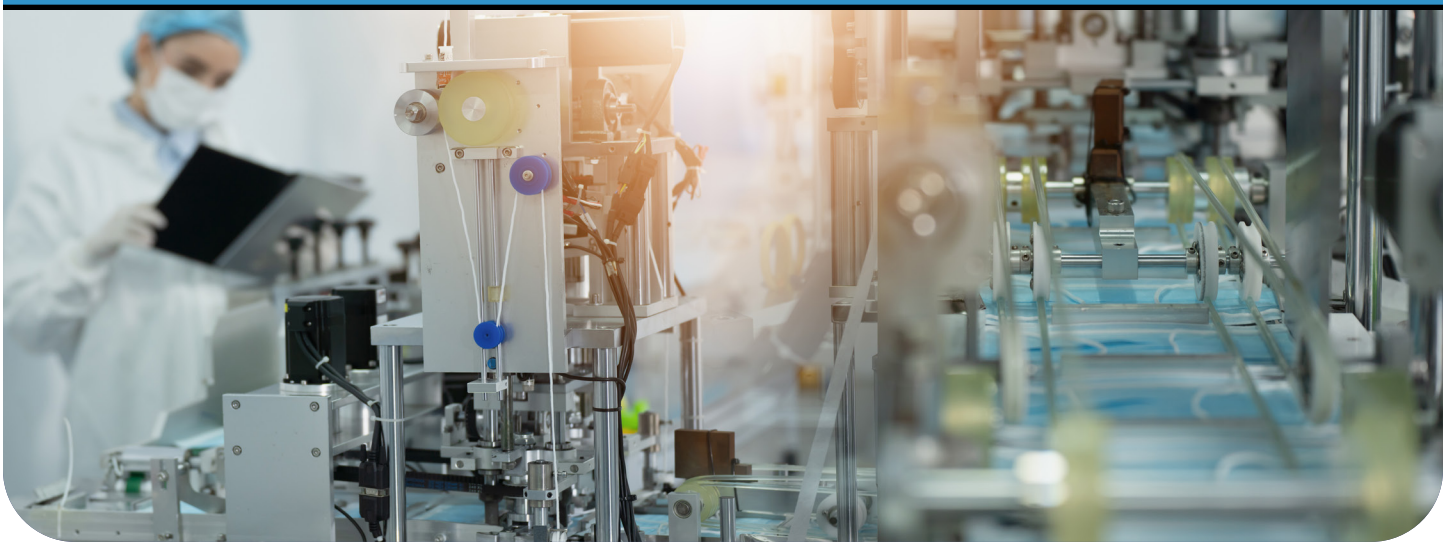
# How to Avoid Product Recalls with Inline Measurement



*Product recalls can be extremely costly for businesses because of the direct expenses associated with the recall itself and the potential damage to the company's reputation. It's hard to underestimate the importance of product quality because the reputation of a reliable brand is hard to earn and easy to lose. And that is even before factoring in the additional cost of the product recall and replacement. All these factors make assurance of product quality before the sale crucial.*

In this article, we will explore how inline measurement can help businesses avoid product recalls and maintain high levels of quality control. In addition, the article will help you understand why and how to incorporate inline measurement into your quality control, focusing on spectroscopy.

## The Importance of Quality Control

Quality control is a critical aspect of any manufacturing process. Without proper quality control measures, products can be produced with defects or inconsistencies, leading to product recalls or other quality issues.

For example, assuring the quality of pharmaceutical products before they are distributed to the customers is vital. Pharmaceutical products directly impact human health and can incur legal consequences that outweigh any costs of quality checks and production destruction in case of anomalies.

### Manual versus Automatic Quality Control

The measurements of the parameters of all components of the final product – for example, their shape and dimensions within the tolerances – were traditionally done by the quality control operators or "offline." The offline testing also applies to pharmaceutical products where each batch of the final compound is tested.

Manual quality assurance constrains the number of products that can be processed in the available time and introduces the possibility of human error multiplied by the number of parts. Even a highly experienced quality assurance operator can be distracted for several reasons. Offline quality control also incurs additional costs

associated with human labor, such as training and sick leave.

Inline measurement is a process used in manufacturing to check the quality and consistency of products as they are being produced. It involves using sensors and other measurement technologies to collect data on various aspects of the production process, such as temperature, pressure, and material thickness. This data is then analyzed in real-time to ensure the product is produced to the required specifications. As a result of inline product quality control (PQC), product rejection can be automated, thus saving on the cost of downstream process adjustments and ultimately preventing product recalls.

The cost of product quality control rises proportionately with an increasing product volume in manual and automatic PQC. While the initial capital investment for Inline PQC can be higher than for offline, producers will recoup their investment quickly with higher production rates and fewer rejects. Furthermore, using Inline PQC significantly diminishes the problem of measurement consistency across time and different production lines and factories, which is vital for any manufacturer, but especially for a brand striving to be global.

The Inline PQC also allows the collection of data about product quality and key parameters and - if the product is repeatedly measured outside the required parameters - to shut down the production line automatically. The automatic shutdown minimizes raw materials loss and energy wastage. Inline PQC also allows you to ascertain the cause of the quality deterioration, further reducing the cost of the upstream parts and materials and utilizing substandard production.

### To summarize:

- Using Inline PQC prior to the final Offline PQC removes one of the bottlenecks of high volume parts production, as human productivity always needs to catch up to the productivity of an automated manufacturing line.
- The automatic measurements also allow product sorting within the product parameter tolerances but may be used in downstream applications that are less sensitive to the precision of the part parameters.
- The Inline PQC allows product sorting.

An example of inline measuring would be a system with sensors installed along a production line to monitor products moving below it continuously. The process of automatic measurement is as follows:

- Measuring a target as it passes the sensor.
- Registering dimensions and shapes (within a tolerance range) to determine whether a product is acceptable.
- Conducting acceptance testing.
- Evaluating the results of the assessment when a product is deemed unacceptable.

However, depending on the objective, Inline PQC doesn't need to be a sophisticated system of sensors. Often a simple spectrometer that measures quality at the source can prevent product recalls.

## Types of Inline Measurement Technologies

Several inline measurement technologies can be used to monitor and control the production process:

### Non-Contact Sensors

Non-contact sensors use optical, ultrasonic, or other technologies to measure aspects of the production process without physically touching the product. The absence of contact can be critical when physical contact could damage the product or cause contamination.

### Contact Sensors

Contact sensors use physical contact to measure aspects of the production process. This type of sensor can be employed when non-contact sensors may not provide accurate measurements or where physical contact is necessary to control production.

### Temperature and Pressure Sensors

Temperature and pressure sensors can be used to monitor the temperature and pressure of the production process. This can be useful in situations where temperature or pressure can affect the quality of the final product.

### X-Ray and Imaging Technologies

X-ray and imaging technologies can be used to inspect the internal structure of products and detect any defects or inconsistencies. Determining the internal structure can be particularly useful when defects are not visible from the outside.

### Spectroscopy

Spectroscopy is a technique that uses light to measure the chemical composition of materials. It can be helpful in situations where it is crucial to monitor the chemical composition of a product, such as in the food and beverage and pharmaceutical industries. The non-destructive nature of the spectroscopic methods makes them some of the most widely used inline quality control methods with applications ranging from the microchip etching PQC to determining the titer of the microorganism in the food sample.

Inline quality control, specifically spectroscopy, is invaluable in the pharmaceutical industry. Pharmaceutical manufacturing must comply with Good Manufacturing Practices (GMP). The compliance requires that tests and other manipulations do not change the chemical composition and/or amounts and ratios of the compounds in the manufacturing process.

For example, Raman spectroscopy (RS) collects detailed information about the composition of pharmaceutical compounds and can detect possible contaminants.

Here are a few examples of how Raman spectroscopy (RS) is used in quality control:

- Pharmaceutical industry: RS identifies and quantifies active pharmaceutical ingredients (APIs) and excipients in pharmaceutical products. It can also detect impurities or contaminants that may affect the quality or efficacy of the drug.
- Polymer industry: RS can identify and characterize polymers, including their chemical structure, molecular weight, and degree of crystallinity. This information can be used to ensure that polymers meet specific quality standards and performance requirements.
- Food industry: RS can analyze food products for their nutritional content, flavor, and quality. For example, it can quantify the levels of key nutrients, such as vitamins, amino acids, and fatty acids.

## Inline Measurement using Spectroscopy

Using spectroscopy in your manufacturing process can prevent product recalls by providing real-time monitoring and analysis of the production process. Here are some steps to avoid product recalls using this technology:

- Establish Quality Specifications: Set precise quality specifications for your product, such as acceptable levels of impurities or the concentration of certain ingredients.
- Choose the Right Spectroscopy Technique: Choose the appropriate spectroscopy technique (e.g., Near-Infrared, Mid-Infrared) that can measure critical quality attributes in real-time during manufacturing.
- Develop a Calibration Model: Develop a calibration model that relates the spectral data to the desired product specifications. This calibration model should be based on a sufficient number of samples representing the range of variation in the product.
- Implement Real-Time Monitoring: Use spectroscopy equipment to measure the spectra of the product in real-time during the manufacturing process. Continuous data collection allows quick detection of deviations from the established quality specifications.
- Analyze Data and Take Action: Analyze the spectral data to determine if the product meets the established quality specifications. If the product is out of specification, take immediate action to correct the issue before continuing with production.

## Summary

The use of inline measurement technologies can provide several benefits for businesses, including:

### Improved Quality Control

By providing real-time feedback on the production process, inline measurement can help businesses maintain high levels of quality control and reduce the likelihood of defects or inconsistencies in the final product.

### Reduced Waste

By detecting any issues early in the production process, inline measurement can help businesses reduce the amount of energy used and waste produced. Waste reduction can lead to cost savings and a more efficient production process and increase business sustainability.

### Increased Efficiency

Inline measurement can help businesses identify and fix issues quickly, reducing downtime and increasing the efficiency of the production process.

### Cost Savings

Inline measurement can help businesses avoid costly product recalls and other quality issues by reducing the likelihood of defects and inconsistencies in the final product.

**Spectroscopy** is a simple and reliable method of inline and offline product quality control. It is uniquely positioned as an add-on to the existing production line and has some surprising applications that probably include yours. Using spectroscopy, you can detect and correct quality issues quickly.

Our company technical specialists would be happy to discuss the needs of your business. **Let's talk** about solutions that will improve the consistency of your production and prevent product recalls.