

# LOAD BOLT

## LOAD BOLT SERIES (LB)

-  **±0.25% FSO Uncertainty**
-  **Electrical Isolation**
-  **Transmission Distance**
-  **EMI & Radiation Immune**

Optical strain sensors can be integrated into a bolt to provide tensile measurements through mounting into the center line of the bolt. Requiring only a small hole (typically 2 mm dia.), the strain measurement can be easily integrated into many different bolt diameters and lengths. The Fibos Load Bolt is available in point measurement or daisy chain configuration. Daisy chain does require the fiber to route through the length of the bolt. If using in series with other FBG sensors, a conventional FBG spectrum can be provided and the desired wavelengths for each FBG can be set. If using a PiMS™ (Pi-FBG Measurement Standard) signal conditioner, please select the PiMS™ FBG configuration. Mounting dimensions and alternative cable lengths can be provided upon request.

The performance specifications presented used a signal conditioner that utilizes the PiMS™ technique. Performance with other interrogators is not guaranteed as the interrogator's measurement performance will impact the overall measurement performance.

### APPLICATIONS

Ideal for measurements on large structures, such as bridges, buildings, and wind turbines. The Load Bolt can be used in high voltage and high electromagnetic areas with long transmission distances without signal integrity issues. Typical applications include:

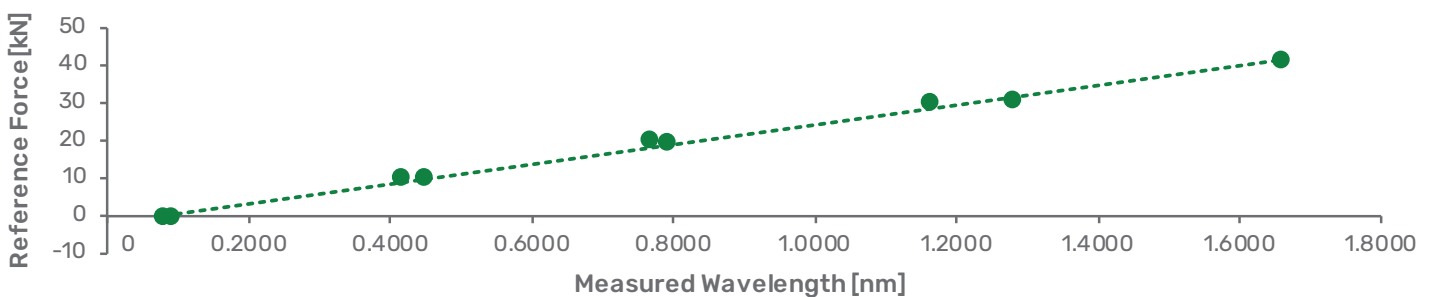
- Structural health monitoring
  - Bridge, tunnel, and other infrastructure monitoring
  - Continuous underwater load measurements
- Wind turbine health monitoring
  - Onshore and offshore pile monitoring

PERFORMANCE	
Transducer Operating Range <sup>1</sup>	-20 to 70°C
Measurement Range	0 to 46 kN
Displacement Sensitivity <sup>1,2</sup>	41 pm/kN
Temperature Sensitivity <sup>1,2</sup>	23 pm/°C
Displacement Resolution <sup>3</sup>	0.0002 kN
Temperature Resolution <sup>3</sup>	0.0004°C
Displacement Uncertainty <sup>4</sup>	±0.05 kN
Temperature Induced Uncertainty <sup>4</sup>	0.57 kN/°C
Optical Sensor Specifications	PiMS™ Compliant or Standard FBG

<sup>1</sup> As designed. Laboratory tested between 0 to 70°C  
<sup>2</sup> As designed. Sensitivity will be provided for each unit  
<sup>3</sup> Based on a PiMS™ compliant signal conditioner with 0.01 pm resolution  
<sup>4</sup> Based on a PiMS™ compliant signal conditioner with ±2 pm measurement uncertainty

ENVIRONMENTAL	
Mounting Method	M16 x 2.0
Dimensions (L x W x H)	M16 x 55 mm
Cable Temperature (OFNP Cable)	-40 to 70°C
Minimum Cable Bend Radius	16 mm
Optical Connector	E2000/APC, FC/APC, or No Connector
Fiber Type	SMF28 Compatible

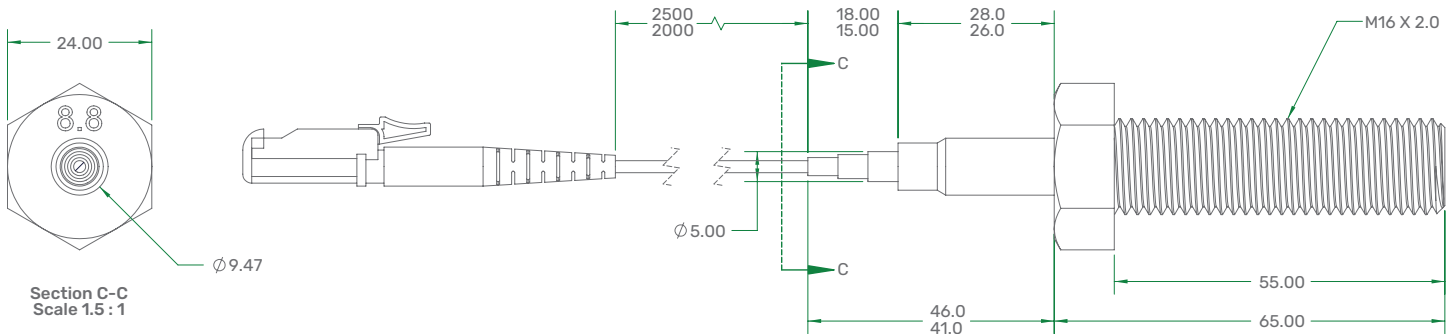
Continued product improvement necessitates that Fibos reserve the right to modify these specifications without notice. With continuous improvement, extensive testing, and conservative specifications, Fibos ensures product reliability expected within the industry.



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Reference drawing provided for model #LB-SPPS-NB1E2



### MODEL PART NUMBER TABLE

LB - \_\_\_\_\_ - \_\_\_\_\_  
 1 2 3 4 5 6 7 8

#### 1. Temperature Range

**S** – Standard (-20 to 70°C)

#### 2. FBG Type

**P** – PiMS™  
**S** – Standard FBG (0.3 nm FWHM, >90% R)  
**X** – Custom

#### 3. FBG Wavelength

**P** – PiMS™  
**1** – 1528.5 nm  
**2** – 1530.1 nm  
**3** – 1533.3 nm  
**4** – 1539.7 nm  
**5** – 1545.8 nm  
**6** – 1552.1 nm  
**7** – 1558.5 nm  
**X** – Custom

#### 4. Bolt Size

**1** – M16 x 2.0  
**X** – Custom

#### 5. Cable Jacket

**N** – OFNP  
**Z** – No jacket  
**X** – Custom

#### 6. Cable Outer Diameter

**A** – 0.9 mm  
**B** – 2.0 mm  
**X** – Custom

#### 7. Cable Length

**1** – 2.5 m  
**2** – 5.0 m  
**X** – Custom

#### 8. Connector Type

**E2** – E2000/APC  
**FC** – FC/APC

### TYPICAL CALIBRATION DATA (LB-SPPS-NB1E2 USED FOR REFERENCE)

Typical Load Bolt Calibration:  
**Angle = Y (FBG1 – FBG2) + B**

Set Temperature [°C]	Reference Force [kN]	DUT Wavelength [nm]
21.0	-0.7	0.1369
21.0	9.8	0.5322
21.0	19.8	0.9112
21.0	29.5	1.3383
21.0	39.1	1.7835
21.0	28.4	1.3407
21.0	18.0	0.8679
21.0	9.8	0.5389
21.0	-0.7	0.1773

### Typical Temperature Calibration

Calibration Temperature [°C]	Temperature Wavelength [nm]
0	1549.878
25	1550.112
50	1550.361
75	1550.624

#### Notes:

- Calibration can be performed via comparison between the device under test and a traceable reference sensor. Calibration above was conducted with a load washer and the load bolt tension applied through a torque wrench.
- Fibos can provide commercial calibration with metrological traceability to the SI. Calibration certificates from accredited calibration laboratories can be provided upon request.
- Calibration data is provided with every sensor produced. This information can be used with a PiMS™ signal conditioner to achieve the specifications listed on the previous page. Performance with alternative interrogators can be provided upon request.

### About us

Developers of a unique optical point sensing platform that can be utilized in a variety of industrial applications.

We design, manufacture, and support customers of the optical platform from our headquarters in Toronto, Canada.

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