

Technical News Bulletin

FleXinspect™ C Application Notes

April 3, 2017

Section 1 Overview

The FleXinspect C (also known as FleX C) is a configurable dual-station 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 24 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.

NOTE: *Actual maximum speed and inspection capabilities of the FleXinspect 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)

Sidewall Transparent (6 views)

Sidewall Stress (6 views)

Shoulder Opaque (6 views)

or

Shoulder Stress (6 views)

Dimensional (height, lean, diameters) 3 views

The FleXinspect C comes equipped with the following inspections

- **Opaque sidewall defects** – Image acquisition is performed using patented wrap-around lighting from super bright LED light sources, and 1396 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 patented wrap-around lighting from super bright LED light sources, and 1396 x 1024 pixel resolution, area matrix cameras (up to 6 views).

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

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

- **Transparent sidewall defects** – Image acquisition is performed using patented patterned lighting with super bright LED light sources, and 1396 x 1024 pixel resolution, area matrix cameras providing up to six 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 1396 x 1024 pixel resolution, area matrix cameras providing up to six views of the container.

Common defects detected: stones causing stress and viscous knots.

- **Shoulder Inspection (transparent/opaque defects)** – An optional shoulder defect detection kit is available for improved opaque and transparent defect detection of containers with steep shoulders. With the shoulder inspection kit, six additional cameras with 1396 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 cameras are equipped with fixed polarizers to detect stress in the shoulder area of a container.

NOTE: *The Shoulder Inspection options for the FleXinspect C are available for transparent and opaque defect detection **OR** stress defect detection.*

Section 2 Ware Range

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

Standard Ware Range:

Body Diameter:	16 to 170 mm [0.625-to 6.7 in.]
Height:	38 to 381 mm [1.5-15.0 in.]
Finish Inner Diameter:	4.5 mm [0.177 in.]
Finish Outer Diameter:	144 mm [5.67 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 FleXinspect 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 offset necks or finishes
- Containers with extreme tapers

Section 3 Machine Speed

The FleXinspect C is designed to acquire images at a maximum speed of 600 bpm (approximately 1200 mm/sec. [47.2 in./sec.] linear conveyor speed). The actual maximum speed is based on container diameter, container spacing, and conveying speed. The machine comes equipped with a belt bottle spacing device to provide a minimum spacing between bottles to maintain accurate sidewall inspection. The following formula can be used to calculate the maximum inspection speed of the FleXinspect C for any container diameter within the machine's ware range:

$$\text{Max. BPM} = \text{Conveyor speed per minute} \div (\text{max. bottle diameter} \times 2)$$

Example: Max. Conveyor speed = 72,000 mm/min. (1200mm/sec x 60)

- bottle diameter = 68 mm
- $72000 \div (68 \times 2) = 529.41$ bpm

Section 4 Inspection Notes – Sidewall Inspections

Three lenses are available for the sidewall inspection cameras on the FleXinspect C. The lenses used are determined by the container height. To maintain the highest image resolution, select the appropriate lenses from the table that meets the container height requirements. If you do not want to change lenses, select a lens that will inspect the entire height range of your production.

Example: A 16 mm lens can be used to inspect the maximum container height, 383.5 mm [15.1 in.]. It also can be used to inspect the shortest container, 38 mm [1.5 inches].

Focal Length	Emhart Part #	Maximum Field of View (container height)
16 mm	27548A (single lens part #14483P)	383.5 mm [15.1 in.]
25 mm	27549A (single lens part #14484P)	274.3 mm [10.8 in.]
50 mm	27550A (single lens part #14485P)	190.5 mm [7.5 in.]

Opaque defect detection

Using LED lighting and up to 18 cameras, the FleXinspect C achieves a full 360° view of the container sidewall. The machine's unique wrap-around lighting design 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 rows 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 very large soft blisters in the glass now appear with high contrast edges.

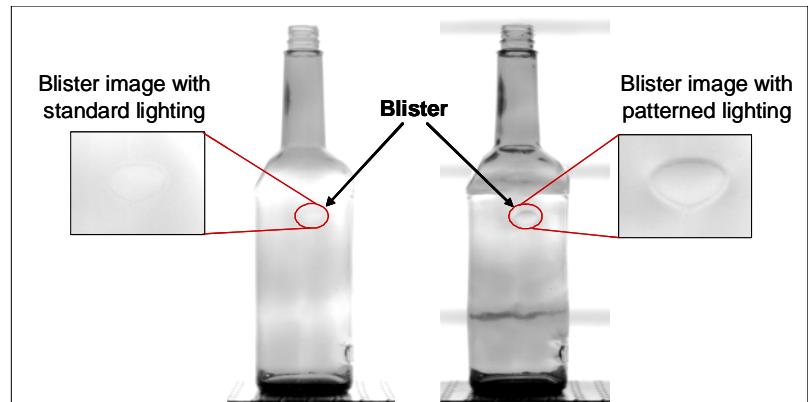


Figure 2: Illustration of transparent defect detection with patterned lighting

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 3 of the opaque images. The dimensional defect inspection consists includes software tools that measure container height, lean, filler offset, and body diameter. This is accomplished by placing a virtual tool (calipers) where dimensional monitoring is desired, then teaching the software the required dimensional units and tolerances. 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: Machine clearances for the FleXinspect C are shown in Figure 3.

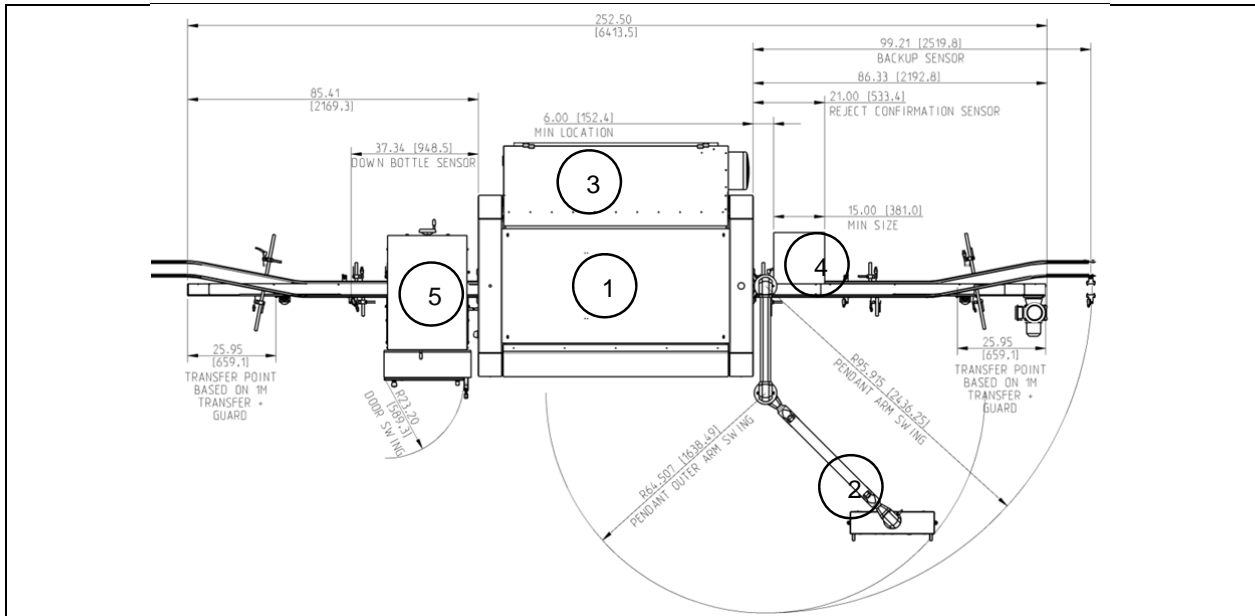


Figure 3: FleXinspect C layout drawing

<ol style="list-style-type: none"> 1. FleXinspect C machine 2. User interface 3. Rear electronics access 	<ol style="list-style-type: none"> 4. Cullet chute 5. Belt spacer
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Area Preparation. The area where the FleXinspect C will be located must be:

- A straight, level area that is free of legs and under-conveyor obstructions (minimum conveyor height is 914 mm [36 in.]). The FleXinspect C and its conveyor cannot be installed on an incline or decline.
- A break in the conveyor approximately 4 meters [approximately 157.5" inches].
- A clear height of at least 2225 mm [87.6 in.] above the top of the conveyor.
- A minimum of approximately 3.6 meters [12 feet] upstream and downstream of the FleXinspect C (measured from the infeed and outfeed sides of the machine).

Conveyor Control System Integration. The FleXinspect 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 FleXinspect C and its integrated Emhart Glass conveyor system.*** A

Conveyor Control Considerations. When the FleXinspect C is interfaced with a plant conveyor control system, the speed of the FleXinspect C must be set in such a way that speed of the machine and the conveyor retain the same ratio.

There are two ways to achieve this machine-conveyor speed ratio goal:

- Configure the conveyor to follow the FleXinspect C and set the amount of time it takes for the conveyor to accelerate (ramp up) to its new speed to be as short as possible.
- Configure the FleXinspect C to follow the conveyor and set the time that it takes for the conveyor to accelerate to be longer than the time it takes for the machine to accelerate to the new speed.

NOTE: *If either of the above two goals is not achieved, ware can accumulate between the FleXinspect C and other machines on the line. If the accumulation of ware exceeds the capacity of the conveyor between machines, containers can fall over or back up into an upstream machine.*

The best way to achieve either of the machine-conveyor speed control goals is to control the speed of the FleXinspect C using a 0-10 VDC analog speed reference signal from the plant line control system to the FleXinspect C.

The line control system then must be configured as follows:

1. The line control system sends a speed control signal to the FleXinspect C.
2. Allow adequate time for the FleXinspect C to change its speed and provide a feedback speed reference signal to the conveyor controller telling the controller how fast the FleXinspect C is now running.
3. Set the conveyor controller to follow the speed of the FleXinspect C as closely as possible.

When the above procedure is followed, the FleXinspect C and its conveyors can maintain the correct speed ratio and the conveyor control system can respond to a speed change demand as quickly as possible, thereby reducing ware flow problems upstream or downstream of the FleXinspect C.

Air and Power Requirements

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

Power: 380 to 480 VAC, 3 phase, 15 amps (max. consumption: 20 amps at 460 VAC)

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

Section 6 Operating Environment

Enclosures: All electrical/electronic enclosures used in the FleXinspect C should be considered rated for NEMA 12 and IP20.

The FleXinspect C is equipped with a closed-loop air conditioning system designed to maintain the FleXinspect C internal temperature at or below 50°C [122°F]. The temperature is constantly monitored and the user interface will display the following conditions when temperatures inside the electronic cabinet exceed set points.

Fault Message	Description	Machine State
Over temperature warning	The temperature inside of the electronics cabinet has exceeded the user set warning.	<ul style="list-style-type: none"> Counters reset Machine status icon is yellow.
Over temperature fault	The temperature inside of the electronics cabinet has exceeded 50 C.	<ul style="list-style-type: none"> Machine stopped Red stop button is illuminated Counters reset icon flashing. Machine status icon is red.
Air conditioner fault.	The electronics cabinet air conditioner has stopped.	<p>Note: Machine will not restart until the condition that caused the alarm is resolved and cabinet temperature is below 50 C.</p>

Operating Temperatures: The FleXinspect 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 FleXinspect C. If the proper operating conditions are not maintained, the electronic hardware will not function as designed.

The maximum allowable temperature inside the machine 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.

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 FleXinspect C conforms to the provisions of the following European CE directives and standards:

- Directive 73/23/EEC and amendments (Low Voltage Directive)
- Directive 89/336/EEC and amendments (EMC Directive)
- Directive 89/392/EEC and amendments (Machine Safety Directive)
- EN292 Parts 1 and 2
- EN50081-2 Part 2
- EN50082-2 Part 2
- EN60204 Part 1
- CEN TC151 WG13 PrEN13042 Part 6: Specific Safety Requirements for Hollow Glass – Part 6: Multi-Station Multi-Inspection Machines

Section 8 Specifications Required for Order Entry

The following items are configurable and require specification when ordering:

- Machine hand
- Plant voltage
- Conveyor height
- Options
- 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 FleXinspect 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.

Wear Parts Kit 12604DSP- This kit contains common wear parts that not covered under warranty.

Basic Kit PN 12604DSP1 – This kit contains parts that are the recommended required parts for the base machine.

Advanced Spares Kit PN 12604DSP2 – This kit contains both the basic spare parts, as well as parts to cover almost all failure conditions, including major vision system components (computer, optics, and light sources for base and sealing surface inspections).

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 FleXinspect C. Training programs, offered at Emhart Glass training centers in Clearwater, Florida (USA), or Leipzig, Germany or at your plant, provide plant personnel with hands-on experience in all aspects of machine job change, maintenance, troubleshooting, and operation. We recommend training 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.

Section 11 Shipping Specifications

Shipment of the FleXinspect C consists of 2 crates;

- Machine and conveyor, crated weight of approximately 1928 KG {4250 pounds}
- Belt bottle spacer, crated weight of approximately 279 KG {615 pounds}

Revisions

Rev.	Date	Description
	May 7, 2012	Preliminary release for review.
A	July 9, 2014	Added section 11
B	August 4, 2014	Corrected speed calculation, added notes for installation.
C	March 23, 2017	Changed lens table, picture, spare part kit numbers and training centers