Overview
September 2016
Corporate Overview

PVA Snapshot
Privately held company with nearly 25 years of experience is the dispensing industry

PVA is a market leading provider of dispensing and coating solutions for global manufacturers

Direct, build to order standard platforms though nearly 2/3 of our business is moderately to heavily engineered to order

Global presence with 198 employees across North America, Europe, and Asia
Markets served

- Automotive Electronics and Infotainment
- Medical Devices
- LED / Display
- Contract Manufacturing
- PCB Manufacturing
- Consumer Electronics
- Alternative Energy
Product Range

- Manual Dispensing
- Pumping Systems
- Batch Automation
- In-line Automation
- Curing
- High Volume
- Custom Automation
Applications

- Thermal Interface Material - TIM
- Conformal Coating
- PCB Assembly – Underfill, paste, SMA, glob-top
- Back End Assembly – Gasket, TIM, screw, pick & place
- Optical Display Bonding
- 2 Part Potting and Bonding
- Form in Place Gasketing
Adhesive / Coating Solutions

Selective Conformal Coating PCB

BTO and Engineered Solutions

Automated Dispensing

Optical Display Bonding

Curing / Board Handling

Manual Dispensing Solutions
Selective Conformal Coating PCB

Adhesive / Coating Solutions

- Custom Engineered Solutions
- Automated Dispensing
- Optical Display Bonding
- Curing / Board Handling
- Manual Dispensing Solutions
Conformal Coating

PCB performance can quickly deteriorate when uncoated boards are exposed to a number of different environments:

- Temperature Extremes
- Humid Environments
- Thermal Cycling
- Salt Fog
- Corrosive Gases

- Apply a polymeric film to protect from harsh environment like temperature extremes, moisture, dust and chemicals
- 25-250um film
- Prevent PCB damage to reduce cost
Considerations for choice

As there are many different applications for conformal coatings, there are also a number of elements that must be considered as part of the selection process:

**Coating properties**
- Adhesion
- Flexibility
- Temperature range
- Mechanical durability
- Electrical performance
- Environmental performance
- Flame retardance
- Mould resistance

**Application**
- Viscosity/application
- Touch dry time
- Full cure time
- Curing conditions
- Is re-work required?
- Cost
- Quality
- Approvals required?
# Materials

## Advantages versus disadvantages

<table>
<thead>
<tr>
<th>Material</th>
<th>Moisture resistant</th>
<th>Chemical resistant</th>
<th>High Temp.</th>
<th>Curing time</th>
<th>Repair ability</th>
<th>Single component</th>
<th>Apply by Machine</th>
<th>VOC Free</th>
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</thead>
<tbody>
<tr>
<td>Acryl</td>
<td>Excellent</td>
<td>NOT</td>
<td>NOT</td>
<td>Fast</td>
<td>Good</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
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<tr>
<td>Polyurethane</td>
<td>Good</td>
<td>Very Good</td>
<td>NOT</td>
<td>Slow</td>
<td>Difficult</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Silicones</td>
<td>Fair</td>
<td>Limited</td>
<td>YES</td>
<td>Slow</td>
<td>Difficult</td>
<td>YES</td>
<td>YES</td>
<td>Yes/No</td>
</tr>
<tr>
<td>UV-curable</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Extreme Fast</td>
<td>Difficult</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Epoxies</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Average</td>
<td>Difficult</td>
<td>NO, 2K</td>
<td>Difficult (2K)</td>
<td>Yes/No</td>
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<tr>
<td>Water-based</td>
<td>Good</td>
<td>Fair</td>
<td>NOT</td>
<td>Very Slow</td>
<td>Fair</td>
<td>YES</td>
<td>Difficult</td>
<td>YES</td>
</tr>
</tbody>
</table>
Application Techniques

ATOMIZED

NON-ATOMIZED

NON-CONTACT JET
Application Techniques

Atomized Spray
Suitable for all coating types

Low pressure air breaks up coating into very fine droplets
- 0.5 psi + atomizing air for solvent-based
- 2-4 psi atomizing air for 100% solid coatings
- Creates less overspray and waste
- Good edge definition and micrometer flow adjustment

Pattern width can vary with z-height (3 – 50mm)

Thin film application – 25 microns

PVA Confidential
FCS300-ES Atomized Spray
Most commonly used atomized spray head

Versatile for intricate board designs and tight keep out areas

Best available coverage on the low end of the pattern width spectrum at 3mm +
Application Techniques

**FCS300-R/F Atomized Spray**
Applications that require a wider coverage area

Wider pattern in sparsely populated areas can optimize throughput by reducing the number of passes required

Pattern widths can extend out to 50mm for rapid coating
Non-Atomized Flow Coat
High coverage film thickness
  • Excellent for solvent-based chemistries (1-100 cps)
  • Wet film builds of at least 0.2 mm (0.008”)
  • High flow rate = high robot speeds (500mm/s)

Pattern width does not change by z-height (8-12mm)
  • Superior edge definition, z-height and viscosity have little to no effect
Application Techniques

Bead or Flood Mode
Ideal for larger fill areas or encapsulation

Excellent for coating underneath or between components

Bead size can vary widely by altering robot speed and needle diameter allowing for process customization

Can process high viscosity fluids so utilizing this technique for damming and masking is very common
Application Techniques

Micro Coating
Selectively coat dense areas and micro components

Suitable for all coating types to 10,000 cps
- Precision application of dots and lines for micro components
- No z-height adjustment needed – rapid dispensing 3 – 8mm above board
- Software controlled shot size, no pulsing of valve for beads
- Down to 0.25mm streams, material dependent
Application Techniques

FCM100 Micro Coating

www.pva.net
Application Techniques

Jetting
Diaphragm design with **two parts** contacting fluid

- Diaphragm and nozzle plate install without removing mounted jet
- Tungsten carbide internal components for long life
- 300 drops / sec as small as 10nl
- Viscosities up to 400K cps
- Nozzle heat up to 70°C
- 100µm, 125µm, 150µm, and 200µm nozzle sizes
- No accumulation or purging through a minimum of 18 hours
2K conformal coating

- 100% solid
- No moisture cure
- No Solvent
- Enhanced thermal performance
- Water and moisture protection
- Highly flexible coating, low stress on components
- Good solvent resistance
- Excellent coverage
Automated Dispensing

**Standard Gantry Systems**
400mm, 500mm and 600mm standard platforms

Benchtop, inline, and custom part handling options

Features Windows® programming environment with offline path generation capability
Software - PVAPortal™

- Operator interface for dispensing and conformal coating systems
- Multi-language support
  - Can create custom language library
- Process monitoring tools
  - Fluid levels
  - Pump speeds
  - Pressures
  - Uptime / Downtime
  - Signal monitoring
- Can integrate with other PVA software for data collection
  - Factory information system
  - Barcode
  - Cycle time
  - Flow monitor data
  - Weigh scale
Software Vision Tools

- Programming / path teaching
- Fiducial recognition
- Conformal coating inspection
- Bead width check
- Dot dispense verification
- Can customize for multiple applications
- Dependent on substrate and fluids used

Conformal Coating on PCB

Thermal Paste on Component
Automated Dispensing

**Dispensing Applications**
Single and dual component chemistries

Potting, bonding, gasketing sealants

Solder pastes and filled epoxies

UV adhesives

SMT adhesives, glues, and encapsulants

Paints, inks, and lubricants

Hot melt adhesives

Virtually any fluid dispensing application
Automated Dispensing

Thermal Interface Materials
Silicone or polymer based, often with aluminum oxide or other conductive fillers

One and two component versions

Designed to fill gaps between heat generating electronic devices and a heat sink or outer enclosure

Applied to component or onto heat sink

Replace thermal pads
PRODUCT Types

Thermal Interface Materials (TIMs) for Consumer Electronics and Information Technology

- Phase-Change Materials
- Thermal Greases and Gels
- Gap Filler Pads
- Thermal Tapes
- Fully Cured Dispensed Gap Fillers
PRODUCT Types

- Thermal Interface Materials (TIMs) for Light Emitting Diode (LED) and Industrial Applications
- TIMs for Military and Aerospace Applications
- Dispensed Gels in Automotive Electronic Control Unit (ECU) Application
- Gap Filler Pad and Dispensed Gels for Telecommunications
Automated Dispensing

Thermal Interface Materials

Thermal Grease
- Smooth, semi-flowable
- Soft fillers
- Dispensed using standard or carbide pumps
- For thin bond line gap or bare die applications

Gap Filler
- Paste/putty consistency
- Non-flow
- Highly abrasive fillers
- For rough surface or inconsistent gaps

Metal Based
- Very high conductivity
- Used with high end microprocessors and heat sinks
- Considerations needed for application and containment in assembly
SILICONE VS. NON-SILICONE

The main difference between silicone and non-silicone pastes is the operating temperature range:
Automated Dispensing

**Thermal Interface Materials – Applications**
TIM to individual components on PCB to remove heat from capacitors and devices

Sink PCB to metal housing via machined plateaus that align with hot spots on PCB
Automated Dispensing

**Thermal Interface Materials – Processing**
Servo controlled progressive cavity pumps (+/-1%) with flow rates ranging from 0.004ml/min to 270 ml/min

Two component carbide “suck back” valve with static mixer
Automated Dispensing

**Thermal Interface Materials – Processing**
Simple processing direct from syringes or two-component bipacks

Bulk processing from Semco™ 20/32 ounce cartridges, 1g, or 5g steel pails
Automated Dispensing

Jetting

Pneumatically driven jet employs diaphragm with ball and seat

- Diaphragm materials – Silicone, Viton, EPDM, Kalrez
- Flat or extended nozzle orifice, 75-200um
- Small volume fluid path <0.1cc

Dispense single dots or continuous lines up to 300Hz

Integrated nozzle heater, up to 70C

Can jet up to 10mm without splashing (material dependent)
Automated Dispensing

Jetting - Applications
Underfill, edge bond, surface mount adhesive, encapsulant, conformal coating, LED phosphor, conductive adhesive, silver epoxy, UV Adhesives

Tall and narrow dams can be achieved by jetting one to two layers of UV material and using a UV wand for 2-3 seconds

Nozzle extension for cavity dispense
JDX – Benefits

• No need for Z axis movement
• Dispense distances up to 5mm+
• Small volume fluid path, <0.1cc
• Only nozzle plate is heated
• Easy to clean, only 2 wetted parts
• No special tools required – only 3mm hex key
• No need for special calibration
• Software controlled, no manual adjustments
JDX – Where to use it?

- Coating on flex circuit
- Surface mount adhesive / chip bonding
- Flip chip & BGA Underfill
- IC corner bonding, wire bonding
- Cell phone camera lens bonding
- Die bonding
- LED assembly
- UV adhesive on glass
- Hotmelt application
Automated Dispensing

Meter-Mix
Gear pump, rod displacement, and progressive cavity options

Gear pump allows for continuous flow, no recharging, but not ideal for abrasive shear resistant chemistries

Rod displacement preferred for wide ratio or abrasive compounds, requires recharging chamber after maximum 60ml shot

Progressive cavity allows for most flexible material handling flow rate a maximum of 12ml/min as standard though custom high flow is available
Automated Dispensing

**Progressive Cavity**
“Absolute”, continuous metering to 10:1

- Programmable servo flow rate
- Adjustments provide linear output
- Metering is at the point of dispense
- Highest accuracy with small or large shots
- Handles wide viscosity range
- Minimal pressure spike/drop = consistent flow
Automated Dispensing

**Meter-Mix Applications**
Lens bonding, micro potting, glass and frame bonding

Gasketing, potting

Valve technology has pushed two component materials further into the micro dispensing market traditionally reserved for single component chemistries.
Adhesive / Coating Solutions

Selective Conformal Coating PCB

Custom Engineered Solutions

Automated Dispensing

Optical Display Bonding

Manual Dispensing Solutions

Curing / Board Handling
Curing / Board Handling

Adhesive and Coating Curing Systems
Ovens for heat (infrared) and UV (ultraviolet) cure materials

Infrared ovens from 4ft to 16ft in length
  • Panel temperatures to 500°F
  • Each zone independently controlled at 2ft increments
  • Humidity control options for moisture sensitive materials

UV light ovens from 6” to 18” curing widths
  • High intensity Fusion UV lamps with broad spectrum range options
UV Curing

What is UV Curing?

Ultraviolet curing (commonly known as UV curing) is a photochemical process in which high-intensity ultraviolet light is used to instantly cure or coatings or adhesives. Offering many advantages over traditional drying methods, UV curing has been shown to increase production speed, reduce reject rates, improve scratch and solvent resistance, and facilitate superior bonding.

Who Uses UV Curing?
Since it was originally introduced in the 1960's, UV curing has been widely adopted in many industries including automotive, telecommunications, electronics, graphic arts, converting and metal, glass and plastic decorating. UV curing is displacing conventional water and solvent-based thermal drying processes due to its increased productivity, improvement of product quality and performance, and environmentally friendly characteristics.
UV Light

Because not all materials react on the same wave length of UV light, the UV sources are available with different power and wave lengths.

- 120W/cm.
- Constant UV emission
- Low degrade UV.
- Minimum on calibration Low maintenance cost.
- 8000-12000 hours
Measure UV Light intensity Radiometers

UV Intensity Meters & Visible Intensity Meter for Light Curing Systems

- **Maintaining a Reliable Light-Curing Process**
  A radiometer helps to ensure that a light-curing system is providing the intensity and dosage levels required for successful curing.

- **Providing a Worker-Friendly Light-Curing Process**
  Radiometers are sufficiently sensitive to measure the intensity of stray or reflected energy (as little as 1 mW/cm²). **Worker recommendation** UVA exposure not exceed 1 mW/cm². For reference, UV (320-395 nm) intensity on a sunny day can range from 2-6 mW/cm².

- **Measuring Transmission Rates Through Substrates**
  A radiometer can be used to measure the transmission rates of various Wavelengths
Curing / Board Handling

Board Handling Equipment
Queue conveyors for part staging, inspection, assembly

Black light inspection conveyors

Inverters for double side processing

Line shuttles for dual lane transfer
Adhesive / Coating Solutions

Selective Conformal Coating PCB

Custom Engineered Solutions

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Manual Dispensing Solutions
## Valve Technology Options

<table>
<thead>
<tr>
<th>Series</th>
<th>Type</th>
<th>Application</th>
<th>Materials</th>
<th>Viscosity Limit*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC</td>
<td>Needle Dispense</td>
<td>Dot, Line</td>
<td>No Solid Fillers</td>
<td>2,000,000</td>
</tr>
<tr>
<td>FCS</td>
<td>Atomized Spray</td>
<td>Dot, Line</td>
<td>Coatings</td>
<td>100,000</td>
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<tr>
<td>FCM</td>
<td>Micro Dispense</td>
<td>Dot, Stream, Non-contact</td>
<td>No Solid Fillers</td>
<td>20,000</td>
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<tr>
<td>CA</td>
<td>Diaphragm</td>
<td>Dot, Line</td>
<td>CA, Anaerobic</td>
<td>10,000</td>
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<tr>
<td>SV</td>
<td>Servo Auger</td>
<td>Dot, Line</td>
<td>Filled paste &amp; epoxy</td>
<td>2,000,000</td>
</tr>
<tr>
<td>MV</td>
<td>Metered Shot</td>
<td>Dot, Fill</td>
<td>Limited fillers</td>
<td>2,000,000</td>
</tr>
</tbody>
</table>
Manual Dispensing Solutions

**Manual Systems**
PVA offers complete engineered turnkey benchtop solutions

Low cost, entry level dispense systems

Operator dependent or semi-automated for low volume processes or integration into your automated system

Dispense directly from syringes to any PVA application head
Manual Dispensing Solutions

Consumables
PVA supplies a full line of consumables including various disposable plastic dispense tips, syringes, cartridges, plastic mixers, caps, and much more

Your source for all dispensing accessories including fittings, material hose, seal kits, pumps, and material reservoirs
Adhesive / Coating Solutions

Selective Conformal Coating PCB

Custom Engineered Solutions

Automated Dispensing

Curing / Board Handling

Manual Dispensing Solutions

Optical Display Bonding
The Application
Optical Display Bonding

**Customer Benefits**
No contaminations, no condensation or fogging

Enhanced shock and vibration resistance

Improved ruggedness

No law US 2018
Typical Bonding Process

Load Parts
- Display
- Cover
- Touch Sensor

Plasma Treat
- Display
- Cover
- Touch Sensor

Dispense Seal and Dam with Cure
- Measure Flatness
- Seal Bezel

Apply Fill

Pick and Place
- Fiducial Correction
- Controlled Press and Dwell

Cure
- Final Wet Out
Optical Display Bonding

Bonding Process
Pretreatment is generally recommended for long term stability

Probe display or frame surface to adjust ‘seal’ or ‘dam’
dispense distance and speed

XYZ robot dispensing of the bezel sealing adhesive

Vents in dam allow air to escape in the lamination process
Optical Display Bonding

**Bonding Process**
Dispense pattern and adhesive volume must be optimized carefully to avoid trapping bubbles and control overflow.

Joining either parallel or under a slight angle

Air (and excess adhesive) escapes through vents in the dam.

After full spreading of the adhesive, cure with heat or UV light.
Optical Display Bonding

Fully Automated Optical Bonding Process
Integrated dam, dam cure, fill, bond, and tack cure

Maximum 17” (430mm) display size for PVA710 module (pictured), inline for high throughput

Entry level to full assembly process

Moderate volume, low mix market
Optical Display Bonding
Custom Engineered Solutions

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Manual Dispensing Solutions
Custom Engineered Processes

**Screw Driving**
- Connector to Assembly
- Board to Base
- Cover to Base

**Inspection**
- Thermal Grease
- Component Presence
- Orientation
- Pin Alignment
- Bead Height

**Assembly**
- Pick and Place
- Press
- Lift, Flip, Insert
- Crimp
Custom Engineered Solutions

Screw Driving
Custom Engineered Solutions
Dual Automatic Shuttle Pick and Place
Custom Engineered Solutions

Custom Automation, Rotary Table