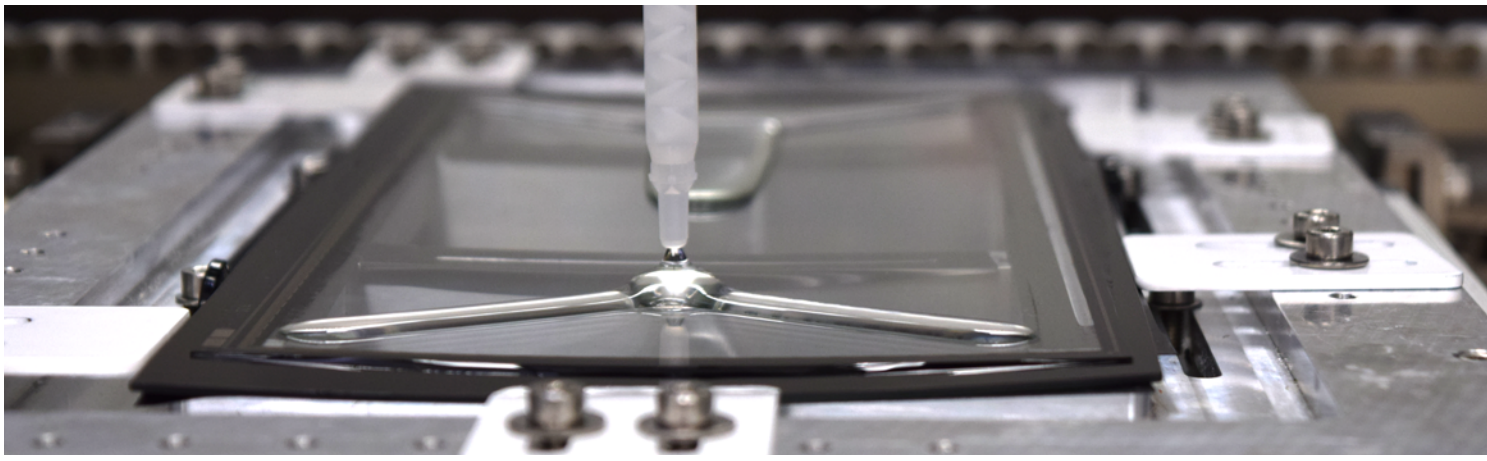
INNOVATION. PRECISION. EXCELLENCE.

PRECISION PACKAGE: OPTICAL BONDING



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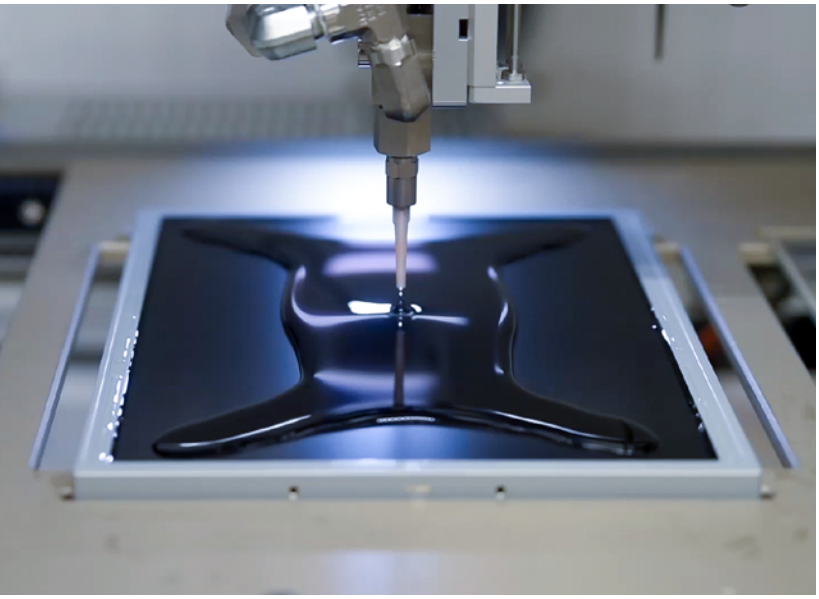
OPTICAL BONDING APPLICATIONS



Optical bonding is the process of applying an optical clear liquid to a digital display, such as LCD or plasma, to bond a cover glass and/or touch sensor to eliminate the air gap between each layer. This provides improved image clarity, especially in outdoor or bright light environments. In environments with fluctuating temperatures, optical bonding can also help to prevent condensation and fogging within displays.

This application is ideal for producing screens that are highly durable and will stand up to harsh environments. Screens that are assembled using an optical bonding process will also have increased touch reliability as a result of higher-pressure accuracy through the substrate.

Contact us for more information on equipment selection and options.

KEY INDUSTRIES

- Aerospace
- Automotive
- Defense
- Energy
- Industrial
- Medical Devices
- Telecommunications
- White Goods

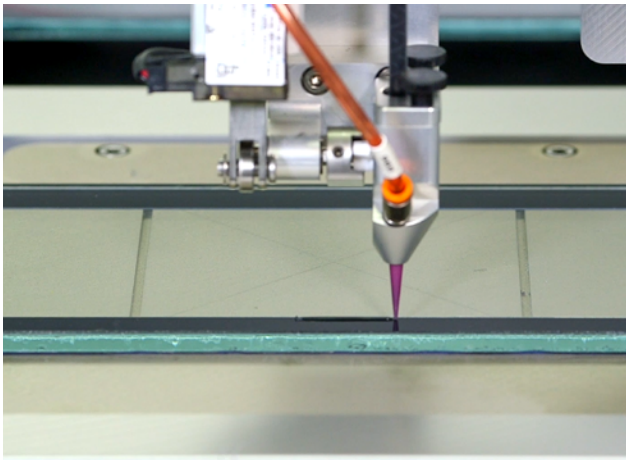
CHOOSE YOUR DISPLAY ORIENTATION

One of the most important components to defining your optical bonding line configuration is based on what type of display you will be bonding: a bezel framed LCD or an open, frameless LCD. Below are some key comparison points that help highlight the differences between the two types.

Bonding Methods		
	Bezel - Framed LCD	**Open - Frameless LCD**
Bonding Orientation	Face up: Assemble cover/lens to display	Face down: Assemble display to cover/lens
Dam Type ***(Sets bond gap & controls LOCA flow; typically UV cure; one or two component material)***	Dispensed on bezel with LED UV cure	Dispensed on cover glass/lens with LED UV cure
Seal	Required between display and bezel to prevent LOCA from leaking into display	Not required
Bonding on Glass Datum	N/A	Provides optimal flatness control and allows for fluid flow vision for faster development along with underside cure in place via LEDs

LOCA Chemistry		
	Bezel - Framed LCD	**Open - Frameless LCD**
Acrylic ***(One Component)***	• UV cure • LED tack cure in place • UV oven final cure	• UV cure • LED cure in place • Underside (through glass datum)
Silicone ***(Two Component)***	• Heat cure via a vertical oven	

CREATE EFFECTIVE DAMS & SEALS

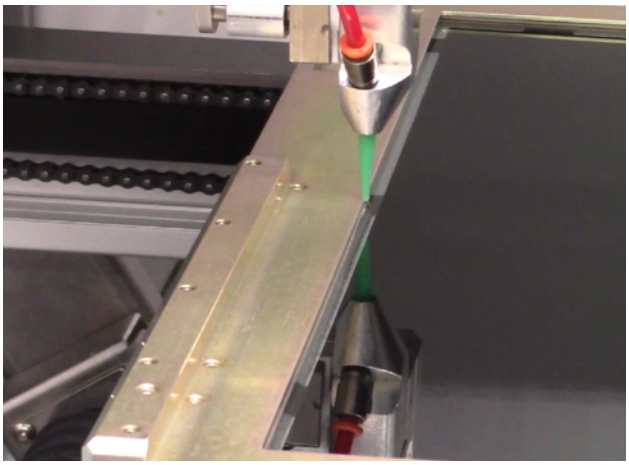


For atmospheric optical bonding applications, a precisely applied dam helps to effectively ensure three main functions:

1. The liquid optically clear adhesive (LOCA) will be contained as it flows to the edges of the display assembly during the bonding process. A properly designed dam can greatly reduce the likelihood of trapping air during the bonding process.
2. This dam helps to create a positive location for an extremely repeatable adhesive bond gap.
3. The dam can also help to maintain the alignment of the lens to the display during the curing process. Many dam materials are designed to be tacky after exposure to UV which serves as a locating method as the display assembly continues into the cure process.

In order to choose the proper dam material, consider the following:

- Compatibility with LOCA
- Cured properties such as durometer, tackiness, etc.
- Cure method - this will be mostly UV cure as it holds the height tolerance and allows for faster cycle times



For bezel displays, a seal dispense will most likely be required to prevent LOCA from flowing between the bezel and the LCD.

While in most cases the same material used for the dam can be used for the seal, remember to consider the following:

- Compatibility with LOCA
- Optical clarity requirements which are especially important closer to the active area
- Cure method
- Viscosity to build a consistent fillet

DAM & SEAL DISPENSING METHOD

Some of our most common valves for deal and seal dispense are shown below with optional features and additions where applicable. To learn more about each valve, scan the corresponding QR code. To inquire about a custom solution, please contact PVA at info@pva.net or 518-371-2684.

FC100-MC

Versatile dispensing valve with a divorced design to prevent material contamination of the air section and micrometer flow adjustment. Compatible with all Luer Lok needle tip designs.

Recommended for one component dam and seal applications.

PCP

Featuring a machined rotor coupled with a rubberized seal to assure drip-free operation with a wide range of viscous chemistries for high precision dosing ±1%.

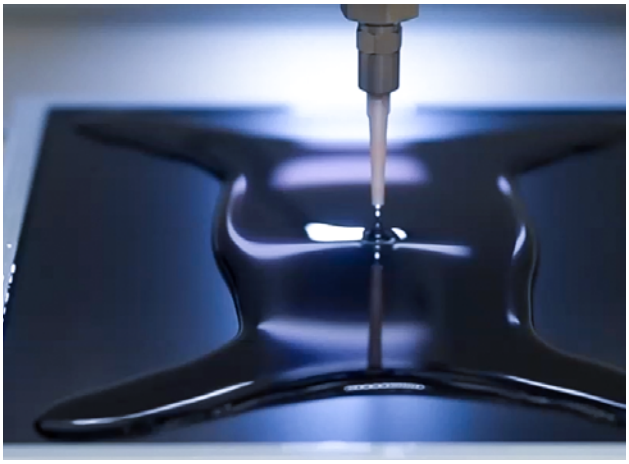
Recommended for one component dam and seal applications.

PDP

Progressive cavity pump with superior volumetric accuracy for your most demanding two-component dispensing applications with high precision dosing ±1%.

Features a programmable flow rate and mix ratio (1:1 to 10:1).

EFFECTIVE LOCA DISPENSING



Choosing the correct automation, material preparation, and fluid delivery method can help ensure your LOCA is accurately dispensed.

LOCAs can be dispensed via a DeltaBond optical bonding machine or in an upstream dispensing machine for reduced cycle times.

Integrating a metering system, such as the Endurance, is recommended to help process one and two component materials. The Endurance precisely meters LOCA material for extremely accurate volumetric fill while maintaining ratio for two component materials.

Adding a PVA-SDC smart delivery cart as a material supply system allows the metering system to be fed fully degassed material with an automated configurable degas schedule. A remote drum fill option can be added to eliminate the need for handling of materials inside the clean room. With the remote drum fill option, the LOCA delivery system is completely sealed for the highest level of purity and cleanliness.

PVA-SDC smart delivery cart

Endurance dispensing metering module

LOCA DISPENSING METHOD

Some of our most common valves for LOCA dispense are shown below with optional features and additions where applicable. To learn more about each valve, scan the corresponding QR code. To inquire about a custom solution, please contact PVA at info@pva.net or 518-371-2684.

FC100-MC

Versatile dispensing valve with a divorced design to prevent material contamination of the air section and micrometer flow adjustment. Compatible with all Luer Lok needle tip designs.

Recommended for one component acrylics for LOCA dispensing.

PC100

Plural component mixing valve with a divorced valve design that prevents material contamination of the air body. Compatible with oversized bell inlet disposable static mixers.

Recommended for two component silicones for LOCA dispensing.

DEFINING YOUR DAM & SEAL AUTOMATION

With dam and seal requirements determined, an inline/batch automation combination can be selected to complete your dispensing process. Scan the corresponding QR code to learn more about each system.

Flex Cell

Designed to meet your specific application requirements. Available in standard to very large work areas and can be highly customized.

Work Area
Various, from 500 mm^2 - 1200 mm^2

Footprint
Varies upon workcell

Delta 8

Conceptualized for maximum flexibility, the Delta 8 features a robust overhead three-axis motion platform suitable for inline or batch operations.

Work Area (1 Valve/Tool)
621 mm x 595 mm x 100 mm

Footprint
1270 mm x 973 mm x 2222.6 mm

Inline/Batch Configuration Options

Number of Axes

3

Valves

One component:
- Front closing high pressure
- Progressive cavity pump

Two component:
- Progressive cavity dual pump

Head Tooling

Touch probe heat sense
UV curing wand (LED or broad spectrum)

Fluid Delivery

Syringe
Cartridge direct mount
Cartridge pump

Substrate Handling

Inline configurations:
- Poly chain clean room conveyor with vacuum datum

Standalone configurations:
- Tooling plate with vacuum fixture
- Single drawer with vacuum fixture
- Dual drawer with vacuum fixture

Vision

Fiducial camera

Software

Barcode
MES
Data logging

Additional Options

Black light
Needle calibration block

DEFINING YOUR BONDING AUTOMATION

With any bonding requirements determined, an inline/batch bonding automation can be chosen to complete your process.

DeltaBond

Suitable for all steps in the optical bonding process and includes precision dispense, fill, image corrected pick and place, and bonding of optical devices. Offers portions on the process including fill dispensing, cover placement, Fluid Flow Vision™, and full area cure in place.

Display Size (Diagonal 16:9)*

DeltaBond-17: Up to 431.8 mm

DeltaBond-24: Up to 609.6 mm

** Display size capacity can vary depending on aspect ratio and lens geometry.*

Standard Footprints*

Small: 973 mm x 1270 mm x 2351 mm

Large: 1332 mm x 1588 mm x 2133 mm

** Custom sizing also available.*

Inline/Batch Configuration Options

Number of Axes

4

Valves

Plural component mixing valve
Front closing dispensing valve

Head Tooling

LOCA dispense valve
Touch probe height sense
Component pick head with theta axis options:
- Custom mechanical gripper
- Custom vacuum pick head

Fluid Delivery

LOCA SDC

Substrate Handling

Inline configurations:
- Poly chain conveyor for clean rooms
- Vacuum datum

Standalone configurations:
- Single or dual drawer
- Vacuum datum

Vision

Substrate fiducial camera (gantry mounted)
Component fiducial camera (fixed, upward facing)

Software

Pallet RFID reader
MES
Data logging

Additional Options

Bond calibration tool
Fluid Flow Vision
Needle calibration block
Tooling and pallet ID

CURING & HANDLING FOR OPTICAL BONDING

Curing and handling options can easily be added to streamline your optical bonding process. Scan the corresponding QR code to learn more about each system.

Curing Solutions

Spectra

With Fusion® UV lamps by Heraeus, the Spectra can initiate fast ultraviolet light polymerization of dam and seal or LOCA materials for an efficient inline process. Various beam widths are available to accommodate a wide range of substrate dimensions.

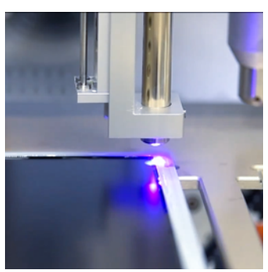
Working Width
50 mm to 500 mm

Footprint
1651 mm x 1066.8 mm x 1661.2 mm

Spectra LED

An LED curing system will provide a variety of high-powered LED sources (365nm, 385nm, and 405nm options available) with programmable LED intensity and optional UV intensity sensor available.

The use of energy efficient LEDs generates less heat equating to reduced product temperatures requiring less ventilation and clean room volume exchanges. Spectra LED ovens can be used post dispense and/or bond for high throughput applications.



Spot Curing

Options to apply UV energy to a specific location for tacking or curing. This can be integrated into a dam and seal robot to cure in place for low volume applications or into a DeltaBond to secure a bonded display prior to the final cure.

Options available:

- Broad-spectrum or LED UV light
- Choose from spot, line, or area curing

Vertical Oven

Often used for the curing of optical bonding LOCA materials, the vertical oven provides a uniform temperature-controlled environment to yield the highest quality bond.

The servo driven elevator and pallet handling mechanism ensures the uncured display is handled without disturbing the component alignment.

Additional options available include humidity control and pallet sensor interlocks to prevent product damage.

Pallet Working Width
Up to 530 mm x 610 mm

Footprint
2220 mm x 2104 mm x 3265 mm

Handling Solutions

Queue-S Transfer & Inspection Conveyor

Ideal for a wide range of part handling applications, the Queue-S transfer and inspection conveyor can optimize material flow between processes for either bare board assemblies or pallet fixtures.

Working Width
50 mm to 500 mm

Footprint
1046 mm x 1003 mm x 2022.9 mm

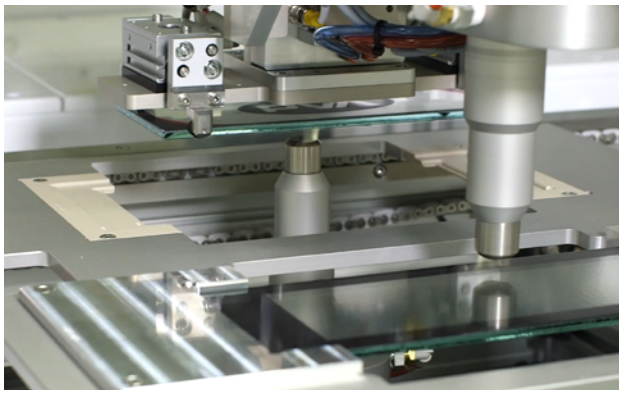
Curing and Handling Configuration Options

Conveyor Height	Component Clearance
940 mm to 965 mm from floor (SMEMA)	100 mm (4 in) maximum top and bottom 4.75 mm (0.187 in) in edge carrying (SMEMA)*

**Applicable for Queue Series*

RECOMMENDED ADDITIONS

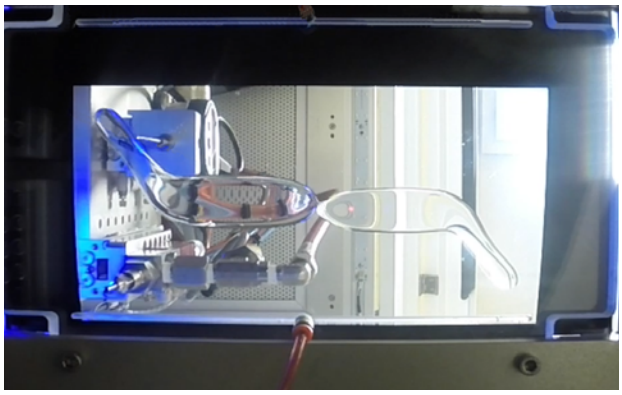
Surface Preparation



There are two cleaning options that are recommended for a surface preparation step before beginning your process:

1. Plasma Treatment: Used for the treatment of both the display and the lens surface prior to the optical bonding process is always recommended. This process increases surface energy which, in turn, promotes better adhesion and LOCA wet out. Faster wet out allows for a higher throughput and more consistent process.
2. Taifun Cleaner: An additional non-contact surface cleaning method that removes dust and debris that is performed prior to the plasma treatment process. Similar to plasma treatment, this promotes better adhesion while also reducing scrap due to foreign object debris (FOD).

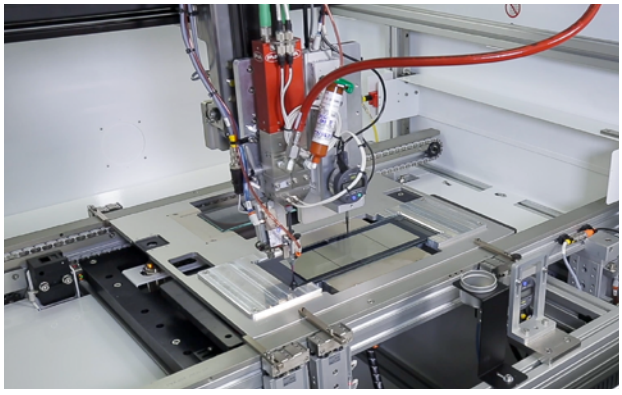
Fluid Flow Vision



PVA's Fluid Flow Vision allows for faster set up and process development.

A live image of the bonding process shows the flow of LOCA in real time, allowing process engineers to make adjustments to dispense paths and component placement to achieve efficient bubble-free bonds. PVA's Bond Manager software displays the relative bond gap in real time allowing for easy correlation to where the process can be improved and optimized when combined with Fluid Flow Vision.

Pallets and Tooling



PVA offers custom built pallets and tooling designed around the optical bonding process. Properly designed tooling will yield lower scrap rates.

Custom Display and Cover Lens Pallets

These pallets are clean room compatible, non-marking, and made with temperature stable materials. Additionally, they can be RFID enabled to provide traceability on the part level for every process in the line.

Custom Display and Cover Lens Bonding Datums

Provides optimal flatness for more consistent bond gaps and LOCA wet out. Additionally, they allow the process to be monitored via Fluid Flow Vision.

Quick Change Tooling

This tooling's ID sensors allow for tool-less change over by verifying correct machine setup for a more robust process.

SAMPLE CONFIGURATIONS

Some of our most common inline configurations for conformal coating are shown below. Please contact us for custom solutions or more information.

Bezel Display Line

Queue

Flex Cell with Plasma Treatment

Flex Cell for Dam & Seal with UV Wand

DeltaBond

Queue

Spectra UV LED

Queue

Frameless Display Line with Underside Return

Elevator[1]

Queue

Taifun Cleaner

Flex Cell with Plasma Pre-Treatment

Spectra UV Dam & Cure

Shuttle

Delta 8

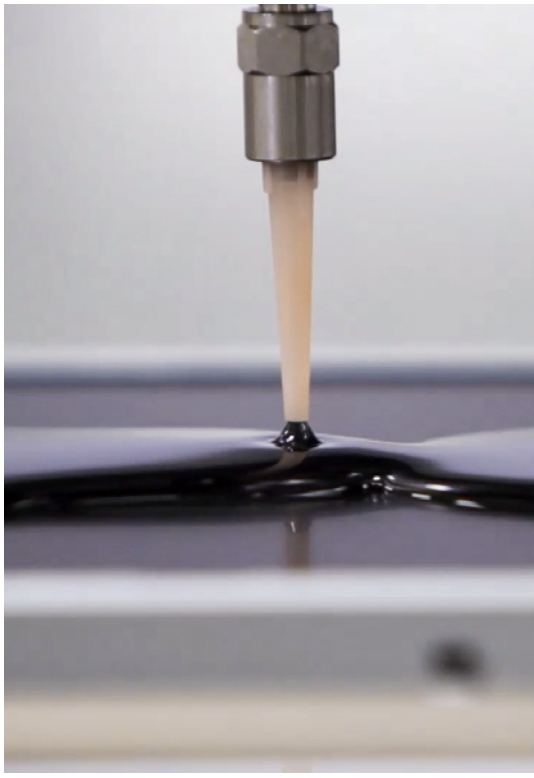
DeltaBond

Queue

Vertical Oven

[1]*Elevators are built to order. Please contact a local representative for more information.*

FREQUENTLY ASKED QUESTIONS



Does optical bonding change a display's operating temperature range?

No, optical bonding only alters the surface of the display rather than the components. Due to this, the operating temperature will not change.

What are some key parameters that the liquid adhesive should meet?

The liquid adhesive used must be transparent and have a suitable refractive index. It should also have an adequate bond strength, reasonable pot life, and cure to the proper finished bond condition using temperatures and conditions that will work within your process.

Why is selecting compatible materials for my LOCA and dam/seals so important?

Different materials expand and contract at varying rates when exposed to temperature changes which can cause thermal expansion mismatches. By taking this into consideration when choosing your materials, it can help to prevent delamination or warping of bonded layers, which can degrade display performance over time.

How important is part alignment to my application?

Even the smallest misalignments can significantly impact the display's quality and touch responsiveness. By achieving micron-level alignment, image distortions are prevented while also ensuring the functionality of touch surfaces.

Why is finding the right curing method so critical?

Balancing both cure speed and bond strength is vital, especially when dealing with sensitive components. Over-curing materials can lead to damaged parts whereas under-curing can result in weak bonds between your materials and components.

What are some factors that can cause bubbles in LOCAs?

Bubble issues can mainly be caused by improper adhesive material selection or poor processing of the adhesive. For adhesive material issues, this can be caused by a very high viscosity of adhesive that prevents the escape of bubbles or high shrinkage of the LOCA. Processing issues can arise due to missing a degassing step during the bonding process, application of very high vacuum pressure that is not well optimized, or manual dispensing which can result in variation in volume and pattern method.

Leader in World Class Dispensing, Coating, and Custom Automation

PVA is a world class innovator of high quality, repeatable dispensing and conformal coating systems. We manufacture turnkey solutions that help our customers improve their competitiveness. We do that through engineering robust processes that introduce repeatable results that reduce waste, increase throughput, and lower manufacturing costs. Our flexibility is unmatched as each solution is customized to optimize your manufacturing goals.

Headquartered in Upstate New York, with regional sites stationed throughout North America, Europe, and Asia, all PVA Systems are backed by a 24-hour global service network.

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