

Technical News Bulletin

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FlexInspect™ C Generation III Application Notes

- Equipped with SCOUT technology software.
- Configurable inspection system that provides non-contact sidewall inspections for glass containers.
- Combining standard and optional inspections, the FlexInspect C can capture up to 30 individual views of the sidewall for each container.
- Setup, operation and maintenance training by Emhart Glass personnel is mandatory for optimum machine operation and performance.

Section 1 Overview

The FleXinspect C (also known as FleX C) is a configurable inspection system that provides non-contact sidewall inspections for glass containers. The FleXinspect C comes equipped with SCOUT technology software, where everything is based on defect classifications, automatic learned variations and predefined defect limits. Combining standard and optional inspections, the FleXinspect C can capture up to 30 individual views of the sidewall for each container.

The FleXinspect C is designed to inspect round and non-round glass containers at speeds up to 600 containers per minute. The maximum conveyor speed is 1m/s.

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

The FleXinspect C is capable of performing the following inspections:

Sidewall Opaque (6 views)

Dimensional (height, lean, shape, diameters) (6 views)

Sidewall Transparent (6 views)

Sidewall Stress (6 views)

Shoulder Opaque (up to 12 views)

Shoulder Stress (6 views)

The FleXinspect C comes equipped with the following inspections

- **Opaque sidewall defects** – Image acquisition is performed using one dedicated super bright LED light source in each of the 6 angle positions, and 1280 x 1024 pixel resolution, area matrix cameras providing 6 views of the container.



Common defects detected: stones, birds wings, seeds, dirt, fused glass, mold dope, and other opaque, aspect-related defects.

- **Dimensional sidewall defects** – Image acquisition is performed using one dedicated super bright LED light source in each of the 6 angle positions, and 1280 x 1024 pixel resolution, area matrix cameras providing 6 views of the container used in a 3 pairs setup.



- Common defects detected: height, lean, shape, filler offset, profile diameters

The FleXinspect C can also be equipped with the following optional inspections

- **Transparent sidewall defects** – Image acquisition is performed using one dedicated super bright LED light source in each of the 6 angle positions, and 1280 x 1024 pixel resolution, area matrix cameras providing 6 views of the container.



- Common defects detected: large soft blisters, ribbon tears, loading marks, heavy washboard, blow-out, and other transparent, aspect-related defects.

- **Stress sidewall defects** – Image acquisition is performed using fixed cross-polarizing filters with polarized lighting from super bright LED light sources and 1280 x 1024 pixel resolution, area matrix cameras providing 6 views of the container.



Common defects detected: stones causing stress and viscous knots.

- **Shoulder Inspection (transparent/opaque defects)** – Optional shoulder defect detection kits are available for improved opaque and transparent defect detection of containers with steep shoulders as well as tallware. With the shoulder inspection kits, up to twelve additional cameras with 1280 x 1024 pixel resolution, area matrix are mounted so that they capture a straight-on image of the shoulder.



- **Shoulder Inspection (stress defects)** – For stress inspection, the optional shoulder stress cameras are equipped with fixed polarizers to detect stress in the shoulder area of a container.

NOTE: Configuration depends on the ware range and product mix.

Section 2 Ware Range

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

Standard Ware Range / Tallware:

Body Diameter:	15 to 160 mm [0.59-to 6.3 in.]
Height:	38 to 350 mm (Tallware 440mm) [1.5-13.8 (15.0 in.)]
Finish Inner Diameter:	4.5 mm [0.177 in.]
Finish Outer Diameter:	120 mm [4.72 in.]

An XL version of the FleX C is available on request (maximum height and diameter 600 mm / 200 mm).

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 C. 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.

Section 3 Machine Speed

The FleX C 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 is a gap of one bottle diameter. The following formula can be used to calculate the maximum inspection speed of the FleX C 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 – Sidewall Inspections

In addition to the standard setup for containers with a max. height of 350mm several alternative configurations are available for the sidewall inspection on the FleXinspect C. The lenses used are determined by the container height and camera configuration. Emhart Glass will support finding the best configuration during specification.

Opaque defect detection

Using LED lighting and up to 18 cameras, the FleXinspect C achieves a full and uniform 360° view of the container sidewall. The machine's unique lighting design featuring an intelligent dedicated light source for each of the 6 angle position enables the FleXinspect C to inspect areas of containers that traditionally have been impossible to inspect. Features on the container such as embossing and uneven glass distribution (settle waves) now become inspectable areas of the container. In addition to the optics and lighting, the FleXinspect C uses powerful inspection algorithms and filters to help reduce the visual effects from embossing and distribution.

Transparent defect detection

Using the same cameras as the opaque defect detection, a second set of images is acquired. This second trigger of the LED light sources is performed using an adjustable light pattern. This patterned lighting is achieved by controlling groups of LEDs on the light board and illuminating them with different intensities. The result is an image of the container with defects on or near the surface of the glass being highlighted with sharp, easy to see edges (refer to illustration at right). Even virtually invisible blisters in the glass now appear with high contrast edges.

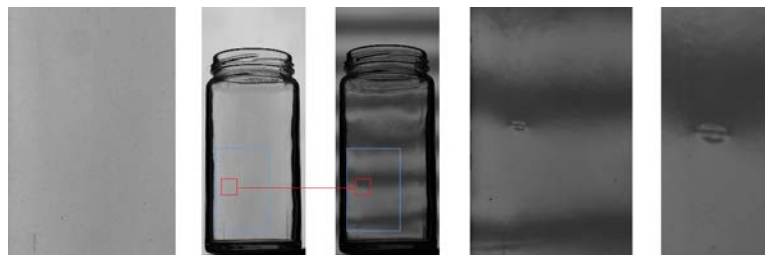


Figure 2: Illustration of transparent defect detection with patterned lighting

Stress defect detection

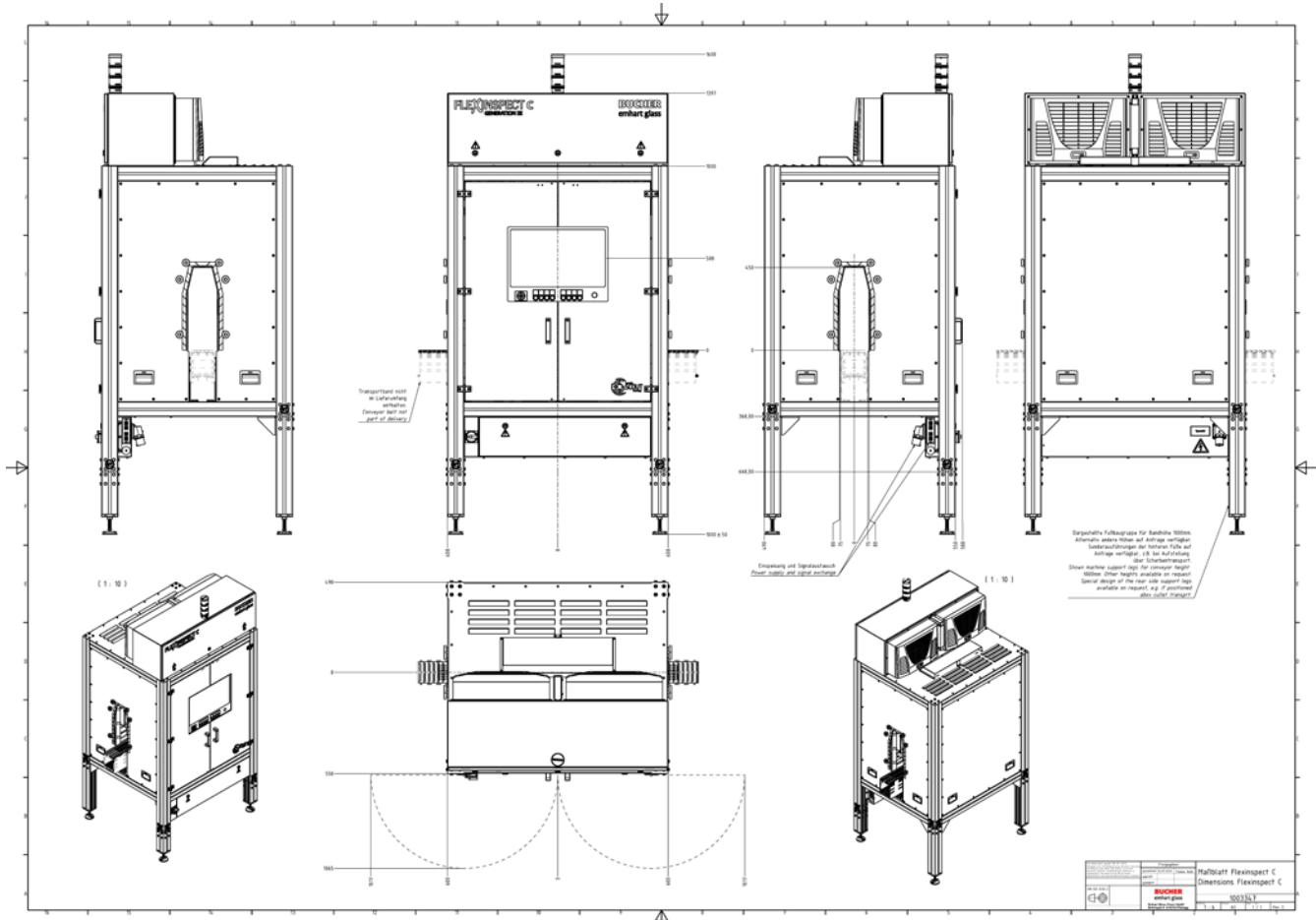
Using the dedicated cameras equipped with cross polarizing filters attached to the camera lenses, the system acquires a black image. If a container has any type of stress causing defect present, the image will have white areas highlighting the defect.

Dimensional defect detection

Dimensional inspection is normally performed on all 6 of the opaque images in 3 virtual pairs in order to eliminate the effects of the container position on the conveyor. The dimensional defect inspection includes software tools that measure container height, lean, shape, filler offset, and body diameter. This is accomplished by placing a virtual tool (calipers) where dimensional monitoring is desired. A multi-trigger tool also allows the light source LEDs to be configured to darken the edge of the container, making it easier to place calipers for dimensional inspection. This multi-trigger capability is especially useful for detecting the edge (or outline) of flint containers.

Section 5 Site Preparation and Installation Requirements

NOTE: Refer to "Dimensions FlexInspect C" dimensional drawings for details shown below.



Area Preparation. The area where the Flex C will be located must be:

- A straight, level area that is free of legs and under-conveyor obstructions (minimum standard conveyor height is 850 mm [33.5 in.]). The Flex C cannot be installed on an incline or decline.
- A straight single line conveyor of at least approximately 1,200mm [47.3 in.] (Flex C only, not counting spacer nor rejecters, appx. 1,800mm [59 in.] with one rejecter).
- A clear height of at least 1,610 mm [63.4 in.] above the top of the conveyor.
- A minimum of approximately 500mm [20 in.] upstream and downstream of the Flex C (measured from the infeed and outfeed sides of the machine).

The Flex C comes without any conveyor. It installs to the factory single line conveyor.

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 (orienter) 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 C 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 C machine.

Conveyor Control Considerations. The Flex C 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 C 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 C. Power fluctuations (high or low voltage conditions) can cause the Flex C 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 C 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 C. 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 C should be considered rated for IP20.

The Flex C is equipped with a closed-loop air conditioning system designed to maintain the Flex C 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 C 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 C 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.

WPK - Wear Parts – 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.

BSPK - Basic Spare Parts Kit – This kit contains both the wear parts kit as well as parts that are the recommended required parts for the base machine (computer, terminals).

ASPK - Advanced Spare Parts– 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)

These kits are assembled according to machine configuration and for stand-alone or coupled (Flex C with Flex B). There are no recommended wear parts for the Flex C (stand-alone).

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 C. 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
	24 September 2021	Preliminary release for review.