John Victor*, a product specialist and machine vision expert for Emhart Glass, explains the importance of machine vision technology in the inspection of critical defects in glass.

A vision of the future

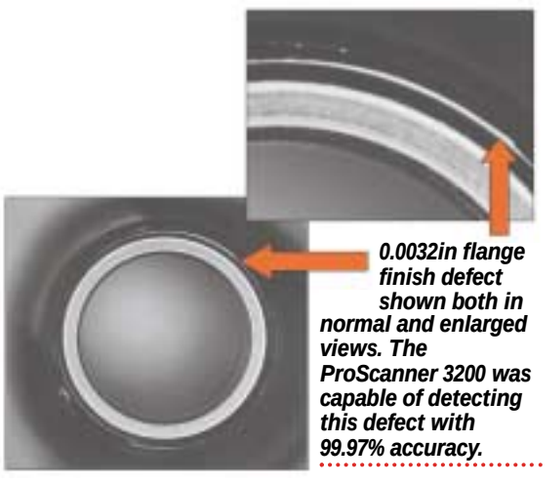
▲ *The Veritas™ iB vision inspection system can perform sealing surface, base, base stress, vision plug and vision dip/saddle inspections and vision mould number reading at speeds of up to 800bpm.*

In today's competitive food and beverage markets, machine vision inspection has filled the gap for high-speed production line inspection of glass containers.

This non-contact, PC-based inspection tool has helped define new levels of container quality in factories around the world. Although machine vision has been around for many decades in the automotive and other major industries, it also has, in recent years, become the standard of choice for inspecting hard to detect defects in glass containers.

There are many types of defects that are best inspected by conventional means, however, the powerful ability of machine vision has been defining new capabilities, especially in detecting defects that historically have been difficult or impossible to detect using conventional inspection methods. The end result: using machine vision inspection techniques, glass producers are now capable of providing higher quality containers to their customers, further enhancing the image of glass as the pre-eminent quality packaging choice.

A good glass container is one that can go through the product filling process without causing production line jams or other damages and into the consumer's hands without health or safety issues. The inspection criteria for glass container quality are based on the entire journey of the glass material from the initial molten state, through the filling, sealing, labelling, packaging and eventually to the consumer. In the production plants where glass containers are made, it is important for the production personnel to recognise the different types of defects and understand what remedies are used to eliminate them. However, in the competitive packaging market, where glass must compete both on quality and cost, production speeds have increased dramatically. Human visual inspection is almost impossible. Conventional inspection methods, together with high speed machine vision tools, offer producers the best chance to both keep costs down and ensure high quality. The inspection system must be versatile enough to cover a range of glass container sizes, while being capable of detecting a variety of container defects at high production rates. It must be easy to use, with minimal downtime required to make production line changes for different sizes or types of containers. For these reasons, the first line of defence in inspecting very small and hard to detect defects at high production line speeds is often machine vision inspection.



0.0032in flange finish defect shown both in normal and enlarged views. The ProScanner 3200 was capable of detecting this defect with 99.97% accuracy.

The throughput rates for a machine vision system inspecting glass containers can achieve speeds up to 800bpm. This capability provides a practical solution for inspecting 100% of the production lot. Capable of performing simultaneous inspections with a variety of algorithm-based software inspection tools, machine vision inspection systems, such as the ProScanner 200 series and Veritas™ inspection systems also can provide mould-correlated inspection results data to higher level process management tools.

This data can be used to provide defect trend information to glass forming system operators. It can later be used to monitor defect trends in production. If for example, a particular defect in the glass container were to occur only intermittently, this could be an early warning sign of a major problem about to occur in the process. The statistical defect data can help to initiate an early investigation into the root cause of the defect, before problems develop and later lead to further container defects, equipment damage and production downtime. A major advantage of using machine vision systems for inspection is that they usually require little or no physical contact with the container, while performing the actual inspection. The Emhart Glass ProScanner 200 series and Veritas inspection systems offer glass producers some of the most advanced inspection and handling technology available. Supplied in a variety of configurations offering the following inspections: sealing surface, base, base stress, vision plug, vision dip, many of these devices can also read machine and alphanumeric mould codes embossed on the container base or heel.

A typical machine vision system comprises one or more cameras, a precise method of illumination and a microcomputer to run the vision software. In general, the smaller and more difficult a glass container defect is, the greater the amount of camera resolution and background illumination that will be required for proper inspection. An example of this is a configuration of the ProScanner 3200 sealing surface inspector, which was able to detect flange finish defects as small as 0.0032in and knockout defects as small as 0.0053in with a false reject rate of less than 0.03%. This configuration included proprietary inspection algorithms, together with a mega pixel camera, custom bowl/beam splitter light and telecentric lens. This configuration is available on the Emhart Glass ProScanner 3200, ProScanner 8200 combined base and sealing surface inspector and the new Veritas iB vision inspection system, which can be equipped to provide base, sealing surface, base

stress, vision plug and vision dip inspections and vision mould number reading.

Powerful inspection algorithms are an important part of any machine vision system, but the key to optimising their effectiveness is providing, clear, high resolution images of container parts to be inspected. The illumination of an inspected glass container is one of the most critical aspects of machine vision. There are many standard types of illuminators available for almost any glass container application. Some difficult inspections may require a custom made illuminator to handle more challenging applications. One example would be the lighting required to inspect for down or rolled finishes, stones, lineovers, overpress, chips (ID and OD), blisters, knockout and flange finish defects.

Critical Defects Requiring Immediate Action

- Freaks
- Split finish
- Checked finish
- Crizzled finish
- Checks under finish
- Unfilled finish
- Choked bore/neck
- Bottom check
- Thin Ware
- Stuck glass
- Spikes

Machine vision systems such as the Veritas iB and ProScanner 200 series use advanced lighting and camera technologies to perform traditionally mechanical inspections such as plug (bore) gauging and dip/saddle finish inspection. With the use of intuitive touch screen displays, the selection of graphical icon based inspection algorithms becomes simple, along with other software tool options for job set-up configurations. The interface makes subsequent changes simpler, allowing multiple container set-ups to be programmed and saved for recall at a later date, ensuring quick and easy job changes.

Programmable software adjustments are automatic, removing the need for parts changeover to inspect different types of container.

Since the machine vision system operates at microcomputer speeds, it can quickly signal a reject mechanism to expel the defective glass container within milliseconds and continuously reject bad containers at rates of over 12 containers/sec. This is especially critical where certain defects, such as those listed in the table *(see left)*, require immediate attention as they can cause damage to production equipment and/or present serious health and safety hazards.

Many of today's producers of consumer food and beverages purchase their glass containers from external suppliers. They rely solely on the supplier to have shipped only good containers to their plant. Even if the supplier performed a thorough inspection before shipping its product, the glass container must be processed at the food/beverage plant. Shipping, handling and conveyor feed systems place additional strains on the containers, each potentially adding new defects before they are filled. The danger is that if container defects fail to be detected by the supplier, they may enter the production filling line and cause damage or even enter the marketplace and cause health problems or personal injury.

Machine vision inspection has become a necessary tool to help reduce or eliminate this risk. Helping glassmakers to cost effectively meet stringent quality requirements in an increasingly competitive packaging marketplace; machine vision has become a standard inspection and quality assurance tool. With its new Veritas and ProScanner 200 series vision inspection systems, Emhart Glass provides the advanced technology that today's glass container manufacturers need to maintain and improve their competitive edge.

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