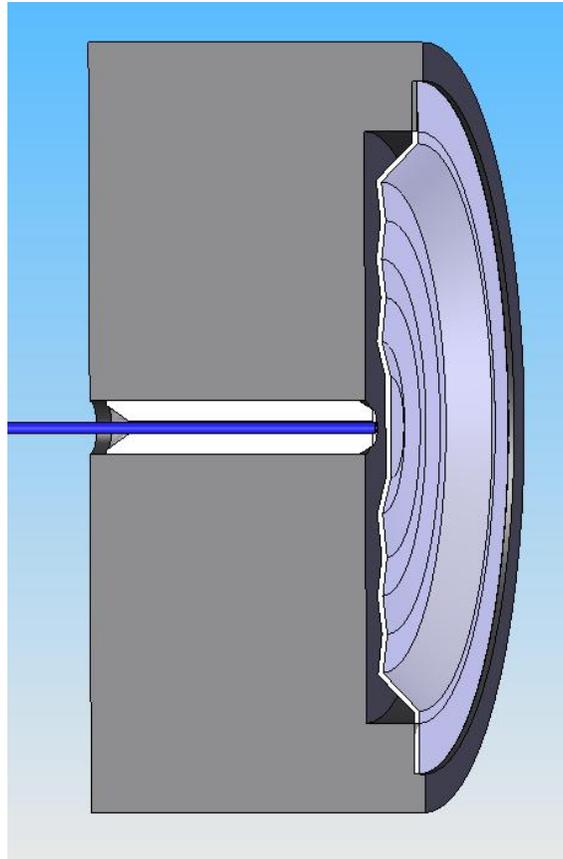


DavidsonSensors™

Resolution and Accuracy



Davidson Fiber Optic Sensing System

- DavidsonSensors™ Measure Temperature, Pressure, and Force
- 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 multichannel 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 website at www.davidson-instruments.com.

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 finer than 0.001% of the full-scale range of its signal conditioning interrogator.

Signal Conditioner Accuracy - Davidson fiber optic signal conditioning interrogator are calibrated with a spectrum analyzer to 0.01% of the full-scale range at 72° F and at a transmission range of 100 feet. The interrogator maintains its accuracy through temperature correction of the output over the specified operating range of temperatures.

Transducer Resolution - Transducers are passive analog mechanical devices and have resolution equal to the interrogator used to interrogate the transducer.

Transducer Accuracy - Transducers are calibrated using state-of-the-art laboratory grade temperature and pressure references in 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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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 error in accuracy due to short wavelength spectral losses. When high accuracy is required in applications that involve long transmission distances, a special calibration can be performed to reduce the error for a specific set of transmission ranges.

Cable Losses - Optical circuits incur losses over the entire length of the optical circuit due to mechanical connectors, splices, microscopic defects in the fiber, bending losses, mechanical strain, thermal conditions, etc.

Davidson's interferometric fiber optic systems are insensitive to these losses and can operate satisfactorily 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. Other system adjustments can be made to offset some of the errors due to losses as defined below.

Sampling Rate - The sampling rate can be increased or decreased with some affect on system accuracy. Slow sampling rates (long integration times)

increase accuracy when making static measurements and can allow the interrogator to operate effectively with more than 6dB loss. Fast sampling rates (short integration times) reduce integration time 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 vs sampling rates for the application.

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 interrogators make independent temperature measurements that allow thermal corrections to be made 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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