

Technical News Bulletin

August 2023



Application Notes

FLEXINSPECT M GENERATION III

Section 1 Overview

The FlexInspect M Generation 3 (Flex M) is a comprehensive inspection solution offering versatility, value and flexibility. This configurable seven station, servo-indexing rotary inspection system is designed to inspect round and non-round glass containers at speeds of up to 350 containers per minute (bpm) (see ware range and machine speed information below). The Flex M comes equipped with SCOUT Ai technology software, where everything is based on defect classifications, automatic learned variations (AI) and predefined defect limits.



The Flex M is an inspection system that includes both the inspection machine and an integrated conveyor system allowing the machine to be installed on a customer's existing single line conveyor (refer to section 6, Site Preparation and Installation Requirements).

Many machines act as one. Standard on all FlexInspect generation 3 equipment

Master track is designed to follow a container through each inspection device before passing or failing the container providing full correlation of inspection data to the cavity mold number and or ID Mark (matrix code). Container position is continuously monitored and verified before the rejection point. Master track generates the data glassmakers need by capturing all of a container's information before removing it from the production line.

Machine link creates a communications network that allows all of the generation 3 devices on the line to share important status information. Generation 3 machines now share their operational status with other Gen 3 equipment installed on the line, allowing them to react when changes or events occur. This optimizes ware handling, increases container throughput and line efficiencies and saves space allowing machines to be installed close together.

The Flex M is capable of performing the following inspections.

Available Inspections

- **Check Detection** – Uses modulated lights and receivers with six, pre-set frequencies to perform finish, neck, shoulder, body, heel, and base check detection (with optional base check mounting hardware). Check detection lights and receivers can be installed at any rotator-enabled station. Standard check detection package includes 8 sensors, and 8 receivers with up to 16 modulated channels.
- **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.
- **Non-contact optical Plug/Ring/Dip/Saddle** – Narrow Neck Field of view “FOV” 70 mm [2.76 in.] max finish diameter standard – Wide mouth optional with up to 113mm [4.45 in.] max finish diameter. These inspections are performed at a single (rotator enabled) station using four multi-triggering cameras.
- **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 up to 4 chromatic thickness measurement inspection systems, which can be mounted at any rotator enabled station. Options for this technology include Precitec or VMA for integration into the Flex M.
- **Sealing Surface** – 11 - 120mm [0.43 - 4.72 in.] max finish dia – Linear scan inspection capable of detecting a range of difficult-to-detect finish defects on the interior or exterior of the finish. (light field illumination)
- **Complete Base inspection** – High resolution array scan camera technology, capturing multiple images of the container as it rotates in the inspection station, the container image is reconstructed to provide an image of the containers base used for defect detection. Base Stress uses a dedicated high resolution array scan camera to inspect for defects such as stones causing stress, viscous knots and other annealing issues (Both Inspections are performed in the same rotate station)
- **2 - point out of round (OOR)** – This inspection is performed using advanced sensing technology to detect out of round containers measuring the maximum diameter, minimum diameter, and ovality of a glass container in a rotation station. (Flex M can support up to 2 elevations)
- **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!
	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.

Section 3 Machine Speed

The FleX M is designed to run at a maximum speed of 350 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	12 Pocket
22 mm [0.875 in.]	320 bpm	260 bpm
38 mm [1.5 in.]	320 bpm	260 bpm
54 mm [2.125 in.]	280 bpm	230 bpm
70 mm [2.75 in.]	250 bpm	180 bpm
86 mm [3.375 in.]	220 bpm	180 bpm
102 mm [4.0 in.]	200 bpm	180 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.]; 12 pocket starwheels are designed for ware diameters of 66 mm to 120 mm [2.60 to 4.72 in.]; (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 on 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.

Section 5 Inspection Notes

Check Detection – 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 modulated lights and receivers 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.

- **Laser Vision Check Finish Module 29581A for flint and amber ware -1 light green -2 Dark green and Blue** – 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.

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 OI heel code	10-dot heel code	8-dot BSN heel code	6-dot mini code
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Specifications for the engraving of the Emhart and SGCC codes are described in the document, 22444A, *Specifications for Bucher Emhart Glass Mold Number Reader*, which can be obtained from a Bucher Emhart Glass representative.

Mechanical Plug/Ring 28588A: 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"). Plug and ring gauges can be purchased from Emhart Glass (if specifications are provided) or blanks of these gauges can be purchased. Plug/ring gauges have min., max. and length, 16399B for custom requirements that are container specific.

Mechanical Dip/Height 29587A: 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.

- **FFS Heads:** Used only when the FleX M is equipped with optional mechanical dip/saddle gauging, FFS heads are specific to the finish diameter of the container and the amount of tolerance allowed for dip and saddle defects. See 1286B 51-131mm or 1295B 18-40mm finishes

Vision Plug/Ring/Dip – Vision plug, ring, and dip/saddle inspections are all performed using four multi-trigger cameras and light sources in a single, rotator-enabled station.

Finish Diameter: Up to 63mm [2.48 in.] max for narrow neck finishes 29583A

Up to 113mm [4.45 in.] max for wide mouth finishes 29583A1

FleX M vision plug inspection is performed using on-axis directional diffuse light and a high resolution camera with telecentric optics mounted above the rotating container. It is capable of inspection for min and max "I" only (refer to Figure 3). It is not capable of dual-step plug gauging often required for corkage bottles. Dual-step plug gauging can be performed only with the mechanical plug/ring gauging option. During rotation several images are acquired. The software measures and reports the largest minimum measurement from the captured images.

FleX M vision Ring inspection, two high speed cameras take multiple images of the container's finish as the container rotates using a diffuse back light (same light source that is used for dip inspection) to measure "E" and "T" dimensions (refer to Figure 3) as well as detecting Knock out, Flanged, and Overhang defects.

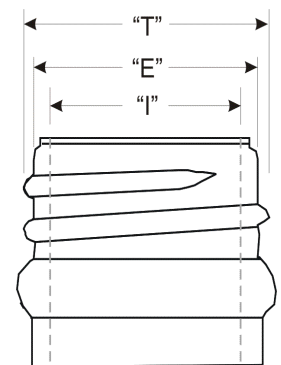


Figure 3: Finish

Wall Thickness Inspection – 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 inspection also has an ovality inspection used to measure the roundness of a container, as well as a fin detector to detect fins on the mold seams.

Chromatic technology sensing system. This 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.

- Precitec standard offering 29576A1 – 4 to determine the number of probes.
- VMA optional 29799A1-4 to determine the number of probes. Used for special applications

Complete Base / Base Stress Inspection – 29584A – The base inspection uses high resolution array scan camera technology, capturing multiple images of the container as it rotates in the inspection station, the container image is reconstructed to provide an image of the containers base used to inspect for opaque defects. This option requires a rotary equipped station and includes Base Stress Inspection that uses a dedicated high resolution array scan camera with cross polarization technology, capturing multiple images of the container as it rotates in the inspection station. The container image is reconstructed providing an image of the containers base and detects defects such as stones causing stress, viscous knots and other annealing issues.

Sealing Surface Inspection (option) 29510A1 - 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) 29585A - 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
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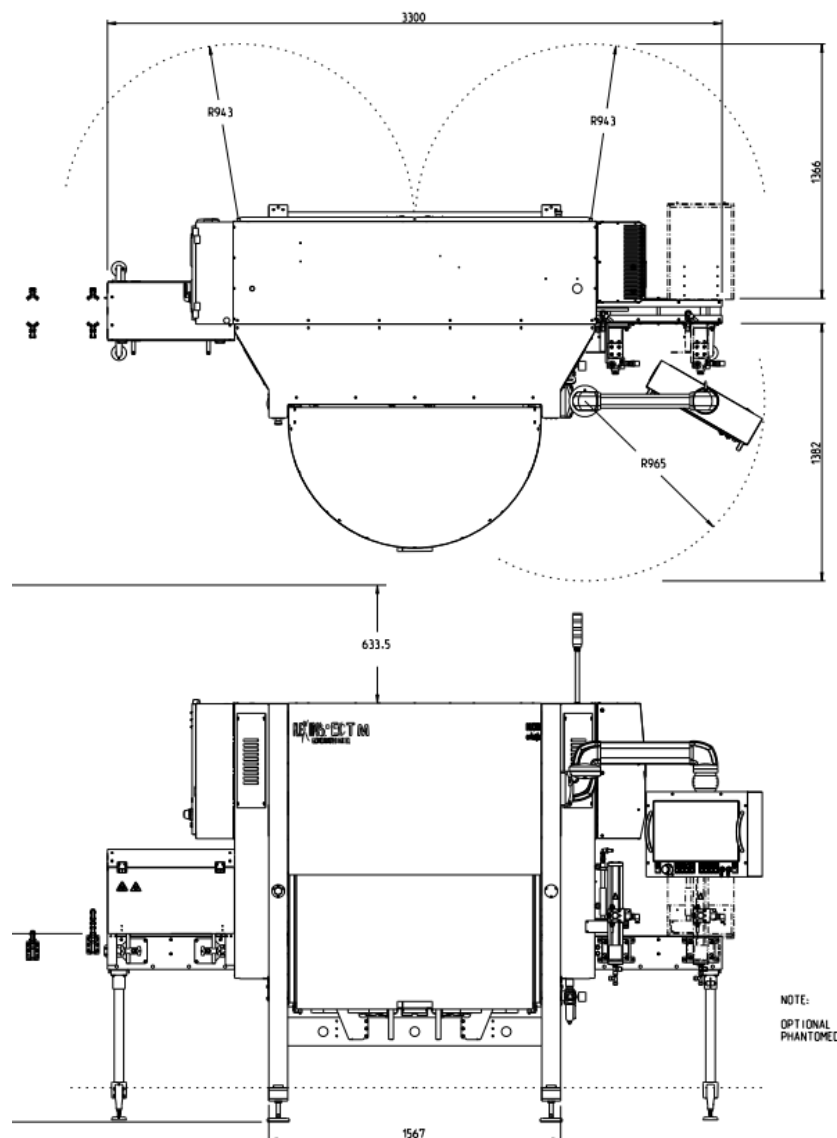
ID Read - Data Matrix Spin Reader 29577A- Camera based data matrix reader. The data matrix code can be located on either the neck or the body of the container. The reader must be located in a rotary equipped station. This inspection is an integral part of the end to end process.

2 Point Out Of Round (OOR) – This inspection is performed using advanced sensing technology to detect out of round containers based on variances in maximum and minimum diameter, as well as maximum acceptable variance from maximum and minimum diameter at a specific position on the container. This inspection can control up to 2 elevations on the container.

Section 6 Site Preparation and Installation Requirements

NOTE: Refer to 13101DIN installation drawing for detailed machine clearances shown in Figure 1.

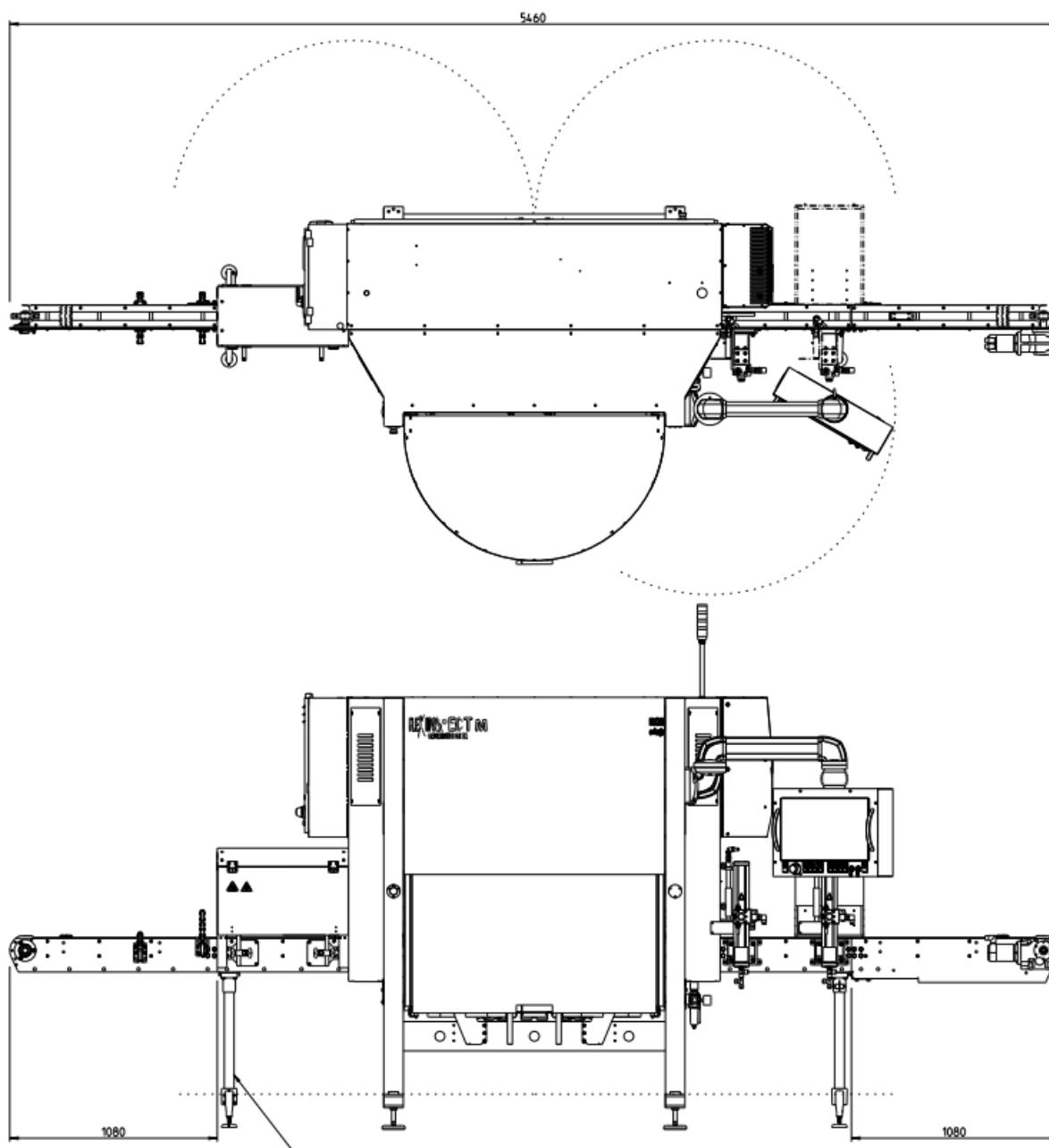
Inline stub conveyor (Figure 1)



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 3300 mm [129 in.] is required to install the machine and its stub conveyors to an existing conveyor.
- A clear height of at least 1870 mm [63.2 in.] above the top of the conveyor.

Parallel transfer conveyor (Figure 2)



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 3460 mm [136.25in.] is required to install the machine and its conveyor in a bypass conveyor configuration.
- A clear height of at least 1870 mm [73.6 in.] above the top of the conveyor.

Moving the FleX M



WARNING!

WARNING!

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.

The machine is front-heavy. If not lifted correctly, the machine will fall forward causing significant damage to the machine and possible serious injury to anyone standing near the front of the machine.

When lifting and moving the machine and the remote electronics cabinet, be sure to follow the installation instructions provided with the machine.

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 the 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 Flex M accepts an analog signal with 4-20ma

1. 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.
2. 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 (28.3 ft. 3/min) .

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. No water chiller cooling option is available at this time.

Fault Message	Description	Machine State
Over temperature warning	The temperature inside of the electronics cabinet has exceeded the user set warning.	- Counters reset - Machine status icon is yellow.
Over temperature fault	The temperature inside of the electronics cabinet has exceeded 50 C.	- Machine stopped - Red stop button is illuminated - Counters reset icon flashing. - Machine status icon is red. Note: Machine will not restart until the condition that caused the alarm is resolved and cabinet temperature is below 50 C.
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.
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- **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 2014 / 35 / EU (Low Voltage Directive)
- Directive 2014 / 30 / EU Electro Magnetic Compatibility Directive (EMC)
- Directive 2006 / 42 /EC Machine Directive
- Directive 2014 / 53 / Radio Equipment Directive (RED)

Additional standards apply

- EN 60204-1:2018, 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 61000-6-2:2019, EMC – Immunity
- EN 61000-6-4:2019, EMC – Emission
- EN 55011 – Radio-frequency disturbance characteristics – Limits and Methods of measurement

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 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.
- Inspection 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:

Machine Spares 12/24 pocket configuration

- **FleX M Wear Parts Kit PN 13101DSP** – This kit contains common wear parts that not covered under warranty.
- **Basic Spares Kit PN 13101DSP1** – This kit contain the recommended required parts for the base machine.
- **Advanced Spares Kit PN 13101DSP2** – This kit contains both the basic spare parts, as well as parts to cover all failure conditions.

Additional Spare Parts Kits:

- 13101DSP3 – Basic spares for Precitec wall thickness
- 13101DSP2 – Advanced spares for Precitec wall thickness including basic spares
- 13101DSP6 – Spare parts for vision Plug / Ring / Dip
- 13101DSP8 – Spare parts for Base / Base stress
- 13101DSP5 – Spare parts for vision Mold reader
- 13101DSP7 – Spare parts for, vision computer
- 13101DSP9 – Spare parts for Laser vision check, LVC

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 Windsor Ct. (USA) or Munich, 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. 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 # 29736A Non-Round Kit) is required for handling rotatable non-round containers.

Mini Ware Kit (Part # TBD) Ware handling kit designed for small ware.

Revisions

Rev.	Date	Description
-	August 2023	Initial release