

# Frequently Asked Questions

## Where can LMF+® be used?

- LMF+® can be used in almost any conventional bolting application such as Rotational equipment bolts, liner bolts, foundation bolts, slew ring, high pressure pumps, pipeline flanges, fluid sealing, gear boxes, gear rings, pinions, cranes and many more.

## What are the size limitations?

- 3/4" (m20) and up on headed product, 1 1/8" (m30) and above on threaded studs.

## What type of fasteners can be used?

- LMF+® can be installed on any headed or threaded end of fasteners. It can be used in hex bolts, 12 points, square heads, round heads, and double-ended studs. In some cases, such as a socket head cap screw, it may be necessary to switch to a 12 point or install in the threaded end due to the broach.

## Where is LMF+® currently being used and how is the performance?

- Since 2015 Data Monitoring Fasteners have been used successfully around the world. It is currently in use on 6 continents in many industries including Mining, Wind Energy, Oil & Gas, Petrochemical, Construction and more.

## Does LMF+® compromise the strength of the fastener?

- The LMF+® instrumentation will not generally compromise the integrity or strength of a headed fastener. Bolts typically fail in the threaded region where the tensile stress area is the smallest. The LMF+® sensor is retrofit into a 1mm radius hole in the shank of a headed fastener, and the stress area and strength in this section will exceed the stress area in the threaded section. For studs or any threaded end, the fasteners may slightly derated which in nearly all cases is negligible. For example, the derated value for 2.25" diameter 8 T.P.I. bolt would be less than 1%. Tensile and shear tests have verified this, and can be reconfirmed upon customer request.

## Are Data Monitoring Fasteners accurate?

- The LMF+® meets the highest standard for an accuracy in load indicating fastener specification ASTM F2482M-21 level (LT1), "The load-indicating fastener shall be calibrated to ±5% accuracy up to the proof load of the fastener unless otherwise specified at the time of order." Calibration certificates and records can be provided for each fastener.
- The calibration process is robust and uses a calibrated digital pressure dial connected to a hydraulic actuator. Cross checks are routinely conducted using calibrated equipment such as tensile testing machines and electronic strain gauges.

## Can LMF+® withstand vibrations, cyclic loads, and shock?

- Yes, LMF+® has been proven to sustain expected and many unexpected in-service conditions.
- Upon customer request, 3rd party vibration and shock tests can be conducted at amplitudes, frequency ranges, and other parameters that match and exceed the expected application.
- The strain gauge is not susceptible to fatigue failure as it operates below its endurance limit.





### **Does LMF+® come with warranty protection?**

- Warranty is available and is application specific.

### **Are replacement parts available?**

- Caps and components are stock items from the supplier and available for immediate replacement.
- Damaged caps can easily be replaced in the field and while in service.

### **Can I monitor the status of more than one fastener?**

- The BoltSense app and GDN provide the ability to simultaneously read thousands of fasteners.

### **How long do the batteries last and can they be replaced?**

- Typical battery life is approximately 3-4 years and can easily be replaced in the field or caps with new batteries can be supplied from Copper State in exchange for units with depleted batteries.

### **Has LMF+® been designed for longevity in harsh environments?**

- Numerous failure modes were considered during the design of this proprietary technology: Mechanical failures, electronic failures, extreme temperature failures, electromagnetic interference, vibrations and shock, water/moisture/dust ingress, battery polarity reversal, and loss of contact with the battery.
- LMF+® comes standard with IP65 water resistance and can be sealed to IP68.
- Corrosion resistance is improved by features such as gold plated pcb pads and application specific sealing systems.
- LMF+® can be easily programmed to provide readings at desired intervals. At 1-hour intervals, the battery will generally exceed 4 years.
- LMF+® module production conforms to BSI ISO-9001 management and documentation standards and supplies a variety of instrumentation for mission critical applications including Royal Navy propulsion systems, hydroelectric power plants, mines, wind turbines, automotive engines, and rail.

### **How long will the LMF+® last?**

- The LMF+® has been designed to last decades for most applications.

### **What tightening tools can be used with the LMF+®?**

- Any conventional tool such as impact wrench, hydraulic torque wrench, pneumatic torque multiplier, and tensioner.

### **Do I need to calibrate my tightening tool?**

- No, the LMF+® will allow the user to know the tension in the bolt.

### **Can the LMF+® be used to calibrate my tightening equipment?**

- Yes, the LMF+® can be used to verify or determine the calibration of a tool or the actual nut factors in an assembly. We also offer a BoltSense Auto Shut-Off Control System that will turn your tool off when the bolt reaches the correct tension.





## What is the range of the LMF+<sup>®</sup> signal?

- The Bluetooth<sup>®</sup> signal can typically be read at least 150 feet away, but depending on the environment, could significantly exceed that distance or in some cases have reduced range. In the near future we will have a 1+ km range with Sub GHz radio transmission. Wireless transceivers can be placed and transfer data to the Internet so that they can be viewed anywhere.

## How can the Global Network help me?

- The Global Data Network enables automated, remote monitoring and trending of bolt preload over an extended period of time.
- When preload drops below a pre-determined level, reports are automatically deployed via email or text messages to key stakeholders. This ensures maintenance is only conducted on bolts requiring attention and allows immediate action to be taken on those installed in mission critical applications.
- The data generated also enables maintenance teams to build a picture of recurring incidents, informing proactive investigation, troubleshooting, and predictive maintenance.

## Can I get assistance interpreting data and troubleshooting problems?

- Transmission Dynamics and Copper State together have decades of experience in assisting customers in critical fastener applications, mechanical engineering, sensor hardware/software design and advanced data analytics.
- Transmission Dynamics are global leaders in combining these skill sets to help identify and resolve root causes to reduce maintenance costs and extend asset life.

## What is the difference between the Load Monitoring Fastener and the Load Indicating Fastener?

- The Load Monitoring Fastener includes a cap that will continually send out data at predetermined intervals which can be captured and stored locally or on the Internet. This information can be accessed and used during installation and while the equipment is in service.
- The Load Indicating Fastener is used in conjunction with a detachable cap that enables real time data collection. The Detachable Reader Caps can be used during installation and to spot check the status of a fastener when the user has physical access to the fastener.
- Load Indicating Fasteners can easily be converted to Load Monitoring Fasteners instantly by attaching a Bluetooth transmitting cap.





# Technical Summary Sheet for the Data Monitoring Fastener

I	<p>Adheres to ASTM F2482:</p> <ul style="list-style-type: none"> <li>Classifies as "4.1.3 Strain Gauge Type (ST)—This type of fastener incorporates a bonded device wired in a Wheatstone bridge configuration which, through changes in relative resistance, reports tension in the fastener."</li> <li>Calibration will be conducted with tension forces at 25 % increments up to the fastener proof load and must exhibit <math>\pm 5</math> % accuracy.</li> <li>Performance. The load-indicating fastener shall be calibrated to <math>\pm 5</math> % accuracy up to the proof load of the fastener unless otherwise specified at the time of order.</li> <li>Calibration Accuracy Test Reports may be requested and shall show the heat number (to ensure that the chemical composition is on record and could be furnished upon request), calibration loads, nominal size, calibration of accuracy lot identification number, ASTM designation, type or grade, issue date, and purchase order number.</li> </ul>
II	Electronics Supplier conforms to BSI ISO-9001:2015 management and documentation standard.
III	Battery life will vary depending upon environment and programed intervals of data collection. For reference, long term testing has shown that with 5-minute intervals average battery life is 3.8 years and typical life with 1-hour data collection intervals can exceed 5 years.
IV	<p>Operating Temperature Ranges:</p> <ul style="list-style-type: none"> <li>-25°C to 85°C with standard battery</li> <li>-40°C to 85°C with non-standard battery</li> </ul>
V	Standard water resistance conforms to IP65 and can be sealed to IP68
VI	Application specific 3rd party testing for vibration, shock, temperature, cyclical loading, corrosion, and combined environment can be conducted at customer's request.
VII	Electronic PCB pads are gold plated for corrosion resistance.
VIII	Shock and Vibrations IEC61373
IX	Corrosion ASTM B117
X	Standard O-ring material is Viton. Application specific sealing is available. Changing O-ring at same time as battery is recommended.

## Coming Soon:

- IOS and Android compatible BoltSense App with many advanced features and increased analytics.
- 1+ km range license free radio frequency transmission.
- Elevated temperature system.

