

Fill Level Monitoring for X-Ray Inspection

A PRACTICAL GUIDE



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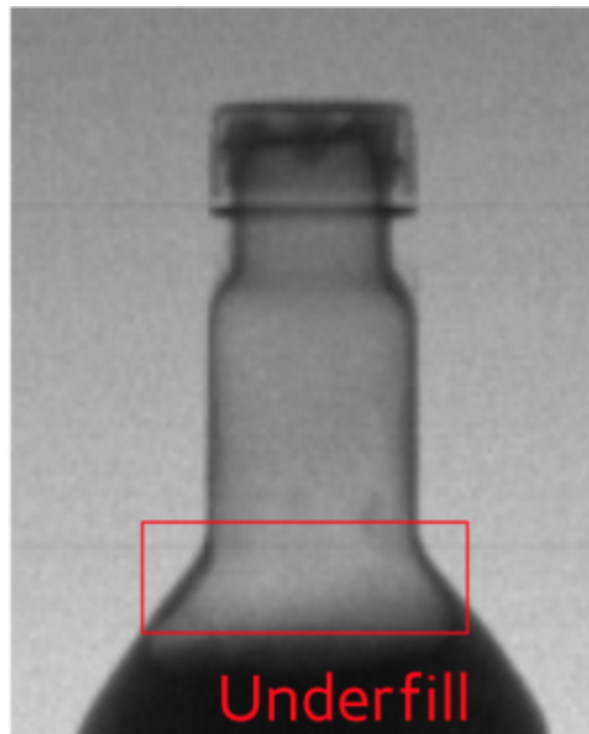
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Fill Level Monitoring for X-Ray Inspection

Purpose of This Document

This document provides prospective purchasers of fill level inspection equipment a good understanding of the technical solutions available to measure the fill height in food and beverage products. This white paper covers both classic fill level monitors as well as more modern full container x-ray solutions, that not only give a much more accurate measurement of fill level but can also provide an extremely accurate assessment of how much product is actually in a container. Full container x-ray systems can also provide insight into why a container is under-filled (such as a case where there is a hole in the container and product is leaking out).

Types of Fill Measurement Solutions and How They Work



There are 2 basic types of automated fill measurement solutions to measure the fill level in a container: 1) a classic fill level monitor and 2) a full container x-ray machine.

Fill level monitors have been available for decades and operate by generating a narrow beam of radiation that is positioned right at the desired fill height of the container being measured. If the container is properly filled, the radiation beam is blocked or significantly retarded by the product itself. If the fill level is low, a greater level of radiation hits the detector and hence triggers a low fill measurement.

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Two Types of Fill Level Monitors

Gamma Sourced

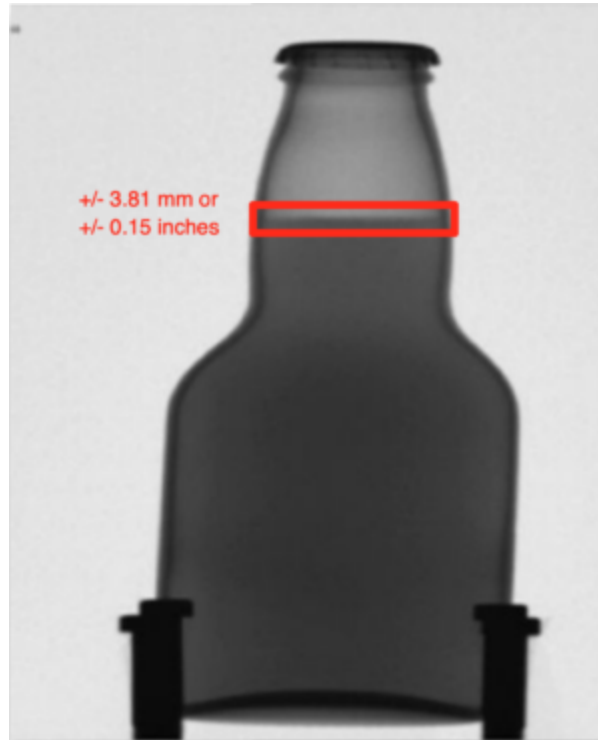
There are 2 general types of fill level monitors: 1) gamma sourced and 2) x-ray sourced units. Gamma sourced units produce radiation from a persistent source of radiation called Americium. The benefit of gamma units is that they are exceptionally simple and the radiation source never wears out. A device called a shutter prevents the machine from emitting radiation when not in use. The primary drawback of this persistent radiation source is that it has a greater regulatory burden than other solutions and in some locations, the regulatory requirements are quite high. Customers must periodically have their gamma fill level monitor tested for radiation leakage and the fill level monitor cannot be moved without completing the appropriate regulatory paperwork. Finally, should the customer decide to discard the fill level monitor special source disposal fees are incurred. Importing gamma sourced fill level monitors into various countries can also be extremely challenging (which is why x-ray sourced systems tend to be the preferred approach for many of our international customers).

X-Ray Sourced

X-ray sourced fill level monitors use an electrically powered x-ray tube as a radiation source. These systems generally require much less permitting and have no conditions on shipment or placement – the reason for this difference in regulatory treatment is that an x-ray tube only produces radiation when it is turned on (i.e. powered by electricity). When an x-ray tube is powered off, it is inert and harmless. One trade-off with electrically powered x-ray tubes is that they do not have a finite life span (and last about 20,000 hours of operational use).

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Accuracy of Fill Level Monitors



Fill level monitors can measure fill level down to about +/- 0.75 mm (+/- 0.03 inches) for cans containing liquid. Glass containers require a slightly wider aperture and hence have a greater error band (about +/- 3.81 mm or +/- 0.15 inches). Full container x-ray systems have a resolution down to 0.8 mm and that accuracy does not vary by application type.

Fill level monitors also have limitations on the band of product that they can see when measuring for both underfills and overfills. This band is about 30 mm or 1.18 inches (Jeff we need a better explanation for this behavior). Measurement over a wider band can require either a dual source fill level monitor or two separate fill level monitors. On the other hand, full container x-ray systems do not have any kind of limitations on measuring headspace, overfills or underfills since they take an image of the entire container.

Solids Fill Verification

In many applications, there is a solid dry fill done prior to adding liquid and then final container sealing. For such applications, the line speed is generally quite high making an accurate check-weigh of the solid fill extremely difficult; a more practical approach is to use a fill level monitor with a wide aperture as it can detect the solids fill level and use that as a proxy for actual weight. This approach is widely used and is about 10% of the cost of a high-speed check weigher.

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Filler Valve Monitoring

A useful option of on fill level monitoring systems is filler valve monitoring. Filler valve monitoring allows the fill level monitor to provide detailed fill statistics on each valve on a filler, which can greatly facilitate filler maintenance.

ATEX Rating

For explosion sensitive environments, fill level monitors are commonly available with ATEX certification. ATEX certification is an elaborate process with many levels of certification. Thus it is important to select the right machine for your specific application.

Note that full container x-ray machines, by nature of operation are much more difficult to make ATEX compliant and even when they are compliant, it is only for the lowest level of certification for the least demanding environments.

Ejection Options

Peco manufactures a wide array of ejector options for a variety of fill-level applications, including the following

Standard "Pusher" Ejector: These are the simplest ejection option consisting of a pneumatically activated ram that pushes the container off of the conveyor. These ejectors are extremely reliable and are exceptionally durable. They work best for closed rigid containers but can be used for other rigid or semi-rigid packages that can absorb the ejection force without being damaged.

Soft Touch Ejector: Soft touch ejectors are designed to very gently remove a container from the production line. They work by using a set of successive fingers that incrementally push the container. Soft touch ejectors are useful for unstable containers that tend to fall over or open containers that will spill if hit with too much ejection force. The drawback of soft-touch ejectors is that they are complex and can be expensive to repair.

Soft Touch Diverter: The soft touch diverter is similar in concept to a soft touch ejector except that a diverter is much simpler mechanically. A diverter uses a slat or series of slats to simply guide a container from one the main conveyor onto a reject conveyor (the takeaway conveyor then assures that ejected containers do not contact each other).

Speed Capabilities of Fill Level Monitors

Fill Level monitors are high-speed devices and can generally operate at speeds above 2,200 cpm. Fill level monitors generally do not require any container spacing between consecutive containers for a proper inspection.

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Safety of Fill Level Measurement Equipment

Fill level monitors are low power devices and are designed not to emit any stray radiation that can harm humans. The only radiation released is in the aperture of the device where the container passes. In some locations, the units must be guarded to prevent any accidental contact with the fill level monitor. Peco InspX can provide special shielding for these installations, but the shielding is not broadly required.

Day to Day Use Of the Fill Level Monitors

Fill level monitors are very easy to configure and operate and plant personnel can be quickly trained to use the machines. A "recipe" is created for each product and the height of the unit is then adjusted to match the desired fill level on the specific product. A precision height adjustment mechanism allows precise changes of fill level monitor height during changeovers.

Peco InspX fill level monitors also have Peco's real-time online support capability. This capability allows Peco service engineers to access all machine functions and conduct any machine adjustment in real-time without the added expense (and time delay in solving a problem) of a service visit. These remote diagnostic tools are a significant advantage – all the customer needs is to plug the machine into an active internet connection.

Cost of Ownership and Maintenance of Fill Level Monitors

Fill Level monitors are simple devices that should last a very long time. Gamma units need periodic radiation wipe tests every 3 years and occasional preventive maintenance on the shutter unit itself. X-Ray units do not require regular preventative maintenance but they do require periodic replacement of the x-ray tube.

Getting More Information

For professional assistance with your fill level needs, please reach out to a [Peco InspX](#) application engineer for more information.

About Peco-InspX

Peco InspX Corporation and InspX Corporation are leading providers of advanced technology inspection solutions for the food and beverage industries. With headquarters in San Carlos, CA, the company serves customers around the world and inspects over 120 million food and beverage containers daily. The company specializes in accurate high speed package inspection in machines that are easy to use with a low cost of ownership.

About Rich Cisek

Rich is the CEO of Peco-InspX. Rich is a serial entrepreneur with strong track record in start-ups and leveraging innovative approaches for large organizations, including IBM, Comcast, AOL and Lockheed Martin. Well-rounded general manager with material experience in senior leadership roles in engineering, marketing, business operations, product development and business development. Data-driven decision maker with extensive expertise in developing analytical models to solve intractable business problems. Coaching-oriented leadership style that inspires team members to get the right things done fast.