One Way Glass Bottles for Beverages

Additional inspection directly before filling is becoming standard

by DR. MARKUS GRUMANN

After a period of decline, glass as a container material for beverages has experienced a strong upswing in recent years. More and more frequently, the control of glass bottles "only in the glassworks" is no longer enough. The solution is to extend inline inspections in the bottling line to include empty glass inspection directly before filling, supplemented by filler monitoring (both as CCP as part of an HACCP concept).

Compared to reusable glass for beverages, one-way glass offers a significantly greater variety of shape and decoration. In addition, the types of defects differ considerably from those in returnable glass. The ideal empty bottle inspector should therefore, in addition to being highly accurate and reliable in terms of defect detection, be able to inspect even the smallest containers and also non-cylindrical glass bottles, in order to be prepared for the future.

Reasons for the one-way glass inspection at the filler:

- declining quality efforts of the glassworks
- resorting to glassworks from abroad (Eastern Europe) with significantly lower quality standards due to the high demand in the market
- Documentation of the quality deficiencies of the glassworks for the purpose of quality improvement or recuperation
- Increasing demands of the bottler's customers, especially at the POS or in the export market
- Possibility to reduce costs: less loss of product and packaging, less downtime
- Avoidance of image loss due to defective products in the trade or even through public recalls
- (www.lebensmittelwarnung.de)

Away from PET, towards glass - it is not presumptuous to speak of a trend reversal in the matter of containers for beverages! While glass lost market shares compared to other container materials, mainly PET, for a long time, glassworks have been recording sales growth for years now, in 2020 even despite Corona. (1)

The trend towards glass, with the attributes of sustainability and purity, are giving the glass manufacturers full order books and exacerbates the conflict between achieving production figures on the one hand and quality specifications at the cold end on the other.

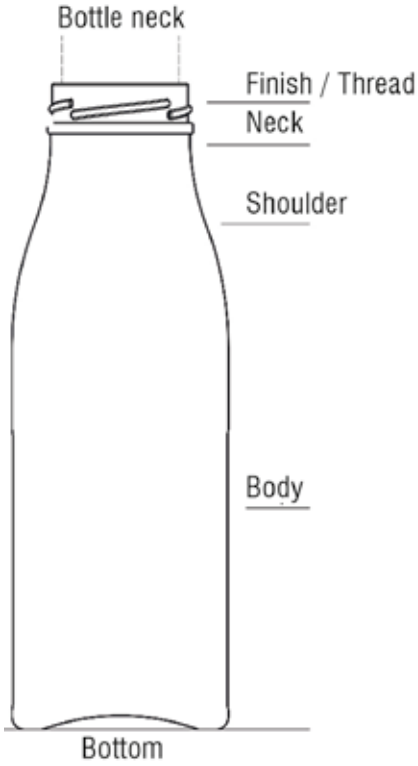
Adding to this for the bottler is the risk of damage to or contamination of glass bottles during transport. And finally, the retailers' demands on product safety, as the buyer of the products, are rising year after year. Conversely, the reliable inspection of the empty bottles enables the beverage producer to document quality defects as his basis for negotiations with the glass supplier for the purpose of recuperation or of motivating to improve quality.

The following article is limited to the inspection of empty bottles for one-way glass in beverage bottling. In combination with modern monitoring of the filler and the capper, the bottler has the guarantee that the filled products are free of glass container related faults, according to the current state of the art and the assessment of the author.

The types of defects in one-way glass

From the point of view of the manufacturer of inspection machines for glass containers, the faults in one-way glass are classified according to the severity of the risk posed by the defect. Secondly – in purely technical terms – according to the position of the defect and the possible detection strategy.

There are countless classifications of defect types, all of which have in common the requirement that container defects that pose a health risk to the consumer are rated as critical.



Location	Critical defects
Finish	Overpressed finish Stuck plug Sugary top / Sugary bore Ring finish damage High top
Neck & Shoulder	Choked bore Glass membrane
Body	Stuck glass Flanged joint Internal contamination Tramp glass Fused glass inside
Bottom	False bottom Spike
General	Birdswing

Figure 1: Critical glass defects and their occurrence, according to the CETIE Institute.

Critical defects are best classified by the location of the defect. The CETIE Institute (3) gives a clear specification of critical defects that can occur along the glass container (from the top to the bottom), see Figure 1. There is an accumulation of faults in the upper area of the container, which, for example, is manufactured with a thread structure for the closure.

The following picture gallery shows examples of one-way glass defects classified as "critical" in the upper area of the bottle (Figure 2). All defects of this type can be reliably detected with the miho David 2 empty bottle inspector from miho Inspektionssysteme GmbH.

For the technology of the inspector, it is very important whether the glass container has a circular shape or has a shape that deviates from circular.

There are plenty of oval, square and one-sided flattened glass containers around. The Inspection of the bottle base or the body of the bottle via the miho David 2 is nevertheless ensured.

The lower area of the glass container

To be able to detect glass fragments on the bottom of the container in particular, some manufacturers now use X-ray technology. The use of this technology, however, is fraught with hurdles such as compliance with special approval procedures and fire protection regulations or the appointment of a radiation protection officer. The follow-

Figure 2: Examples of critical defects in the top area of glass bottles: Finish, thread area and transition to the neck area. Defects of this type can be reliably detected and rejected with the miho David 2 Empty Bottle Inspector.

Classification of new glass defects according to the risks involved, according to American Glass Research[2]:

- **Critical defects**, which primarily lead to a risk to the consumer.
- **Functional defects** that can lead to failures in the subsequent process, e.g. bottle breakage
- Impairment of **stability**
- Increase in internal stress
- **Cosmetic defects** that do not affect the function of the product

up costs with regard to X-ray generators and image converters are not to be neglected.

In addition, there is the worldwide organic trend (for example, www.bio-mineralwasser.de) with the consequence for the bottling plants to stay away from using ionising X-ray radiation.

The ideal inspector of the empty one-way glass bottle in the filling line

In a performance range from approx. 20,000 containers per hour filler output, one cannot ignore the concept of a linear inspector with lateral belt guidance as the central part of the unit. The equipment manufacturer should be aware of the special demands of beverage filling and have the necessary experience.

With a modern empty bottle inspector like the miho David 2 in the version for glass containers, the detection possibilities for one-way glass faults are great and offer additional security after the final inspection in the glassworks, see figure 4.

However, even a linear machine such as the miho David 2 with the lateral belts for the base and neck finish inspection reaches its limits when the container deviates significantly from the circular shape. Because then the 90° rotation of the container in the area of the lateral belts is no longer possible - a prerequisite for the 360° sidewall inspection. In the case of complex bottle shapes, special turning mechanisms are required that are established and can be used depending on the project's requirements, see figure 3.

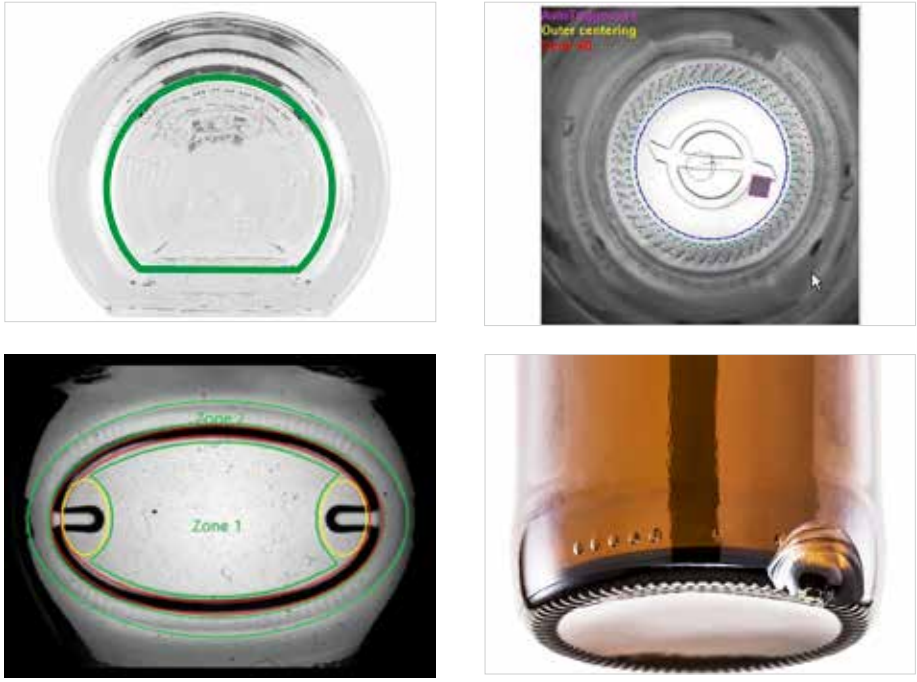


Figure 3: Empty bottle inspection in the lower area of the glass container: Here, the shape of the glass container poses a particular challenge if it deviates from a circular shape or has embossing. If the inspection of the empty bottle is positioned in front of the rinser/filler, the bottles are dry which is advantageous for the base inspection: a sharper defect detection with acceptable false rejection is then possible.

Inspection of empty glass bottles with decoration

Decorations such as ACL (applied ceramic label) or "direct digital print", pose an additional challenge to empty bottle inspection. There seems to be no limit to the variety of decorations. The art of the sidewall inspection is to distinguish between the structures of the decor and soiling or damage.

Especially for such glass bottles, where the identification of a defect has to be carried out highly dynamically, miho

Figure 4: The miho David 2 empty bottle inspector from miho Inspektionssysteme GmbH in three different device configurations, suitable for inspecting glass containers.

Inspektionssysteme offer the sidewall inspection also in the areas with décor via its OpAL (optimized allocation logic) software. Miho OpAL not only works with decor such as printed motifs (ACL), but also for special features such as embossing or a relief structure.

Inspection of the smallest containers

Actually paradoxical: the smaller the container, the greater the inspection difficulties! With the innovative XS variant of the David 2, miho is now able to inspect empty glass containers down to 65 mm container height and 30 mm container diameter and nominal volumes down to 50 ml, see figure 5!

In order to ensure clean bottles of this small size, a special drive and transport concept for the empty bottle inspector was designed, which, on the one hand, enables the bottles to be safely transported inside the machine, and on the other hand, ensures the inspection of the sealing surface and the bases of the bottle to be as accurate as possible.

An investment that pays off

Many bottlers of beverages in one-way glass bottles do not yet have a monitoring device to check the integrity of the bottles before filling. From the point of view of quality assurance, the inspection at the glass manufacturer alone will not be enough in the long run. The good thing is that an investment in empty bottle inspection brings commercial advantages.

Figure 5: A one-way glass bottle with a nominal volume of 60 mL and a blister in the base. This defect is reliably detected with the XS version of the miho David 2.

Yes, it pays off!

In a current project with a sparkling wine bottler the calculated ROI (return of investment) is less than two years, even though the bottling capacity is less than 20,000 bottles/hour and the annual filling hours is less than 1,000 hours.

The miho David 2 empty bottle inspector is designed for the inspection of one-way glass bottles before filling. It is based on robust and well-established technology and has been further developed following the market requirements for more than two decades.

For bottlers of shots, smoothies or spirits, the machine is just as perfectly suited as for the food sector (baby food, jam...).

The Author

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Defects in glass bottles, apart of increasing risks related to safety, can lead also to glass breakage. Inclusions, blisters, cracks, etc. in certain conditions, compromise the resistance of the container to loads – such as impacts, internal pressure, vertical load or thermal shock. One can experience breakages on the filling line, and sometimes also the so called delayed breakage – in package cases, transport, even in trade. This regards every type of container, including lightweighted bottles in companies that make efforts towards sustainability

Yes, in such cases we can analyze the breakage reason and file claims. Still, wouldn't it be a best practice to – avoid occurrences of filling line stoppage or pallets of ready to ship bottles/jars flooded with product from broken packaging? And to collect the defective, but still unbroken bottle from the machine's reject bin, to act as evidence of the saved efficiency, along with data from the inspection systems showing how many containers had to be rejected?

Reliable inspection machines are key in modern filling processes, along with attention to forces acting on our bottles and the understanding of glass properties.

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Commercial advantages of an empty bottle inspector in a one-way glass filling line
Avoid loss of product
Avoid loss of container and closure
Refund from claims to glass suppliers
Away from visual inspection
Reduced staff assignment
Reduced down time due to line-stops