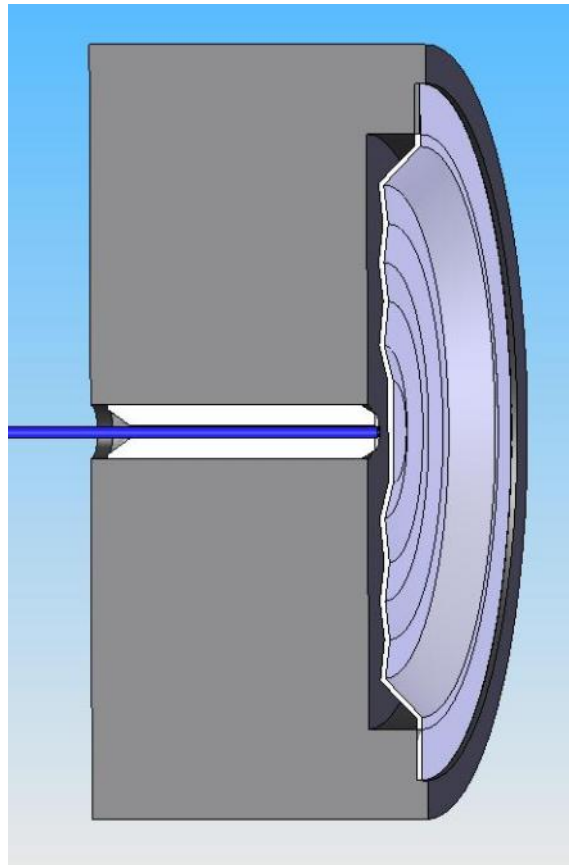


## DavidsonSensors™

### Resolution and Accuracy



### Davidson Fiber Optic Sensing System

- DavidsonSensors™ Measure Temperature, Pressure, Vacuum, Flow, Level, and Vibration
- DavidsonSensors™ Transmit Intrinsically Safe Signals to Passive Fiber Optic Transducers
- DavidsonSensors™ are Immune to Lightning Damage and Grounding Problems
- DavidsonSensors™ are Immune to Electromagnetic and Radio Frequency Interference (EMI/RFI)
- DavidsonSensors™ Operate at 1000°F
- DavidsonSensors™ are Easy to Install and Require Very Low Maintenance

## Resolution and Accuracy

### 1. Introduction

Fiber optic sensing technology offers a number of advantages for measurement in harsh industrial environments. Fiber optic transducers are tolerant to high temperatures, intrinsically safe, and immune to electromagnetic interference. Since many fiber optic transducers can be multiplexed with a single signal conditioner, significant cost savings can be achieved. To realize the full potential of this technology, it is helpful for the user to understand some of the details about resolution and accuracy of the fiber optic sensing measurements. This guide is intended to provide clear definitions of resolution and accuracy and to describe some of the factors that can affect accuracy under field conditions.

For more advanced information to help with the planning of a fiber optic sensing system, see the Davidson Guide to Configuring a Fiber Optic Sensing System which is available at [www.davidson-instruments.com](http://www.davidson-instruments.com). For more detailed technical information about fiber optic sensing systems, see Davidson technical publications at [www.davidson-instruments.com/techpubs.html](http://www.davidson-instruments.com/techpubs.html).

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**System Accuracy** - Specifications for accuracy of Davidson fiber optic sensing systems combine measurement errors due to the signal conditioner, transducer, and cable.

**Signal Conditioner Resolution** - Davidson fiber optic signal conditioners can resolve better than 0.001% of full-scale range of Fabry-Pérot gap displacement.

**Signal Conditioner Accuracy** - The signal conditioners are calibrated with one or more HeNe lasers and calibration instrumentation to provide the highest level of precision through the entire operating range of the signal conditioner. The displacement measurement is accurate to 0.02% over the specified displacement range at 72° F and with a transmission range of less than 1000 feet. The system maintains its accuracy through temperature correction of the output over the specified operating range of temperatures.

**Transducer Resolution** - Transducers are passive mechanical devices and have resolution equal to the signal conditioner used to interrogate the transducer.

**Transducer Accuracy** - Transducers are calibrated using state-of-the-art laboratory grade temperature and pressure references and stable thermal and pressure environments. Calibration constants provided with each transducer provide correction for thermal sensitivity and non-linearity. The transducer specifications define the accuracy of specific devices.

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# INSTRUMENTS

Resolution and Accuracy

**Other Factors** - Several other factors can affect the overall system accuracy.

**Cable Length** - Very long transmission distances, i.e. in excess of 1000 feet, are possible with the system but may result in slight shift in the measured value due to spectral losses. When absolute precision is required in applications that involve long runs of fiber, a special field calibration can be performed to bring all readings back into specification.

**Cable Losses** - Optical circuits incur losses over the entire length of the optical circuit due to mechanical connectors, fusion splices, microscopic defects in the fiber, bending losses, mechanical strain, thermal conditions, etc. Davidson fiber optic systems are insensitive to these losses and can operate with up to 6dB of loss. If the loss in the optical circuit exceeds 6dB, the signal level may be too low to maintain system accuracy. Adjustments can be made to offset some of the losses as defined below.

**Update Rate** - The update rate can be increased or decreased with some affect on system accuracy. Slower update rates increase accuracy or allow the system to operate effectively with

reater than 6dB loss. Fast update rates reduce integration time and signal averaging and can decrease system accuracy.

**Optimizing the System** - At the time of commissioning, Davidson tests the cable systems and optimizes the system setup parameters to balance the need for accuracy, update rate, and host process control requirements for communication.

**Thermal Correction** - Davidson pressure transducers can operate over a much greater range of temperatures than conventional electronic transducers. For most high temperature applications, Davidson fiber optic sensing systems make corrections to maintain high accuracy of the pressure readings over the full range of thermal operating conditions.

**Thermal Gradients and Transients** - In a rapidly changing thermal environment or where the transducer is subject to a significant thermal gradient, the system error may exceed the system specifications. Once the transducer has reached thermal steady state, the accuracy of the system should return to specification.

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