

Technical News Bulletin

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FleXinspect M Application Notes

Section 1 Overview

The FleXinspect M (FleX M) is a seven station, servo-indexing rotary inspection system designed to inspect glass containers. As a stand-alone system, it is capable of inspecting round and non-round ware at speeds up to 300 containers per minute (see ware range and machine speed information below). The FleX M comes equipped with SCOUT technology software, where everything is based on defect classifications, automatic learned variations and predefined defect limits.



The FleX M is an inspection system that includes both the inspection machine and an integrated conveyor system. The unique longer infeed feeds containers at a 30-degree entry angle allowing the machine to be installed on a customer's existing single line conveyor (refer to section 6, Site Preparation and Installation Requirements).

The FleX M is capable of performing the following inspections;

Standard Inspections

- **Check Detection** – Uses modulated lights and receivers with six, pre-set frequencies to perform finish, neck, shoulder, body, heel and base check detection. Check detection lights and receivers can be installed at any rotator-enabled station. Standard check detection includes 16 channels of modulated check inspection.
- **Mold Number Reading** – Heel dot code reader located at any rotator-enabled station (for ease of setup, the front center station is generally preferred).
- **Mechanical Plug/Ring** – Mechanical go/no go inspection for min/max plug and ring gauging.
- **Mechanical Dip/Saddle** – Mechanical inspection using conventional FFS head and compressed air to detect effective finishes.

Optional Inspections

- **Laser Vision Check Finish Module** – The “LVC” finds cracks in the glass by detecting light scattering. This is done by injecting high intensity, coherent laser light into the glass wall and looking for a disruption in the coherency. Area of inspection is 35mm from top of finish for diameters up to 55mm.
- **Optical Wall Thickness** – The FleX M can be equipped with 4 chromatic thickness measurement inspection heads, which can be mounted at any rotator-enabled station.
- **Sealing Surface** (120 mm max finish dia.) – Line scan vision inspection capable of detecting a range of difficult-to-detect finish defects on the interior or exterior of the finish.

- **Base** – Line scan camera inspection set up in a rotator-enabled station; designed to detect base defects.
- **Base Stress** – Line scan camera inspection set up in a rotator-enabled station; designed to detect stress causing defects. Inspection performed in the same station as the base inspection.
- **Base Mold Code Reading** – Vision system capable of reading base dot, peanut or seven-segment numeric mold codes.
- **Data Matrix Spin Reader** - Camera based data matrix reader. The data matrix code can be located on either the neck or the body of the container

Section 2 Ware Range

The FleX M is designed to handle both round and non-round containers.

Diameter: 16 mm to 120 mm [0.625 to 4.72 in.]

Height: 38 mm to 350 mm [1.5 to 13.8 in.]

*Containers shorter than 51 mm (2 in.) might require a mini ware update kit.


Finish outer diameter 11 mm min – 110 mm max (.433 in. to 4.33 in.)

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

Non-round containers are limited to containers that have enough round surface areas in the neck or body to permit the container to be rotated in place. Special tooling is required for handling rotatable non-round containers. Containers also must be delivered to the machine standing upright on a conveyor. Certain shapes with rounded bases, such as ampoules, light bulbs, etc. are excluded.

Other considerations: Some containers (round or non-round) might cause handling problems and should be tested by Bucher Emhart Glass. Examples of those containers include:

- Containers with extreme tapers.
- Odd round or non-round shapes
- Containers with handles and/or curved label panels
- Small diameter tall, round containers that tend to be top heavy and unstable.

	CAUTION!
	<p>Misshapen and structurally weak containers might break during handling in the FleX M. This might cause unscheduled down time and/or damage to handling components. The installation of a squeeze tester or freak detection device upstream of the FleX M is strongly recommended.</p>

Section 3 Machine Speed

The FleX M is designed to run at a maximum speed of 300 bpm. Actual machine speed is affected by container dimensions and shape, starwheel configuration and plug penetration. The minimum speed the FleX M is capable of is 60 bpm. The following chart is to be used as a guideline only.

Starwheel Configuration				
Maximum Speed				
Plug Penetration	24 Pocket	18 Pocket	12 Pocket	9 Pocket
22 mm [0.875 in.]	300 bpm	265 bpm	215 bpm	185 bpm
38 mm [1.5 in.]	300 bpm	265 bpm	215 bpm	185 bpm
54 mm [2.125 in.]	280 bpm	250 bpm	200 bpm	150 bpm
70 mm [2.75 in.]	250 bpm	250 bpm	180 bpm	150 bpm
86 mm [3.375 in.]	220 bpm	220 bpm	180 bpm	150 bpm
102 mm [4.0 in.]	200 bpm	200 bpm	180 bpm	150 bpm

Section 4 Tooling

Tooling Overview: Tooling for the FleX M consists of 1 or 2 infeed screws (dual infeed screws are recommended for some tall containers), starwheel assemblies, plug/ring gages and FFS heads (dip/saddle/height gauging).

Infeed Screws: FleX M infeed screws are bottle diameter-specific.

Starwheels: Starwheel tooling usually consists of an upper and lower starwheel assembly, although some shorter ware might require only one starwheel assembly. The 24 pocket starwheels are designed for ware diameters of 16 mm to 66 mm [0.625 to 2.60 in.]; 18 pocket starwheels are designed for ware diameters of 16-80 mm {0.625 to 3.1 in.}; 12 pocket starwheels are designed for ware diameters of 66 mm to 120 mm [2.60 to 4.72 in.]; 9 pocket starwheels are designed for ware diameters of 80 mm to 120 mm [3.1 to 4.72 in.]; The 9 pocket starwheels can be used for the entire ware range; however, the maximum machine speed in 9 pocket configuration is 150 bpm (depending on container characteristics and inspection setup). Lower starwheels are designed to handle a limited range of container diameters. A different lower starwheel is usually required for each 2 mm change in container diameter. Upper starwheels are generally container specific, depending are where they are to be placed on the neck of the container.

Starwheels are available as complete assemblies (three segments with roller wheels and hardware) or as unfinished segments. Roller wheel hardware can be purchased separately.

Plug/Ring Gauges: Plug and ring gauges are specific to the acceptable dimensions of the finish. Plug/Ring gauges have min and max and length requirements that are container specific. Plug and Ring gauges can be purchased from Bucher Emhart Glass if specifications are provided, or blanks of these gauges can be purchased for in-plant or third-party fabrication.

FFS Heads: FFS heads are specific to the finish diameter of the container and the amount of tolerance allowed for the defects. For FFS head specifications, refer to TW0934, "Fluidic Finish Selector Heads".

Section 5 Inspection Notes

Check Detection (standard): Inspection is limited to predominantly round surfaces on transparent containers. Containers that are opaque, translucent or have very low light transmittance properties within the spectral range of standard lights and/or sensors cannot be inspected. Container surfaces that are not round can present difficulties in inspection. Inspection of these containers might not be possible. Containers that are heavily embossed or lettered may present difficulties in inspection, requiring additional setup time.

Mold Number Reading (standard dot code reader): The FleX M standard dot code reader is capable of reading dots embossed on the heel of the container. Dots must be within proper specification, with proper clearance from other container markings, to allow proper sensing. The FleX M mold number reader cannot read “peanuts” or numeric codes located on the base of the container. (Base codes, including peanut and numeric, can be read by the optional vision mold number reader.) The dots must be positioned on a round surface of the container, usually in the heel area, although neck and shoulder areas also might be suitable. The reader must be placed perpendicular to the container at the elevation of the dots. Certain container shapes might cause the reader head to be positioned at an angle that conflicts with tooling (guide rails) requiring additional setup time. The FleX M Mold Number Reader supports the following code types:

- 9-dot heel code
- 8- and 9-dot Owens heel code
- 10-dot heel code
- 8-dot BSN heel code
- 6-dot Mini code

Specifications for the engraving of the Emhart and SGCC codes are described in the document, 16049A, *Specifications for Bucher Emhart Glass Mold Number Reader*, which can be obtained from a Bucher Emhart Glass representative.

Mechanical Plug/Ring (standard): Servo position mechanical plug/ring gauge whose position and penetration levels are adjusted in the software. There are separate output measurements for plug and ring. The following defects can be detected: minimum bore, maximum bore, maximum T (over diameter) and minimum E (under diameter). Mechanical plug gauging will affect the overall speed of the machine. The plug penetration required affects maximum machine speed (refer to table in Section 3. “Machine Speed”).

Mechanical Dip/Height (standard): Mechanical inspection performed using a servo positioned FFS (Fluidic Finish Head) whose position and compression levels are adjusted in the software. The following defects can be detected: dipped/unfilled finish, saddled/warped finish, over height and under height.

Laser Vision Check Finish Module (optional): The “LVC” finds cracks in the glass by detecting light scattering. This is done by injecting high intensity, coherent laser light into the glass wall and looking for a disruption in the coherency. Area of inspection is 35mm from top of finish for diameters up to 55mm.

- Stones, blisters, and cracks disrupt the light within the glass wall and creates a new light paths within the glass that are then detected by the cameras.
- Surface features do not affect the coherent properties of the light.
- Defects are then classified using ADC principles to determine the defect type and limits.

Wall Thickness Inspection (option): The FleX M can be equipped with an inspection system that uses a chromatic light method to measure glass thickness of containers as they rotate in front of adjustable sensing heads. This system has an ovality inspection to measure roundness of the container, as well as fin detection to detect mold seam fins.

The wall thickness measurement technology uses the color spectrum of light reflected from glass to determine glass thickness of round, as well as some non-round, containers. The chromatic system also uses relatively small sensing heads that can be positioned easily so that almost any area of the container can be inspected as it is rotated in front of the sensing heads. Up to four sensing heads can be installed at any rotator-enabled inspection station.

Testing of the chromatic system has proven that the accuracy and repeatability of the measurement system exceeds the capability of other measurement systems on the market. A given container will repeat its measured value within $\pm 1.0\%$ of the median value more than 65% of the time and repeat within $\pm 3.0\%$ of the median value 90% of the time. This repeatability applies to both minimum and maximum thickness measurements.

Base Inspection (option): The base inspection uses high resolution linear scan technology, capturing multiple images of the container as it rotates in the inspection station to inspect for opaque and transparent defects. This provides an unwrapped image of the container base.

Base Stress Inspection (option): A rotating base stress inspection using high resolution linear scan technology with cross polarization. This inspection is performed using the same camera as the base inspection detecting defects such as stones, and viscous knots.

Sealing Surface Inspection (option): Surface inspection using linear scan technology in a rotator-enabled station acquiring multiple images and then unwrapping the image. Used for finishes up to 120 mm.

Base Code Vision Mold Number Reader (option): Image acquisition is performed using a super bright LED light source with a high speed area array matrix camera (640 x 480 resolution) positioned above the container. The FleX M Vision Mold Number Reader supports the following base code types:

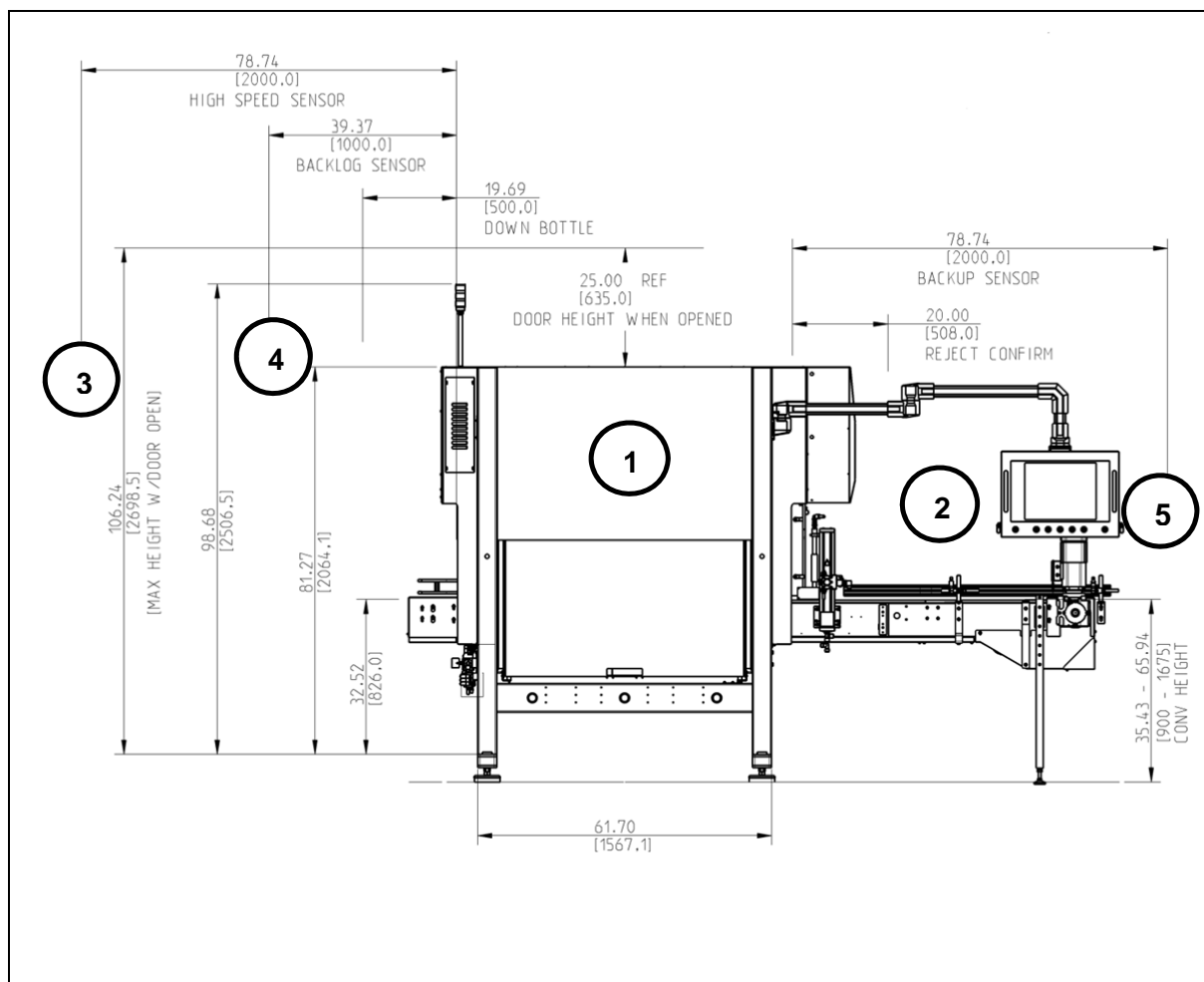
- Seven segment alphanumeric
- 10 dot round bottom
- 8 dot peanut
- 7 dot bottom
- Owens 8 dot bottom

Data Matrix Spin Reader - Camera based data matrix reader. The data matrix code can be located on either the neck or the body of the container. The reader must be located in a rotary equipped station. This inspection is an integral part of the end to end process.

Section 6 Site Preparation and Installation Requirements

Area Preparation The area where the FleX M is to be installed must include:

- A straight, level area that is free of legs and under-conveyor obstructions (minimum conveyor height is 940 mm [37 in.]). The FleX M has an integrated conveyor system, which can allow the machine to be installed on the plant's existing line conveyor. A clear area of 3675.5 mm [144 in.] is required to install the machine and its conveyor to an existing conveyor. For slower production speeds a shorter conveyor is available requiring a clear area of 1564 mm [61.6 in.].
- A clear height of at least 1600 mm [63.2 in.] above the top of the conveyor.
- A minimum of approximately 3.6 meters [12 feet] upstream and downstream of the FleX M (measured from the infeed and outfeed sides of the machine).



FleX M Machine Layout Drawing (ref. 9016C25)

- | | |
|---|--|
| 1. Machine front | 4. Backlog (prime) sensor location |
| 2. Pendant user interface | 5. Ware backup sensor location (minimum distance from machine) |
| 3. High speed sensor location (minimum distance from machine) | |

Moving the FleX M

The weight of FleX M (1451.5 kg [3200 pounds] uncrated; 2041.2 kg [4500 pounds] crated) requires special handling when moving and installing the machine. Whenever possible, the machine should not be unbolted from its pallet until it is at the installation site.

Conveyor Control System Integration. The FleX M is designed to interface with most plant conveyor control systems. However, ***Bucher 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 M and its integrated conveyor system.*** Any conveyor/machine control issues must be reviewed and resolved during machine specification. Bucher 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 M machine and conveyor.

Conveyor Control Considerations. When the FleX M is interfaced with a plant conveyor control system, the speed of the Flex M 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 FleX M 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 FleX M 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 machines. 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 mechanical machine using an analog speed reference signal from the plant line control system to the FleX M.

The following is the formula used to determine the speed of the machine;

Emhart Constant = 4105 = C (This is a value required for the Analog to digital input on the PLC)

B = Bottles Per Minute

D = Bottle diameter of container in MM

V = Voltage in volts

A = Current in Amps

$$V = (B * D) / C$$

$$A = (B * D) / (2 * C)$$

The line control system then must be configured as follows:

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

When the above procedure is followed, the FleX M and its conveyor 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 FleX M.

Air and Power Requirements

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

Power: 380 to 480 VAC, 3 phase, 25 amps

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

Section 7 Operating Environment


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

The FleX M is equipped with a closed-loop air conditioning system designed to maintain the FleX M 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. <p>Note: Machine will not restart until the condition that caused the alarm is resolved and cabinet temperature is below 50 C.</p>
Air conditioner fault.	The electronics cabinet air conditioner has stopped.	

Operating Temperatures: The FleX M 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 Bucher Emhart Glass hardware and software associated with the FleX M. If the proper operating conditions are not maintained, the electronic hardware might not function as designed.

- The internal temperature (with covers closed) must be maintained at or below 50° C [122° F].
- The maximum allowable temperature inside the machine is 55° C [131° F]. Although control components can operate at this temperature, life expectancy of the electronic components will be reduced. The lowest recommended operating 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 8 Conformity Statement

The FleX M 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 (ECM 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 TC WG13 PrEN13042 Part 6: specific Safety Requirements for Hollow Glass – Part 6: Multi-Inspection Machines.

Section 9 Specifications Required for Order Entry

The following items are configurable and require specification when ordering:

- Machine hand
- Plant voltage
- Conveyor height
- Line layout drawings
- Tooling – Container specifications and drawings are required.
- Options

Section 10 Spare Parts

Spare parts kits are available for the base machine, as well as for the optional inspections. The FleX M is covered by a one-year parts and labor warranty; however, 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 Bucher Emhart Glass under a Return Authorization number provided by Bucher Emhart Glass.

The following spare parts kits are available for the FleX M:

- **FleX M Ware Parts Kit PN 12601DSP L/R** - This kit contains common wear parts that not covered under warranty.
- **Basic Spares Kit PN 12601DSP1 L/R** – This kit contain the recommended required parts for the base machine.
- **Advanced Spares Kit PN 12601DSP2 L/R** – This kit contains both the basic spare parts, as well as parts to cover all failure conditions.
- **Basic Spares Kit WTIS PN 12601D1SP3** – This kit contains the basic parts needed to maintain the wall thickness inspection.
- **Advanced Spares Kit WTIS PN 12601D1SP4** – This kit contains both the basic spare parts as well as parts to cover almost all failure conditions for the wall thickness inspection.

Section 11 Training

Setup operation and maintenance training by Bucher Emhart Glass personnel is mandatory for optimum machine operation and extended life. A machine-specific service program also is available for the FleX M. Training programs, offered either at Bucher Emhart Glass training centers in St Petersburg, FL (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 12 Special Handling Kits

Special tooling (Part # 27755AL/R Non-Round Kit) is required for handling rotatable non-round containers.

Mini Ware Kit (Part # 27773AL/R) Ware handling kit designed for small ware.

Revisions

Rev.	Date	Description
	3 Dec. 2010	Initial release
A	6 Jan. 2010	.
B	5 Aug 2014	Added formula for speed, temperature warning chart
C	22 April 2015	Removed 8 channel check inspection, added mini ware kit
D	03 Jan.2017	Added 9 and 18 pocket tooling, Added longer conveyor
E	18 May 2018	Added laser vision check finish module
F	25 September 2018	Added scout and data matrix spin reader