

## Application Note:

# Why Is My Sensor Out of Tolerance?

## Introduction

Coherent sometimes receives inquiries from customers asking questions or statements such as:

- “Why is my sensor or meter out of tolerance?”
- “What can I do to prevent this from happening again?”
- “Because of this, I must now draft non-compliance documentation for the FDA.”

To answer such questions, you must understand many aspects about the sensor. Some of these take reflection about the internal processes and operations within your company. This document offers information to assist you in answering questions relating to:

- Care and handling of sensors
- Regular calibration
- Application conditions
- Understanding calibration uncertainty
- Exposure Level
- Normal aging of equipment

## Care and Handling of Sensors

One of the most important factors in the continued as-designed operation of your equipment is how the instrument is being handled. See details in the Application Note titled “Care and Handling of Sensors”. To summarize, the temperature, humidity, and storage conditions play important roles in the accuracy and life of a sensor.

Some questions about your company’s processes address conditions that can alter the coating over long periods of time and normal use, such as:

- “Is the sensor covered when not in use?”
- “Is the sensor kept free from contaminants?”
- “Is the sensor or meter handled with care or has it seen a number of drops and cord pulls?”

## Regular Calibration

Regular calibration schedules are important. Coherent verifies the condition of your equipment when it arrives for calibration. We center the tolerance when needed, which can be an adjustment even when the sensor is not out-of-tolerance upon receipt. This process guides the equipment into a safe area of its tolerance.

You determine your calibration schedule; however, some questions to ask might include:

- Are you regularly calibrating at a two-year cycle?
- If the equipment undergoes hard treatment, is this the appropriate interval at which calibration should be done? Should you increase the frequency of calibration?
- Do you find that the equipment is regularly out of tolerance?

## Application Conditions

If you have a sensor that is being used to the extremes of its range of operation, then you can expect a sensor to fall out of tolerance in its life time. For example:

- If you use a PM10 sensor and regularly measure power levels of 30W, you can expect that—over time—this will degrade the coating faster than if you were using that same sensor to measure power levels of 10W.
- If your usage model includes beam diameters that exceed the damage threshold (that is, too small of a spot size), you can expect to see the sensor drift over time. Small spot conditions can also be created by moving a sensor through a focal point unintentionally when trying to place the sensor in its measurement location.
- If you use DUV wavelengths, the coatings will bleach over time and could be a factor for out-of-tolerance conditions.

## Understanding Calibration Uncertainty

It is important to understand the uncertainty level inherent in Coherent's calibration process. There are some additional Application Notes to help you understand this process:

- "Understanding the Certificate of Calibration"
- "ISO 17025 Whitepaper"

## Exposure Level

If and when your sensor falls out of tolerance for any reason, it is important to understand the value that is out of tolerance.

In many cases, it may be that your sensor is being called out-of-tolerance by 1mw. This is the exposure level, and means this is the potential error induced in previous readings that were taken. Although 1mw out of tolerance is a small factor, that may or may not be an important issue for you.

A sensor that is out of tolerance by 1mw is likely a condition (however unfortunate) of simply regular operations. On the other hand, a sensor that is out of tolerance by several percent is more likely an indication of a shift or change in the coating. That may be an indication of an event like a spill on the coating and the Responsivity shifted.

## Normal Aging of Equipment

Coherent has sensors that have been calibrating the same unit with the same element for 20+ years and has never fallen out of tolerance. However, Coherent also has sensors that are just as old and, for some reason, has fallen out of tolerance after only 5 years. This does happen, and can be caused by many factors.

## Summary

Look at your situation to determine what is best for you. If you find that you are regularly having sensor out of tolerance, then there may be some action that we can take. You may want to consider increasing the frequency of calibration. We may need to look at is this the best sensor for your application, is the process that you are measuring fall in the middle of your sensors operating range? You may decide that you need to purchase an additional sensor to create an internal golden standard so that you can have your operator check the accuracy daily against a working standard to ensure that you are always using a device that you are certifying before measurements.

## Contact Coherent

For additional information, contact Coherent Technical Support as follows:

- Contact your local Coherent Service Representative (or visit [www.Coherent.com](http://www.Coherent.com) to view a list of contacts worldwide)
- Send an e-mail to: [LSMservice@Coherent.com](mailto:LSMservice@Coherent.com)
- Call the Coherent Technical Support Hotline
  - Within the USA: 1-(800)-343-4912
  - Outside of the USA: 1-(408)-764-4042

For additional information about **sensor products**, go to:

<https://www.coherent.com/measurement-control>

To download the **current software** for sensor products, go to this link and scroll down to the Software, Drivers & Manuals section:

<https://www.coherent.com/measurement-control/measurement/laser-measurement-and-control-help-center>