require numerous calibrations which compromise their ease of use and efficiency



**Bolt iQ is a new, DNV-certified technology that requires zero device calibrations, can be used on the installed base and provides full traceability for every bolt tested**

- Bolt iQ uses DNV-certified bi-wave technology to measure tension directly. It uses a proprietary deep learning model for each bolt type, meaning that once a bolt type has been modelled and added to the system, it can be used on any bolt of that type, including those in-situ
- Unlike other methodologies, Bolt iQ measures tension directly without relying on inaccurate conversions from proxies and does not require baseline bolt measurements or device calibrations

# The Bolt iQ System

Bolt iQ is the first AI-powered bolt tension measurement tool for the global wind industry. It measures tension directly and accurately in seconds, without device calibrations or reliance on proxies such as elongation or torque

## Fast Facts

1. Bolt iQ tested 100 bolts in 30 mins during field trials, reducing maintenance inspection time by >90%
2. DNV certified methodology & accuracy<sup>1</sup>
3. Accurate to within 5.5% of yield stress
4. Works on bolts in-situ without baseline measurements
5. Weighs approx. 1.5Kgs
6. Multiple forms of connectivity

[1] DNV Statement No: 80QT-DNV-SE-0160-07114-0 Issued: 2025-01-24

## How it Works – in less than 30s per test

1. Select the bolt to be measured in the device's software (can be done by scanning a QR code)
2. Place the solid couplant on the head of the bolt
3. Place the transducer in the centre of the bolt and twist the magnetic clamp to fix it in place. The alignment device can be used if required
4. Initiate the test on the tablet. The device will take a few seconds to generate the measurement
5. Confirm the result, which will then synchronise with the cloud platform, ready to be viewed and downloaded

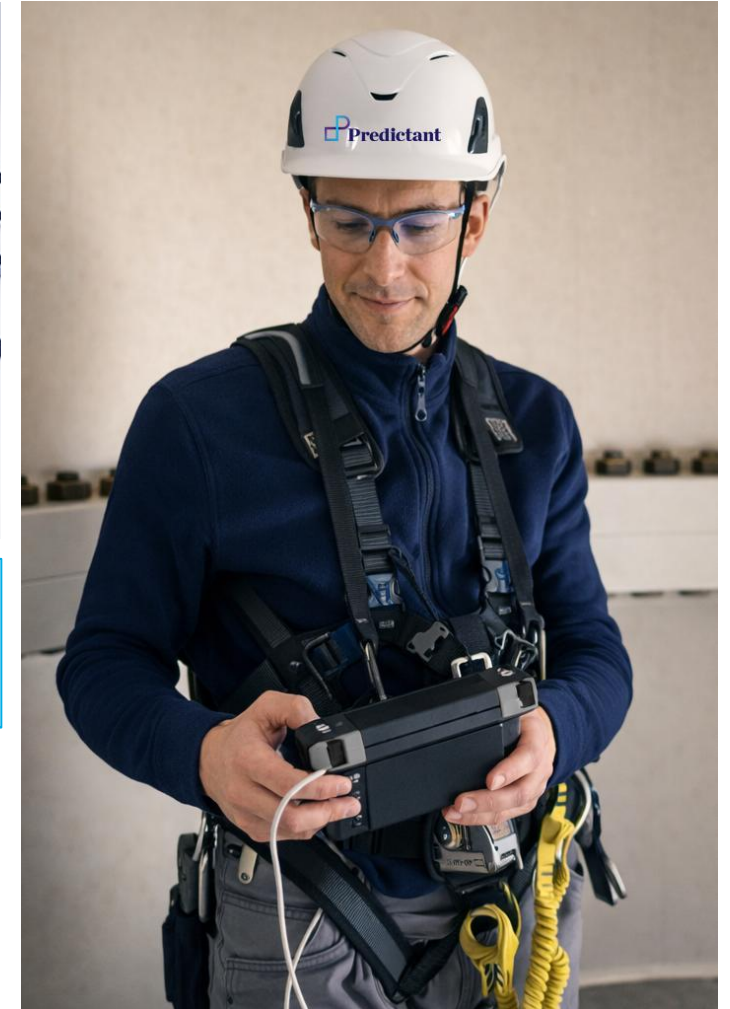
[Watch our demo video here](#)



- 1 Handheld tablet
- 2 Transducer with magnetic clamp
- 3 Solid, reusable couplant
- 4 Adjustable alignment device



The system has a range of harness options for hands-free carrying alongside other equipment.

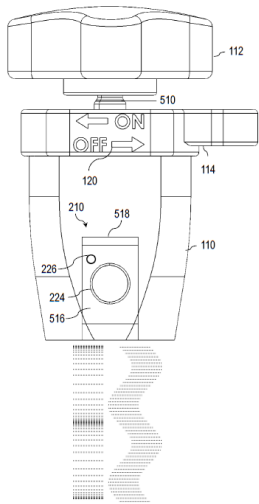


# Bolt iQ's Technology

Bolt iQ combines proprietary hardware and software to measure tension to a high degree of accuracy

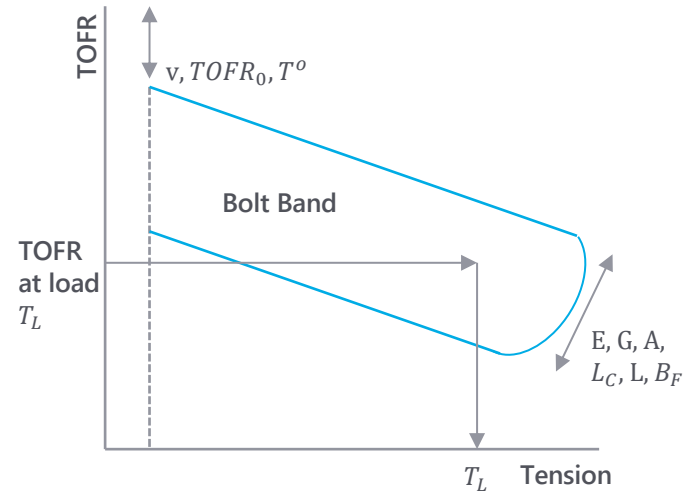


## 1. Proprietary Hardware



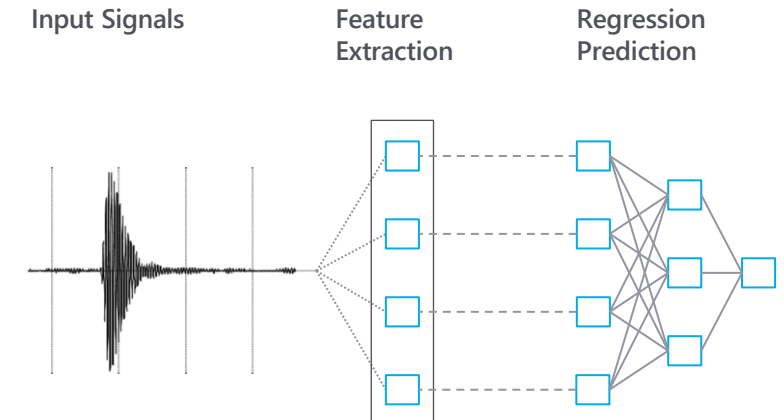
- Predictant's proprietary transducer generates both longitudinal and shear waves

## 2. Time-of-Flight Ratio Calculation



- Tension is measured using the time-of-flight ratio between longitudinal and shear waves
- Tension also depends on other factors (diameter, clamp length, Young's modulus, temperature etc.) but the system adjusts for all of these variables

## 3. Proprietary Software



- Predictant's proprietary model analyses the wave forms, extracts the relevant features, and produces an accurate reading, which is displayed on the tablet and uploaded to a cloud-based platform for viewing, analysis and reporting

# The Benefits of Bolt iQ: Technical & Operational



Bolt iQ has several key benefits vs. hydraulic equipment and elongation-based devices. It is faster, more accurate, easier to use, has full traceability, and can be used on the installed base with equal efficiency

	Benefits	Tensioner / Torque Wrench	Elongation Device	Bolt iQ	Bolt iQ Notes
<b>Technical</b>	Accuracy	✗	~ <sup>1.</sup>	✓	+/- 5.5% with a C.I. of 95%
	Measurement speed	✗	~ <sup>2.</sup>	✓	Seconds vs minutes
	Usable on in situ bolts	✓	✗	✓	No pre-install measurements needed
<b>Operational</b>	Safe and lightweight	✗	✓	✓	Bolt iQ weighs around 1.5kgs
	Ease of use	✗	✗	✓	Minutes of non-specialist training only
	Clean handling	✗	~ <sup>3.</sup>	✓	No mess solid couplant
	Automated set up/reporting	✗	✗	✓	Eliminates error and time
	In-field calibration	✓	✓	✗	Not required
	Baseline bolt measurements	✗	✓	✗	Not required

1. Elongation tools typically claim +/- 10% accuracy, but this usually refers to measurement of the elongation of the bolt rather than actual tension, and numerous factors (Young's modulus, bending, temperature etc.) can further impact the veracity of the conversion from one to the other
2. Once elongation devices are set up and working, they are significantly quicker than torque wrenches. However, this assessment of them vs. Bolt iQ includes the requirement for multiple calibrations (e.g. system zero, transducer to device, stress-factor compensation, length, etc.)
3. Elongation devices do not involve the same risks of oil leakage etc. that torque wrenches do, however, they do require liquid couplant. Bolt iQ functions with a proprietary, solid, reusable couplant that can be transferred from bolt to bolt and replaced when required.



# The Benefits of Bolt iQ: Time & Cost Savings

Bolt iQ can save over 90% of the man hours required for an annual checks of 10% of bolts. In other use cases where a higher percentage of bolts are tested such as QC for manufacturing & assembly or break-in maintenance, Bolt iQ delivers more savings

## Key Results

In an example case of the annual test of 10% of blade and tower bolts in a 2MW onshore turbine, testing bolts with Bolt iQ vs. a torque wrench delivered\*:

### 91% reduction in man hours per service

The benefits of using Bolt iQ increase as more bolts are tested, so would be even higher during a post-installation break-in maintenance check or QC for manufacturing & assembly, where a higher percentage of bolts are tested.

**The more bolts that are tested with Bolt iQ, the greater the benefits Bolt iQ delivers.**



\*excel support can be provided and can be adjusted to suit customer fleet/turbine specifications

## Value Drivers

### Tangible

- Faster testing of bolts: Bolt iQ successfully tested 100 bolts in 30 mins during field trials – a rate of less than 20s per bolt
- Faster, safer movement around the turbine from flange to flange compared to moving around with heavy hydraulic equipment. Movement with and use of heavy hydraulic equipment is limited to addressing bolts that actually require retightening
- Labour cost savings from reduced man-hours
- Increased turbine availability/uptime from faster services

### Intangible

- Instant, digitised reporting for data analysis and compliance purposes
- Better data – an actual tension value that can be tracked over time
- Technician safety & workload from reduced time carrying hydraulic equipment

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# Appendix

1. DNV Certification
2. Disclaimer



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