

Fiber Optic Smart Bolt

Description

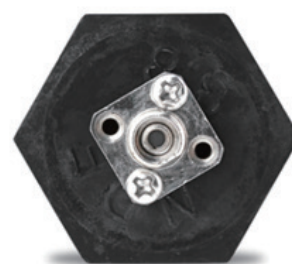
The Fiber Optic Smart Bolt is an intelligent structural component that utilizes Fiber Bragg Grating (FBG) technology to measure internal strain through spectral variations. It enables real-time monitoring of bolt preload, deformation, loosening, fatigue, and other key parameters.

Features

- Passive operation and immune to electromagnetic interference
- Excellent linearity
- High repeatability
- Integrated temperature compensation
- Capable of monitoring bolt loosening and fatigue

Application

- Tower cranes
- Wind power equipment
- Construction elevators and hoists
- Power transmission lines
- Railway tracks
- Signal towers



Specification

Item	Unit	Specification
Linearity between wavelength and torque	%	≥99.9
Strain coefficient of wavelength	pm/με	~1.2
Torque vs. preload relationship	-	Linear
Correlation coefficient of repeated torque-wavelength tests	-	~0.999
Number of Bragg gratings	-	2 (strain grating & temperature compensation grating)
Temperature compensation	-	Yes
Operating temperature range	°C	-40 to +85
Bolt size requirement	mm	Diameter ≥10, Length ≥6
Connector	-	FC/APC (or specified)

Torque (Q) Calculation Formula:

$$Q = \frac{(\lambda_{Q2} - \lambda_{Q1}) - (\lambda_{T2} - \lambda_{T1})}{k_Q}$$

Where:

λ_{Q2} (nm): The center wavelength of the strain grating in the smart bolt under an applied torque Q (N·m) and at an ambient temperature of T_2 (°C).

λ_{Q1} (nm): The center wavelength of the strain grating in the smart bolt without any torque at an ambient temperature of T_1 (°C).

λ_{T2} (nm): The center wavelength of the temperature grating at T_2 (°C).

λ_{T1} (nm): The center wavelength of the temperature grating at T_1 (°C).

k_Q (nm/(N·m)): The wavelength-to-torque sensitivity coefficient of the strain grating, defined as the change in wavelength per unit applied torque (provided by the manufacturer).