

Technical News Bulletin

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FleXinspect™ B Generation III Application Notes

- Equipped with SCOUT technology
- The FleXinspect B captures and mold correlates up to 9 individual views of the sealing surface and base of a glass container
- Setup, operation and maintenance training by Emhart Glass personnel is mandatory for optimum machine operation and performance.

Section 1 Overview

The FleXinspect B Generation III (also known as FleX B) is a configurable multi-station, servo-controlled inspection system that combines contact (belt handler) and a non-contact inspection to provide a comprehensive suite of vision inspections for glass containers. Combined standard and optional inspections can capture and correlate up to 9 unique views of the sealing surface and base of a glass container.

The FleX B comes equipped with SCOUT technology, where defect classification, automatic learned variation and predefined defect limits are standard features in the software.

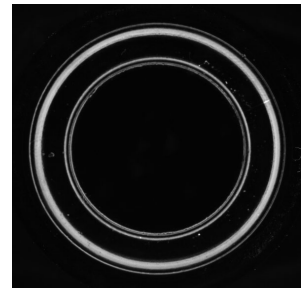
The FleX B is designed to inspect round and non-round glass containers at speeds of up to 600 containers per minute (bpm). The maximum conveyor speed is 1m/s.

NOTE: *Actual maximum speed and inspection capabilities of the FleX B can vary depending on container size and characteristics, as well as inspection setup.*

Standard Inspections –

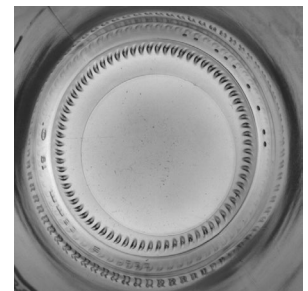
- **Sealing Surface Finish 1** - reflective lighting – Image acquisition is performed using a super bright LED light source with a 2448 x 2048 pixel resolution area matrix camera.

Common defects detected: chips, lineovers, finish blisters, seeds, and overpress.



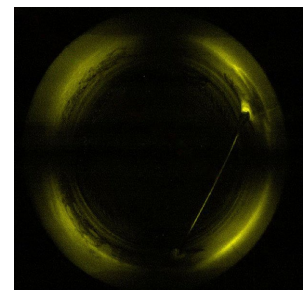
- **Base Inspection** – Image acquisition is performed through a cross-over lens using a super bright LED light source with a 2044 x 2044 pixel resolution area matrix camera.

Common defects detected: blisters, seeds, fused glass, plunger pulls, dirt, deep or damaged baffles, tramp glass, and birdswings contacting the lower heel or base.



- **Base Stress** – Image acquisition is performed using the same light source and cross-over lens that are used for base inspection, but with a cross-polarizing filter and dedicated 2044 x 2044 pixel resolution area matrix camera.

Common defects detected: seeds, stones, viscous knots and other stress causing defects that may be impossible to detect with conventional base inspection.



Optional Inspections –

- **Sealing Surface Finish 1 with Wire Edge “add on”**– Image acquisition is performed using a super bright LED light source with a 2448 x 2048 pixel resolution area matrix camera. The wire edge “add on” uses an additional four dedicated 1280x 1024 pixel resolution area matrix cameras.

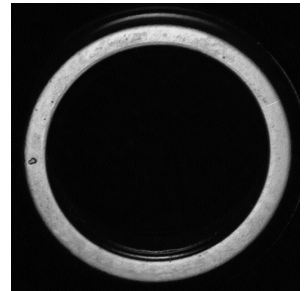
Wire edge can be used on bottles with finish diameters up to 42mm.

Common defects detected: chips, lineovers, finish blisters, seeds, overpress and wire edge



- **Sealing Surface Finish 2** (incident lighting) – Image acquisition is performed using a super bright LED light source with a 2448 x 2048 pixel resolution area matrix camera.

Common defects detected: lineovers, unfilled finish, crizzled finish and overpress.



- **Finish 3 - Pinhole** (inside view) – Image acquisition is performed through a 360° view lens using a super bright LED light source with a 1280 x 1024 pixel resolution area matrix camera.

Common defects detected: checks under finish, corkage checks or tears & pinched necks.

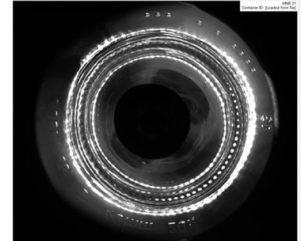


The chart below provides additional information on lenses available for various finish sizes for Finish 1 and Finish 2 inspections in order to optimize results.

Max. Finish Size	Lens
Up to 28 mm	50 mm
Up to 44 mm	35 mm
Up to 70 mm	25 mm
Up to 120 mm	16 mm

- **Bottom Up Vision Mold Number Reader (BUVMNR)**

Image acquisition from below the container with a 1280x1024px camera, located in a fully motorized enclosure, with a super bright LED light source allows for the reading of heel codes located on a height of up to 10mm on containers with a diameter of up to 90mm



Mold Number Reading (MNR)

Mold number reading enables mold-defect correlation for all inspections in the FleX B as well as the whole inspection line when coupled with a FleX C and all other additional inspection options. The optional (software) mold number reading capability is provided at the base inspection station and uses the base inspection image. This mold number reader may be effective with both heel dot, and base codes, but only if the codes can be seen clearly in the base inspection image with enough contrast to determine the mold code. This built-in optional software feature of mold reading in the base inspection image is not intended to be used for mold/cavity sorting of defective containers. Reading the mold codes in the base image is intended to provide defect correlation to the mold/cavity they derive from. The MNR software supports the following types of heel codes (dots in round as well as straight layout):

- | | |
|------------------------------|--------------------|
| ➤ 7 dot bottom | ➤ Owens 8 dot heel |
| ➤ 9 dot heel | ➤ 8 dot peanut |
| ➤ Alphanumeric seven segment | ➤ BSN 3-8 dot |

Optional Mold Number Readers

- **Smart Vision Mold Number Reader for alphanumeric seven segment** – This optional reader is based on artificial intelligence and uses the base inspection image. It is capable of reading seven segment codes in extreme situations where the codes may be difficult to read due to container shapes or embossed features.

Section 2 Ware Range

The FleX B is designed to inspect round and non-round containers

Standard Ware Range:

Body Diameter:	15 to 160 mm [0.59-to 6.3 in.]
Height:	38 to 440 mm [1.5-15.0 in.]
Finish Inner Diameter:	4.5 mm [0.177 in.]
Finish Outer Diameter:	120 mm [4.72 in.]

Round containers include almost all cylindrical round shapes and most tapers within the machine's ware range.

Non-round containers include most non-round shapes; however, some non-round containers that are rectangular in shape may need to be oriented prior to entering the FleX B. Certain shapes with rounded bottoms such as ampoules, light bulbs, etc. are excluded.

Some containers may cause handling problems and should be tested by Emhart Glass. Examples of these containers include:

- Containers with extreme tapers
- Containers with offset necks or finishes.

CAUTION: **Misshapen and structurally weak containers may break during handling in the FleX B. This may cause unscheduled down time and/or damage to handling components. The installation of the IQM (Infeed Quality Monitoring) peripheral option or a squeeze tester or other freak detection device upstream of the FleX B is strongly recommended.**

Tapered containers and containers with different diameters can be inspected in the FleX B, as the upper and lower belt handler arms can be adjusted independently "in / out" to permit handling of many different container shapes.

Section 3 Machine Speed

The FleX B is designed to acquire images at a maximum speed of 600 bpm with max. 1000 mm/sec. [39.4 in. /sec.] linear conveyor speed. The actual maximum speed is based on container diameter, container spacing, and conveying speed. The minimum distance between bottles required (for a full inspection line including a Flex C) is a gap of one bottle diameter. The following formula can be used to calculate the maximum inspection speed of the FleX B for any container diameter within the machine's ware range:

$$BPM = \text{Conveyor speed per minute} \div (\text{max. bottle diameter} + \text{spacing})$$

Example: Max. Conveyor speed = 60,000 mm/min. (1000mm/sec)

- bottle diameter = 68 mm
- $60,000 \div (68 \times 2) = 441.18 \text{ bpm}$

Section 4 Inspection Notes – Base & Sealing Surface Inspections

Sealing Surface Finish 1 and Finish 2. Sealing surface inspection is accomplished by illuminating the container finish with two separate light sources in the Finish 1 and Finish 2 inspections

- *Finish 1* - reflective lighting: *Diffuse illumination* is accomplished using a LED bowl light. This provides light along the beveled edges of the sealing surface that are not perpendicular to the optical axis. When properly illuminated, the sealing surface is a uniform black ring (beveled edges will mostly show as bright rings).
- *Finish 2* - incident lighting: *Axial illumination* is performed with a beam splitter. This provides light along the optical axis and illuminates the surface of the container that is perpendicular to the camera. When properly illuminated, only the perpendicular sealing surface reflects light into the camera and becomes visible as uniform grey ring.

Defects that occur on the finish will appear darker or lighter than the rest of the finish. This change in appearance is what the system will look for in detecting defects.

Finish 1 with Wire Edge Inspection. In addition to the Sealing Surface Finish 1 described above, inspection for wire edge defects is accomplished with four additional cameras looking from the side above into the finish onto the inner finish sidewall (at a flat angle). This covers the relevant area with high resolution with views at the appropriate angle. An artificial intelligence based inspection algorithm examines this area for wire edge defects.

Finish 3 Pinhole. This station creates an inside view of the inner sidewall finish area using a 360° lens. *Diffuse illumination* is accomplished using a LED bowl light. This setup creates mostly concentric black and white rings giving the inspection the possibility to look for deviations.

Base Inspection. Base inspection is accomplished by illuminating the container base with diffused back lighting. The camera then looks through a cross-over lens and the opening in the neck and is focused on the base of the container. Setting the light intensity to get the proper gray level is important. Defects that occur in the base will appear darker or lighter than the rest of the base image.

Base Stress. Inspection of the base for stress defects is accomplished by illuminating the base with diffused back lighting through a set of polarized filters. These filters cross polarize the light, canceling out all of the light being received by the camera. When a stress-causing defect is present in the base, it changes the orientation of the light allowing the camera to see visible light.

Vision Mold Number Reading. The FleX B mold number reader is capable of reading most mold codes used throughout the glass container industry.

NOTE: *The mold reading capability of the FleX B is limited to mold codes that are cut correctly, according to specification, and can be seen in the acquired image.*

For all vision mold number readers, the mold codes must be within specification and also have clearance from other container markings to allow proper sensing. Specifications for the engraving of the various mold codes read by the FleX B mold number readers are described in the following document available from Emhart Glass:

22444A, Bottom and Heel Code Specifications for VMNR.

Typical line layouts

NOTE: These configurations show just some of the possibilities of this fully modularized system. Configurations with FleX C as the first inspection are equally possible. All modules in the whole inspection line are part of one container tracking and all inspection results are fully mold synchronized with the MNR option regardless of the order in which the machines are installed.

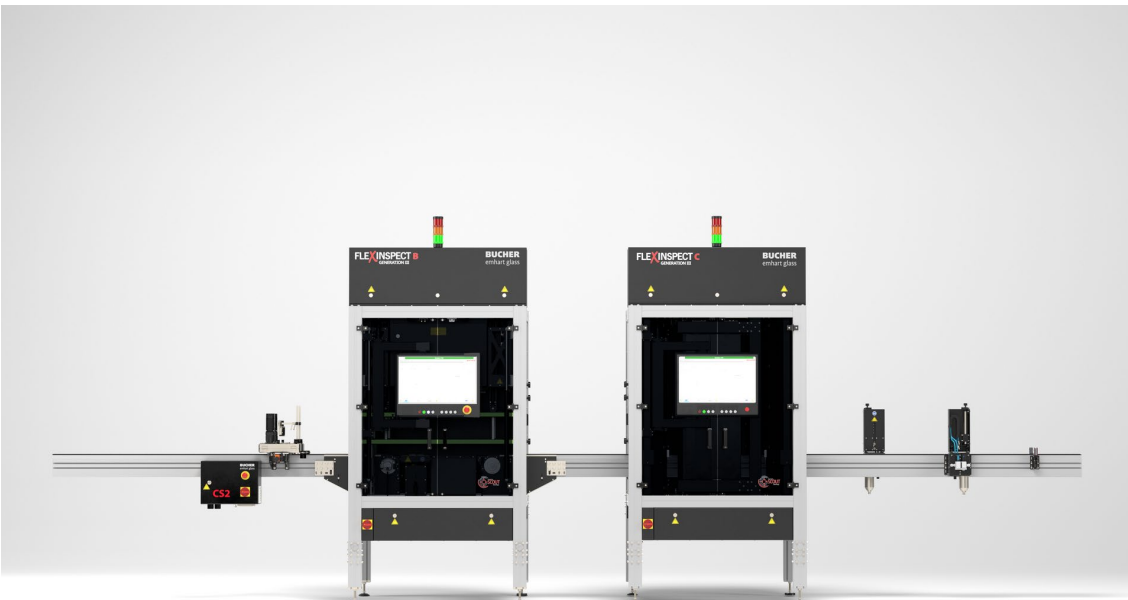


A typical FleX BC inspection line consists of a container separator (spacer), here the CS4 (four motor - four belt) together with an IQM (infeed quality monitoring) in order to ensure proper spacing and continuous operation of the line. The CS4 makes sure bottles are properly spaced also on fast lines even when running unstable containers as the speed of the belts at the outfeed of the separator is fully synchronized with the conveyor speed. The IQM filters the input stream and automatically removes broken bottles, overheight and underheight containers, cullet, monsters as well as downware. The FleX B with its belt handler enables base and finish inspections. The optional AL container alignment station (orients) can align the bottles based on features detected by the FleX B in the base of the container in order to improve sidewall inspection. The FleX C performs sidewall and dimensional inspections. The optional DIM provides telecentric dimensional inspection. One or more pneumatic rejecters remove defective bottles from the production line while the tracking is constantly monitoring that only containers which were inspected and have a good inspection result stay on the conveyor.

High speed lines should be equipped with the CS4 container spacer in order to guarantee proper separation at higher speeds.



The CS2 (two motor - two belt) separator in a standard line.



NOTE: It is always recommended to add the IQM to limit line stops and improve the production flow.

Conveyor Control System Integration. The FleX B is designed to interface with most plant conveyor control systems. However, ***Emhart Glass cannot be responsible for the modification or performance of a conveyor control system. Our responsibility is limited to the supply and performance of the FleX.***

Any conveyor/machine control issues must be reviewed and resolved during machine specification. Emhart Glass will work with customers and/or their conveyor supplier(s) to meet specific line requirements; however, the customer has the ultimate responsibility for any changes that must be made to the conveyor control to enable interface with the FleX B machine.

Conveyor Control Considerations. The FleX B will follow the speed of the conveyor and thus adapts automatically to the line speed. As bottles must be spaced and there must be no backpressure to keep this spacing under all conditions the line control must stop the line when the FleX B is not ready or stopped.

Air and Power Requirements

NOTE: ***It is the customer's responsibility to provide a stable, clean power supply to the FleX B. Power fluctuations (high or low voltage conditions) can cause the FleX B to shut down and/or stop unexpectedly, as well as damage electronic components in the machine.***

Power: 230 VAC, 50/60Hz, 1 phase, 1 neutral, 10,5 amps (max. consumption: 16 amps at 230 VAC)

Air: 3.5 bar [50 psi] nominal (consumption 0.8 to 0.85 m³/minute [105.9 cfm]).

Section 6 Operating Environment

Operating Temperatures: The FleX B is controlled by electronic equipment that is designed to operate in the majority of glass plant environments without modification. However, since conditions can vary from one installation to another, the following operating conditions must be observed. Failure to maintain these requirements will affect the applicable warranties covering the Emhart Glass hardware and software associated with the FleX B. If the proper operating conditions are not maintained, the electronic hardware will not function as designed.

The maximum allowable ambient temperature is 50°C [122°F]. Although control components can operate at this upper temperature, life expectancy of the electronic components will be reduced. The lowest recommended operating temperature is 5°C [41°F]. Maximum relative humidity is 95%, non-condensing.

Enclosures: All electrical/electronic enclosures used in the FleX B should be considered rated for IP20.

The FleX B is equipped with a closed-loop air conditioning system designed to maintain the FleX B internal temperature at or below 35°C [95°F].

CAUTION! **Components within the electronic consoles must be kept clean. The life expectancy of electronic components will be substantially reduced if they are contaminated with plant dirt (swab oil, dust, etc.). The accumulation of these substances on electronic components causes the actual temperature of these components to be much higher than the temperature of air within the control cabinet.**

Container Temperature: The machine handling equipment is rated for 60°C [140°F] maximum container temperature at machine infeed. Containers hotter than this can cause damage to handling equipment and can cause the internal machine temperature to rise above acceptable limits as outlined above.

Section 7 Conformity Statement

The FleX B conforms to the provisions of the following European CE directives and standards:

- Directive 2014 / 35 / EU (Low Voltage Directive)
- Directive 2014 / 30 / EU Electro Magnetic Compatibility Directive (EMC)
- Directive 2006 / 42 /EC Machine Directive

Additional standards apply

- EN 60204-1:2006/A1:2009, Safety of machinery – Electrical equipment of machines - Part 1
- EN ISO 12100:2010, Safety of machinery - Basic concepts, general principles for design
- EN ISO 13849-1:2015, Safety of machinery. Safety-related parts of control systems. Part 1
- EN ISO 13849-2:2012, Safety of machinery. Safety-related parts of control systems. Part 2
- EN 61000-6-2:2005, EMC – Immunity
- EN 61000-6-4:2007, EMC – Emission

This declaration relates exclusively to the machinery in the state in which it was placed on the market, and excludes components which are added and/or operations carried out subsequently by the final users.

Section 8 Specifications Required for Order Entry

The following items are configurable and require specification when ordering:

- Machine hand
- Plant voltage
- Location of cullet conveyor
- Conveyor height
- Conveyor type (including conveyor body)
- Options / Inspections
- Line layout drawings

Section 9 Spare Parts

Spare parts kits are available for the base machine, as well as for the optional inspections. Although the FleX B is covered by a one-year parts and labor warranty, spare parts kits are strongly recommended. If an adequate supply of spare parts is maintained, critical parts, when needed, will be available if they fail or wear out prematurely. An adequate spare parts inventory also helps reduce downtime or extended unsatisfactory machine operation caused by occasional out-of-stock conditions and time required to order and ship required parts. Parts failing within the specified warranty period will be replaced free of charge when returned to Emhart Glass under a Return Authorization number provided by Emhart Glass.

Spare parts have been organized in the following manner.

For the FleX B as stand-alone:

Wear Parts Kit for FleX B PN SY-020304 – This kit contains parts to be considered consumables, these are parts that need to be replaced over time. Items like belts and protective windows are included in this kit.

Basic Kit for FleX B PN SY-020305 – This kit contains both the wear parts kit as well as parts that are the recommended required parts for the base machine (computer, terminals).

Advanced Spares Kit for FleX B PN SY-020306 – This kit contains the basic spare parts, as well as parts to cover almost all failure conditions, including major vision system components (optics, and light sources for base and sealing surface inspections).

For both the FleX B and the FleX C when coupled:

Wear Parts Kit for FleX BC PN SY-020310

Basic Kit for FleX BC PN SY-020311

Advanced Spares Kit for FleX BC PN SY-020312

Section 10 Training

Setup operation and maintenance training by Emhart Glass personnel is mandatory for optimum machine operation and extended life. A machine-specific service program also is available for the FleX B. Training programs, offered at Emhart Glass training centers in Windsor, CT (USA), Planegg, Germany or at customer locations. Training provides the plant personnel with hands-on experience in all aspects of machine job change, maintenance, troubleshooting, and operation. Training is recommended for all lead maintenance and setup personnel (at least one per shift). This helps facilitate optimum, 24-hour-a-day machine operation and can virtually eliminate costly machine maintenance and service calls.

Revisions

Rev.	Date	Description
	18 June 2021	Preliminary release for review.
B	19 December 2023	Added specifications for Wire Edge and BUVMNR