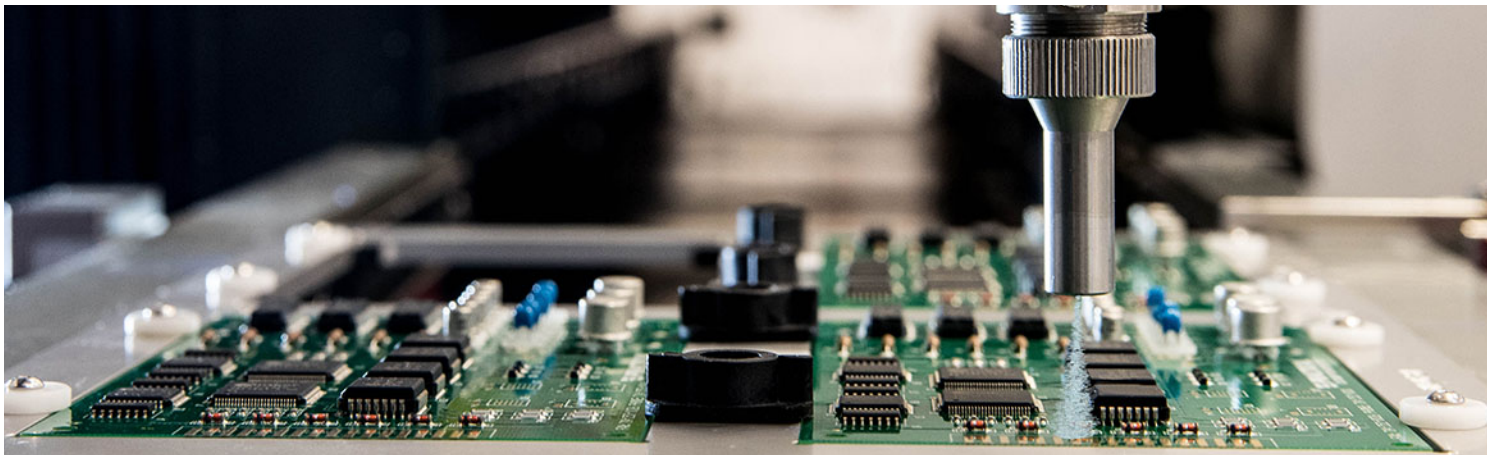
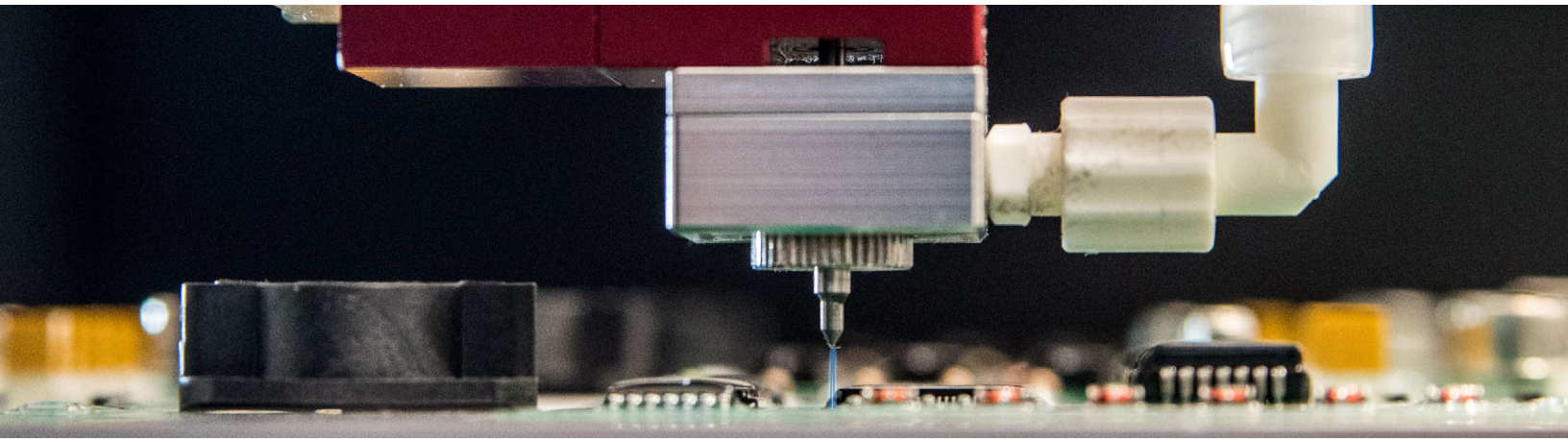
INNOVATION. PRECISION. EXCELLENCE.

PRECISION PACKAGE: CONFORMAL COATING

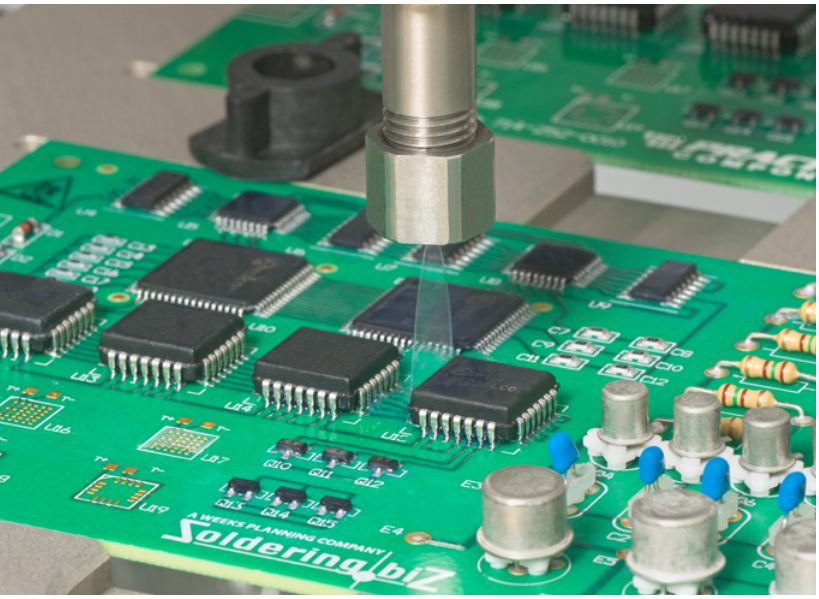


REV B - 2/2024

TABLE OF CONTENTS



CONFORMAL COATING APPLICATIONS



Conformal coating is a protective coating or polymer film that "conforms" to the circuit board's inherent irregularities to protect electronic circuits from harsh environments. Conformal coatings are a breathable protective layer that protects a printed circuit assembly from its exposed environment by filtering out airborne contaminants and maintaining long-term surface insulation resistance. Entrapped moisture, however, is allowed to escape.

Conformal coatings are available in a wide range of formulations dispersed in organic solvents (solvent-based), water (water-based), or 100% solids (silicones and many UV curables). Common conformal coating chemistries include acrylics, urethanes, silicones, epoxies, synthetics rubbers, parylene vapor phase deposition, thin film "nano" coatings, and UV curable acrylated urethanes. Each chemistry has desirable physical properties for end uses.

Numerous automated application techniques exist to match an end user's desired application results with the chemistry to be utilized. Atomized spray techniques introduce minimal air pressure to break the coating into droplets in a wide variety of patterns and coverage widths. Atomized spray valves are versatile for a wide range of coating chemistries including silicones, 100% solids, and UV curables. Non-atomized coating is ideal for chemistries under 100 cps and results in a thick film that is ideal for solvent-based formulations that have a high evaporation rate.

For detailing smaller topographies, flood applicators, micro-streaming, and jets are available to work around tight keep-out areas. Contact us for more information on equipment selection and options.

KEY INDUSTRIES

- Aerospace
- Automotive
- Energy
- Industrial Coating Systems
- Telecommunications
- White Goods

DEFINING YOUR SOLUTION

With the wide range of coating chemistries and equipment options available, your application may seem hard to define. Having answers to the key points listed below will help start the process of creating a solution in a reasonable time frame.

STEP 1: Understand the Coating Chemistry

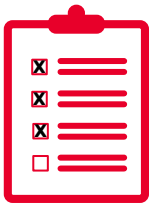
If necessary, call the material manufacturer to obtain information and discuss properties such as:

- Base chemistry
- Solvent based or 100% solids composition
- Viscosity
- If dilution is required for spraying
- Thickness limitations
- How to cure
- How it will be supplied (cartridge, can, pail, bladder bag, etc.)

STEP 2: Understand Coating Requirements

Clearly define the requirements of the coating application. For example:

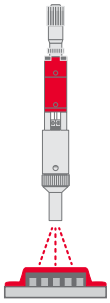
- Must coat and no coat areas
- Target thickness
- Distance from keep out zones
- Throughput requirements
- If coating is required on both sides of substrate



STEP 3: Choose the Application Method

The application method can be determined by asking the following:

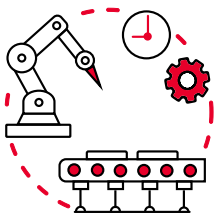
- Does the applicator reach all areas?
  - » Spray valves for a thin film
  - » Needle or jet valve for detail or hard to reach areas
- Is a gel or masking step required?



STEP 4: Define the Automation Required

Defining automation is driven by answers for Steps 1-3. For example:

- What is the required number of robot axes?
- How large is the required work area?
- What type of handling is needed?
  - » Manual load/unload or conveyorized?
- Are carrier pallets required?
- Are there any additional process control options needed (flow monitor, pumps, etc.)?
- What is the target throughput?



CHOOSING YOUR APPLICATION METHOD

Once your coating chemistry and requirements have been successfully defined, you will be able to choose your application method. Some of our most common valves for conformal coating 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.

FCS300-ES

Extended spray valve for atomized spray processes with excellent edge definition and coating transfer efficients in excess of 99%.

Pattern
Narrow cone, 3 - 6 mm

FCS300-ES-UF

Atomized spray valve that produces a fine cone-shaped pattern with edge definition of ±1 mm with a 99% transfer efficiency.

Pattern
Narrow cone, 2 - 4 mm

FCS300

Atomized spray valve ideal for low pressure, low volume processes. Available in round cap or flat cap options.

Pattern
Round cap:
Conical, 3 mm - 25 mm

Flat cap:
Fan-shaped, 19 mm - 50+ mm

FC100-CF

Airless film coating valve that produces a sharp stream of low viscosity fluids and is ideal for solvent based coatings.

Pattern
Stripe, 8 - 10 mm

FC100-MC

Needle dispense valve that uses standard Luer Lock needles. Use for detail or hard to reach areas. Capable to use with high pressure for dispensing gels, masking, staking, and encapsulants.

Pattern
Dot or line, varies with needle

FCM100

Micro dispense valve for non-contact application of low viscosity coatings.

Pattern
Dot or line

JDX

High precision non-contact jet valve for fine dots and lines of coatings, adhesives, and encapsulants.

Pattern
Dot or line

DEFINING YOUR AUTOMATION

With an application method chosen, a benchtop or inline/batch automation method can be selected to complete your process. Scan the corresponding QR code to learn more about each system.

Benchtop Solutions

Sigma

Powerful benchtop robot with robust gantry. The Sigma allows for many of the same options available on our larger systems, but in a smaller footprint.

Work Area (1 Valve/Tool)
330 mm x 300 mm x 100 mm

Footprint
743 mm x 643 mm x 805 mm

PVA350

A compact 3 axis robot ideal for entry level automation of a variety of coating and dispensing applications.

Work Area (1 Valve/Tool)
365 mm x 378 mm x 101 mm

Footprint
944.3 mm x 831.8 mm x 793.7 mm

Inline/Batch Solutions

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
1046 mm x 1270 mm x 2350.9 mm

Delta 6

Designed with a slimmer footprint, the Delta 6 features improved structural and gantry rigidity for robustness and easier access for both inline or batch operations.

Work Area (1 Valve/Tool)
521 mm x 485 mm x 100 mm

Footprint
847 mm x 1136.9 mm x 1606 mm

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

Inline/Batch Configuration Options

Number of Axes

3, 4, or 5*

Valves

Spray
Needle
Jet

Head Tooling

3-Axis, 2 head
3-Axis Dual Tool, 4 Station - Servo or manual adjust
4-Axis - Up to 3 heads
5-Axis - Up to 4 heads*

Fluid Delivery

Syringe
Cartridge
Pail
Bladder bag

Substrate Handling

Edge chain conveyor
Pin chain conveyor
Flex fixture
Tooling plate
Single drawer
Dual drawer

Vision

Fiducial camera
Programming camera

Software

Barcode
MES
Hermes
CFX

Additional Options

Black light
Blower
Needle calibration block
Flow monitor

**Applicable if a Valve Tool Changer is added*

CURING AND HANDLING

Curing and handling options can easily be added to streamline your 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 adhesives and coatings in 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

DeltaTherm

Utilizing infrared panels, the DeltaTherm can efficiently cure adhesives and coatings in a controlled, heated environment. With its double-sided configuration, the DeltaTherm offers custom top and bottom heat profiling in each two-foot section. Optional humidity control feature is available for further control of moisture cure applications.

Working Width
50 mm to 500 mm

Footprint
Varies upon oven
4ft, 8ft, 12ft, and 16ft options available

Handling Solutions

Q Series Conveyor

Ideal for a wide range of part handling applications, the Q Series inspection conveyors 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
890 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 Q Series Conveyors*

SAMPLE CONFIGURATIONS

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

Coat + Cure UV

Delta 8 + Queue Inspection Conveyor + Spectra + Queue Inspection Conveyor

Coat + IR UV

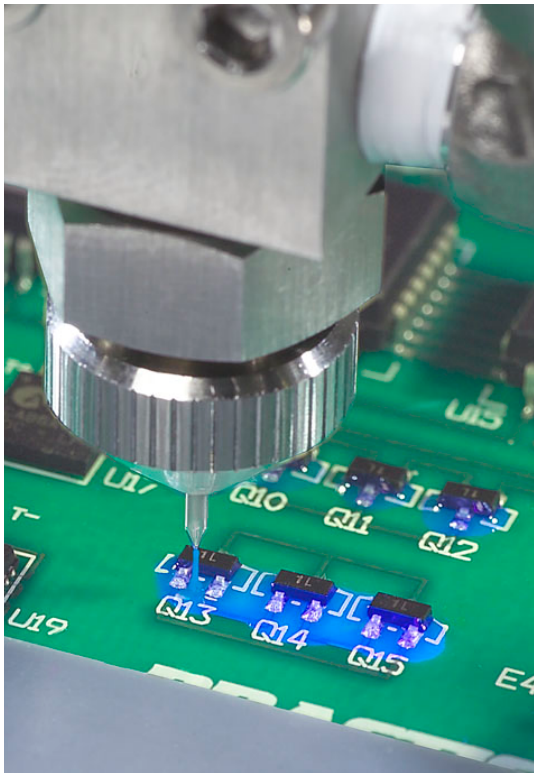
Delta 8 + Queue Inspection Conveyor + DeltaTherm + Queue Inspection Conveyor

Send Return Line

Elevator† + Delta 8 + Queue Inspection Conveyor + DeltaTherm + Queue Inspection Conveyor + Elevator†

†Elevators are built to order. Please contact a local representative for more information.

FREQUENTLY ASKED QUESTIONS



What can I do to eliminate bubbles in my coating on the surface of my circuit board?

Numerous variables can contribute to micro bubbles appearing on your coated surface. Starting back at the material reservoir, check for moisture in the tank that may have altered the viscosity of the chemistry and degas the pressure vessel. Make sure your material reservoir is relieved of pressure at night when not in use. The fluid delivery system may need to be purged to flush any existing entrapped air. At the application valve, if the process is atomized, reduce the air pressure.

If bubbles only appear after the cure process, excessive coating thickness, an overly aggressive cure profile, or residue on the board surface are often contributing factors.

How do I measure conformal coating thickness?

There are numerous ways you can measure coating thickness. Wet film thickness can be measured directly by using gauges that have a series of notches and teeth - each having a calibrated length. The gauge is placed directly into the wet film, and the measurement is then multiplied by the percent-solids of the coating to approximate dry coating thickness.

A simple non-destructive method is to measure points along the uncoated substrate with calibrated micrometers then remeasure these points after coating, with the difference being the dry thickness. Other non-destructive measurement options include use of Eddy current probes or ultrasonic gauges.

How can I measure/monitor viscosity of my coating?

Viscosity can be monitored by utilizing a zahn measuring cup. A zahn cup has a hole in the base on a wire. Dip the cup into the liquid and lift it out of the coating. Since the volume of the cup is fixed, if you time the flow of the coating out of the cup you get a relatively accurate and simple method of measuring viscosity. Many coatings can have thinner added to lower the viscosity, allowing you to calibrate to your standards. Consult your conformal coating supplier..

What do I do if my conformal coating is not sticking to the board surface?

It is not unusual for coatings to retract, or pull away, from areas of a circuit board that may have been contaminated, preventing adhesion. Debris, fingerprint oils, and solder mask compatibility with your coating can all contribute to the conformal coating material's lack of adhesion to the desired surface. In some cases, cleaning or surface treatment may be necessary prior to the conformal coating application.

What application head(s) should I be using for my selective coating project?

Choosing the appropriate application tool is a product of evaluating your coating material, desired thickness, and process coverage area. Typically solid coatings, including UV-curables, are atomized. Chemistries with a high percentage of solvents can be film coated with our FC100-CF. Virtually all PVA applications ship with a wide coverage valve and detailing capability. Detail valves allow you to work around keep out areas and minimize flow of the coating. Dispense, stream, and jetting processes are all employed and selection hinges on your desired thickness and the proximity of a coated area to a keep out zone. PVA's application team can assist you in identifying the appropriate coating valves for your process.

CURRENT TRENDS IN CONFORMAL COATING

by Frank Hart, Sales & Marketing Managing Director

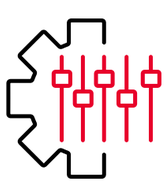
To an equipment manufacturer, conformal coating materials are the essential piece to a customer's success or failure. The marriage of material and correct application equipment dictates everything from process implementation, line efficiency, quality, and customer satisfaction. This interdependency drives chemical companies and equipment suppliers to a unique relationship. New product or process development is often dictated by the capabilities of each other and developed in tandem.

While performance properties, reworkability, and cure mechanisms all contribute to the marketability of a coating material, ease of application can often dictate how widely a product is accepted by consumers. Further, the technology must exist to process a chemistry per its intended application. This requires equipment manufacturers to work diligently with formulators to assure they have products to meet the demands of material trends throughout the industry.

The Rise of the Equipment-Chemical Relationship

One of the most prominent examples of this chemical equipment supplier relationship occurred nearly 30 years ago as formulators began to heavily market solvent-free, higher viscosity coatings (>100 cps). These materials could not be processed well with non-atomized film coaters, the prevalent technology of the era. The material didn't flow as well as its lower viscosity alternatives and the coating was applied much too thick as there was no solvent evaporation. This problem quickly turned to opportunity as dispensing companies started to invest in researching atomized application solutions.

The atomized spray valve would subsequently fill this niche while also allowing formulators the opportunity to sell these products to a larger potential market of end users. In the end, equipment manufacturers, chemical formulators, and the customer all benefited as they were able to access their preferred material and process the chemistry in the most efficient way possible. This type of win-win scenario is very indicative of the relationship shared by equipment fabricators and chemical formulators. Precision atomized spray heads are still widely used today for coatings above 100 cps and virtually all UV coatings.



An Era of Customization

We are now in an era of customization. Chemistries are highly tailored for critical properties such as protection characteristics, adhesion, and viscosity. Two-component coatings can provide more rapid curing times. As formulations continue to get customized for users, the traditional lines for coating materials and industries continue to blur as end users have more options than ever.

No matter what the request may be, from appearance to viscosity, to the cure mechanism or even changing the solvent carrier to a VOC friendly alternative, customizing formulations has become the norm more than the exception and chemical manufacturers are marketing these products as standard solutions.

End users should always work with formulators to assure that any modification to the original chemistry does not affect performance properties such as adhesion, protection, or curing.

From an application standpoint, having your chemistry slightly altered may affect a variety of process parameters so always consult your material manufacturer and applications staff prior to making any formulation change. In an automated process, the changes may be as simple as modifying the robot speed or adjusting the path spacing to compensate for the new flow characteristics, but these factors can always be pre-qualified in a test laboratory.

More often, we are seeing the application options available to end users increase significantly into less flexible, but more process specific solutions. Customization in material properties has led to an equivalent niche market of application heads. The scope of end users' process parameters has never been more divergent. High mix, low volume users still seek the most flexible solutions whereas high volume manufacturers are sacrificing flexibility in favor of fast, accurate applicators designed specifically for their process.

Other Considerations: Industry, Time, Geography, Regulations

Many coating chemistries generally follow the industry they are serving. For instance, strength in the global automotive industry drives demand for silicone coating products due to their excellent temperature and moisture resistance. Similarly, as aerospace, white goods, and consumer electronics products are coated, you tend to see more UV and moisture cure acrylics and urethanes due to their overall protection properties and ease of reworkability. The industry and subsequent environment that the end product is exposed to absolutely drives trends in formulation demand and equipment design.

Today, many of our customers favor the fast-cure properties of UV chemistries. Our high-volume coating lines are nearly 2:1 in favor of UV cure over heated or moisture cure alternatives. The geography of the application can also greatly influence the coating selection. Regional preferences often drawn from local environmental regulations can sway users to a specific coating type.

While silicones have been favored in automotive electronics, formulation improvements to quick-cure UV chemistries have penetrated this market. Improved adhesion, moisture resistance, and secondary cure mechanisms have led us to see more automotive applications, particularly, EV projects, move to UV materials.

Solvent-based acrylics and urethanes remain very popular in Europe where they have historically dominated this market. In the United States, there are states that have very tight restrictions on solvent or VOC emissions. These regulations drive coaters to more environmentally friendly formulations. Restrictions or simply personal preferences such as these have caused many chemical companies to revisit their formulations over the past decade and introduce more environmentally friendly versions of their coatings to open new markets for their products.

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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