Coatings?

From Dilbert.com, January 12, 1997

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What is Conformal Coating?

Wikipedia definition:

• **Conformal coating** material is applied to electronic circuitry to act as protection against moisture, dust, chemicals, and temperature extremes that, if uncoated (non-protected), could result in damage or failure of the electronics to function. When electronics must withstand harsh environments and added protection is necessary, most circuit board assembly houses coat assemblies with a layer of transparent conformal coating rather than potting.

• As stated above, it’s a coating that protects assemblies against:
  – Humidity
  – Corrosive materials
  – Contamination (particulate or otherwise)
  – Mechanical stresses

• It also increases electrical clearance tolerance
Conformal Coating vs. Potting?

- **Potting** does the same thing as conformal coating except that it seals the electronic circuitry from all environments inside a shell or mold.

But...
- Reworking is not as easy or even impossible given the material used.

- Conformal Coating could yield the same harsh environment protection with the advantage of rework-ability.
Coating Process Development

1. Determine what are you trying to protect the assembly from.. (i.e. Select the Material)
2. Ensure that the assembly can be coated (Surface Energy Testing etc.)
3. Develop the Requirements. (Determine required thickness, keep out areas, materials, acceptance criteria, etc.)
4. Develop the Process. (Spray Patterns, Tooling, Machine Programs, Cure Process & Times, Viscosity, Test Coupons, Humidity Controls Etc....)
5. Clean the assembly
6. Mask non-coating areas
7. Apply coating
8. Cure coating
9. Unmask board before or after curing
10. Repair/touchup
11. Inspect

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# Conformal Coat Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Typical Brand Names</th>
<th>Typical Application Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic/Urethane hybrid</td>
<td>Conap CE1170</td>
<td>Automated Selective coat</td>
</tr>
<tr>
<td>Acrylic</td>
<td>Humiseal 1B31</td>
<td>Automated selective coat</td>
</tr>
<tr>
<td>Acrylic (Low Organic Content)</td>
<td>Humiseal 1B31LOC</td>
<td>Automated selective coat</td>
</tr>
<tr>
<td>Acrylic</td>
<td>Humiseal 1B73</td>
<td>Automated selective coat</td>
</tr>
<tr>
<td>Acrylic (Aqueous)</td>
<td>Humiseal 1H20AR2</td>
<td>Dip Coat</td>
</tr>
<tr>
<td>Silicone</td>
<td>Dow 1-2577</td>
<td>Manual Dispense</td>
</tr>
<tr>
<td>Urethane</td>
<td>Conap CE1155</td>
<td>Manual Selective coat</td>
</tr>
<tr>
<td>PTFE</td>
<td>Acota Certonal</td>
<td>Solvent Deposition</td>
</tr>
<tr>
<td>Parylene</td>
<td>Parylene</td>
<td>Chemical vapor deposition</td>
</tr>
</tbody>
</table>
### Conformal Coat Types (cont.)

<table>
<thead>
<tr>
<th>Type</th>
<th>Material Cost</th>
<th>Ease of Application</th>
<th>Repair Costs</th>
<th>Temp Range</th>
<th>Solvent Resistance</th>
<th>Electrical Resistance</th>
<th>Abrasion Resistance</th>
<th>Material Pot Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylic</td>
<td>Low Cost</td>
<td>Multiple Methods</td>
<td>Easy to Touch Up</td>
<td>Good Range</td>
<td>Poor</td>
<td>Good</td>
<td>Good</td>
<td>Good once in inert atmosphere</td>
</tr>
<tr>
<td>Silicone</td>
<td>Higher Costs</td>
<td>Contaminates other materials</td>
<td>Difficult</td>
<td>Excellent</td>
<td>Good</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>Urethane</td>
<td>Low Cost</td>
<td>Multiple Methods</td>
<td>Very Difficult</td>
<td>Good Range</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Short Pot Life</td>
</tr>
<tr>
<td>PTFE</td>
<td>Higher Costs</td>
<td>Specialized Equipment</td>
<td>Very Difficult</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>Parylene</td>
<td>Higher Costs</td>
<td>Specialized Equipment</td>
<td>Very Difficult</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
</tr>
</tbody>
</table>
## Conformal Coat Processes

<table>
<thead>
<tr>
<th>Type</th>
<th>Application Process</th>
<th>Masking Complexity</th>
<th>Process Controls</th>
<th>Cure Process</th>
<th>Product Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dip</td>
<td>Fastest Application Method. Automated equipment better than manual process</td>
<td>Needs very careful masking and sealing, so no leaking into connectors etc.</td>
<td>Pot needs viscosity and contamination review regularly. Difficult to measure thickness</td>
<td>Needs special handling, as product must drip dry.</td>
<td>Depending on material choice, may have very high coating thicknesses in areas.</td>
</tr>
<tr>
<td>Manual</td>
<td>Usually applied with a brush on dispense needle. Labor intensive. Low startup costs</td>
<td>Usually, no masking required.</td>
<td>Difficult to ensure, consistent thickness</td>
<td>Dependent on Material Selection</td>
<td>More suited to touchup, repair and selective coating of moisture sensitive components</td>
</tr>
<tr>
<td>Aerosol</td>
<td>Air or gas mixed with materials. Can be applied manually, or by equipment</td>
<td>Dependent on Keep-out area requirements.</td>
<td>Process Controls important to provide consistent repeatable process</td>
<td>Dependent on Material Selection</td>
<td>Very repeatable process, if process setup and monitored.</td>
</tr>
<tr>
<td>Non-Aerosol</td>
<td>Material dispensed under pressure. Usually mechanical pumped automated equipment</td>
<td>Dependent on Keep-out area requirements.</td>
<td>Process Controls important to provide consistent repeatable process</td>
<td>Dependent on Material Selection</td>
<td>Very repeatable process, if process setup and monitored.</td>
</tr>
<tr>
<td>Vapor Deposition</td>
<td>Custom Equipment required</td>
<td>Needs very careful masking and sealing, so no leaking into connectors etc.</td>
<td>Closed Loop System</td>
<td>Instant, within deposition chamber</td>
<td>Usually used for Medical devices etc.</td>
</tr>
</tbody>
</table>
• Boards should be cleaned prior to coating.
• Cleaning removes particulates, flux residues, oils and fingerprints which will affect coating adhesion.
• Cleaning can be accomplished using aqueous or solvent based chemistries. Aqueous cleaning usually contains a saponifier. ($$$ Running Costs ). Alcohol can also be used.
• Keep-out areas need to be masked to prevent inadvertent coating. Masking utilizes Reusable Boots, Tape, Peelable latex, etc.
• Air ionizers need to be used at all stations due to the increased generation of ESD from peeling tapes etc.
• Need to ensure that black lights are available for inspection of fluorescent dye.
• Material curing methods include Chemical Cross linking, Heat, and UV Flash Ovens.
Process Development

• Followed the medical industry’s practices of IQ/OQ/PQ

  – **Installation Qualification (IQ)** – ensuring that the machine has been installed correctly and its basic functionality is present

  – **Operational Qualification (OQ)** – exploration of operating parameters and their interactions, limit testing, determining allowable tolerances for key input parameters

  – **Performance Qualification (PQ)** – Using trained operators running actual product while following the limits set above to determine if key output characteristics are met consistently with high reliability and confidence
Installation Qualification

• Followed BTW’s standard IQ form (excerpt below)

<table>
<thead>
<tr>
<th>Item #</th>
<th>Process Step or Question</th>
<th>Answer</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Has the machine been leveled per manufacturer’s recommendation?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>1.2</td>
<td>Have all of the shipping brackets been removed?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Has the machine been locked/tagged out prior to verification of utility services below?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>Has the machine been calibrated?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Electrical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>List the measured line voltage:</td>
<td>210V</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>List the size of the service in amperes:</td>
<td>20A</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>List the required line voltage: was 480V now 210V single phase listed on tag</td>
<td>210V</td>
<td>Tag on machine was crossed out and new label applied prior to purchase</td>
</tr>
<tr>
<td>2.4</td>
<td>List the required service size in amperes:</td>
<td>14A</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Do the voltage and current capacity meet the manufacturer’s recommendation?</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>Air/Nitrogen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>List the measured air pressure, in psi, at the machine entrance:</td>
<td>82psi</td>
<td></td>
</tr>
</tbody>
</table>

• Verified that facility hookups were correct: voltage, amperage, CFM draw for exhaust, air pressure
• Ensure that maintenance plan is established and in system
• Ensure that safety features are operational
• Verified that machine could perform basic tasks: Programming and operating software functional, communicates with network, sprays coating, control coating deposition rate
Operational Qualification

• OQ Plan written in advance, although not absolutely necessary (may need to deviate from plan as the process is learned)

• Purpose:
  – to find optimum operating conditions by pushing the limits of the process
  – to determine how input parameters work together to create the output condition
  – to determine how tightly one must control key parameters to keep the output in the target range, i.e. process specification limits
  – to learn various other techniques and intricacies of the process that are necessary to ensure an optimum result
Spray Coating Input Variables

- Pass Rate or Speed
- Angle
- Air Pressure
- Viscosity
- Cleanliness & Residue
- Masking
- Surface Tension and/or Roughness
- Topography
Spray Coating Output Variables

- Thickness
- Air Bubbles ("Fish Eyes")
- Coverage
- Cobwebbing vs. Stream
- Pooling
- Adhesion
Operational Qualification

• Test Vehicles
Operational Qualification

Masking Tape Tests

• Purpose:
  – To determine if the masking tape varieties selected will stand up to the chemistries and adequately mask the areas necessary on the printed circuit assembly

• Method:
  – Masking tapes and tape dots applied to PCBs and sprayed with coating
Operational Qualification

Masking Tape Tests Results

- Notes:
  - All tapes reviewed had difficulty with curves
  - One tape was extremely ineffective at blocking the coating
Operational Qualification

Coating Adhesion Tape Tests

• Purpose: To determine if conformal coating material adheres properly to substrate material

• Method: Simulated IPC-830 test method:
  – Incisions were made through the material in a grid pattern
  – Masking tape was pressed down over cut area and then lifted in one firm stroke directly away from the substrate
  – Masking tape and substrate material is inspected for missing coating
Operational Qualification

Coating Adhesion Tape Tests - Results

• **Results:** Passed. CC debris directly from the cut line where the coating was pierced was detected, but no where else.

• **Note:** This test only qualifies one masking type in combination with the coating material used. If the soldermask material changes, the adhesion of the coating to the substrate will need to be re-evaluated.

• Since this was a generic qualification plan designed to potentially include many products, the adhesion tape test was performed on an aluminum substrate to give a general determination that the adhesive characteristic was met.
Investigation of Inputs and Outputs - Methods

• 10” x 10” metal coupons were sprayed at various settings for coating material viscosity, head travel speed, spray height, tank pressure, atomization spray pressure, and flow rate

• After drying 24 hours, coupons were measured for coating thickness and spray pattern defects, (uneven coating, ridges, bubbles, skips, etc.)

• Spray pattern was monitored during the coupon spray for uniformity, cobweb creation, etc.
Operational Qualification

Investigation of Inputs and Outputs – Methods Continued

• Charts were plotted to explore the interaction and correlation of various parameters to one another

• Key Input Factors Determined:
  – From the data following, it can be seen that head travel speed and flow rate are both very influential upon coating thickness
  – Tank pressure is also influential, but on a secondary level. Tank pressure influences flow rate
  – Viscosity has counterbalancing effects: The thinner the material, the easier it flows through the valve. However, for a set flow rate, each drop of material has a lesser solids content, and, since we measure and adjust flow rate before spraying, thinner material leads only to less thickness
These charts show the linearity of the data when other factors are held constant, such as head speed and tank pressure.
Operational Qualification

Investigation of Inputs and Outputs - Flow vs. Tank Pressure

- Helps determine how tightly to control tank pressure

- Slope approximately 0.065g/5 sec flow per psi – about 9% change in flow per psi change in tank pressure in the operating range

- BTW controls tank pressure to between 16 and 17 psi, so 1 psi = approx. 9% variation due to flow alone

- This variation must be accounted for when setting target nominal thickness
Operational Qualification

Investigation of Inputs and Outputs – Speed vs. Thickness

- These charts show the strong correlation of thickness the head travel speed. Variability is due to other factors being modified in the data set, such as flow rate – another key variable.
Operational Qualification

Investigation of Inputs and Outputs - Speed vs. Thickness – Holding Flow Rate Constant

- These charts show the strong correlation between thickness and the head travel speed with flow rate constant.
Operational Qualification

Investigation of Inputs and Outputs - Combined Flow Rate and Speed vs. Thickness

• Flow rate is directly proportional to coating thickness and head travel speed is inversely proportional to coating thickness, so the ratio of flow rate/speed was plotted vs. thickness to determine if it is linear in the range under consideration. It was roughly linear, so an equation of the line was made in the form of $y = mx + b$ where

\[
\begin{align*}
  y &= \text{thickness} \\
  m &= \text{slope} = \text{thickness change} \\
  b &= \text{y-intercept} = \text{thickness at flow rate/speed} = 0 \text{ if this interaction was truly linear}
\end{align*}
\]
Operational Qualification

Investigation of Inputs and Outputs - Combined Flow Rate and Speed vs. Thickness

Flow Rate/Speed vs Thickness (mils) - 1B73

1B31 Flow Rate/Spd vs Thickness - 1B31

Flow Rate/Speed vs Thickness - Data - 1B73
Operational Qualification

Investigation of Inputs and Outputs - Viscosity Measurement Method

• #2 Zahn Cup – drain time measured using stop watch

• Fluid must fall within process specification limits (lift to first stream break)

• Average of 3 measurements is charted
Operational Qualification

Investigation of Inputs and Outputs - Viscosity Evaluation

- In early testing, viscosity was varied between 16 and 22 seconds on #2 Zahn cup
- Started with 1:1 ratio by volume per Humiseal recommendation
- Settled on 16 – 17 seconds (0.95:1 ratio)
- Higher viscosity led to cobwebbing
- Excessively low viscosity led to excessive running of material and lower thickness due to lower overall solids content %

<table>
<thead>
<tr>
<th>Zahn Cup</th>
<th>#2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zahn Range (sec)</td>
<td>19-60</td>
</tr>
<tr>
<td>Centistoke Range</td>
<td>39-238</td>
</tr>
<tr>
<td>Applications</td>
<td>Thin Oil or Lacquer</td>
</tr>
</tbody>
</table>

See ASTM #D 4212: Viscosity by dip-type viscosity cups at 77F (25C)
Operational Qualification

Investigation of Inputs and Outputs - Thickness Measurement Method

- Spray metal coupon with same parameters as program
- Use eddy current thickness meter – Positector 6000
- Average and range of 10 points charted
- Must fall within process control limits to safely meet customer specification limits
Operational Qualification

Investigation of Inputs and Outputs - Flow Test Method

- Measures amount of material sprayed into cup in 5 seconds

- 10 individual purges of 5 seconds each are sprayed into cup to get average 5 second shot time

- **Charted:** Must be within process control limits to safely meet customer specification limits

- Purchased higher resolution scale (10x better – resolution 0.1g) which allows better fine tuning of flow rate to increase sensitivity of flow test which results in less thickness variation
Process Monitoring

Process Control Charts Example - Thickness

CC Thickness Chart & Daily Maintenance Sign-Off

Month: May  Year: 2012  Material: Humiseal 1B73

Thickness (mils)

Day of Month  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26  27  28  29  30  31
Thickness (mils)

Upper Control Limit for Average = 3.5mils. Call Engineering.
Lower Control Limit for Average = 1.6 mil. Stop process and call Engineering.

Daily Maintenance Sign-Off

Sweep Floor
Wipe Tables

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Conformal Coat Flow Test Chart

Month May Year 2012 Material Humiseal 1B73

Day of Month
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Average of 10 Readings (g)
Chart this value

Upper Control Limit 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88 0.88

Lower Control Limit 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75 0.75

Initials

5 Second Weight Test (g)

Upper Control Limit = 0.85 grams. Adjust needle valve.

Lower Control Limit = 0.65 grams. Adjust needle valve.
Process Monitoring

Process Control Charts - Viscosity

Conformal Coat Zahn Cup Viscosity Chart

Month May Year 2012 Material Humiseal 1B73

Day of Month 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

#2 Zahn Cup Seconds

Upper Spec Limit 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8 17.8

Stop process and adjust viscosity.

Lower Spec Limit 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17

Stop process and adjust viscosity.
Productivity

Masking Caps

- A lot faster than masking tape, but it does allow some seepage or wicking.
- Notice pink masking for extra sealing on problem areas
Productivity

Liquid Masking

- More effective than tape dots for features with height
- Easier than tape to remove when wet
- Application time is about the same (except waiting to dry)
Productivity

Removing While Wet

- Put enough liquid mask on such that it can be easily gripped with a tweezers while still wet.
- Advantage = no fringe of dried coating at edges, does not tend to lift up the coating.
Productivity

Forced Drying or Air Cure

- Air drying produces less bubbles
- Oven drying drives out the solvents faster and allows faster turnaround time to second side or to next process (more helpful for a double-sided line)
- Oven drying captures the solvent vapors and exhausts them for less overall odor creation in the coating area
Mix and Check Viscosity → Setup machine → Flow Test → Run Daily Coupon → Spray Side 1

Dry to Touch → Inspect/Touchup → Spray 2nd Side → Dry to Touch → Inspect/Touchup

Air Dry for 24 hours → Measure Coupon → Release job
Inspection

• Blacklight (UV) is required to pick up the UV tracer in the coating material

• Magnified or not depending upon complexity
Surface Energy

- Not all Solder Masks are acceptable for good conformal coating adhesion
- A Surface Energy measurement is used to give an indication as to how well the conformal coating may adhere.
Surface Energy

• The surface energy can be specified as a part of the PCB requirement
• Note the difference in dewetting between the various dyne levels

- Units are dynes/cm
- This surface is 32 – 34 dynes/cm
- Coating vendor may specify or know the necessary dyne level
- Otherwise, experiment!
NOTE: Need to have defined rules for head travel speed and line spacing because these are:

- Highly significant factors for the final coating thickness
- Controlled only in the machine program.

2 Methods of Programming:

- Point & Teach or “bombsight” programming
- CAD data for off-line programming
Programming - Topography

- Tall components create shadows that block the spray pattern.
- Use the tilt/rotate feature to spray the material at a greater angle.
- Use the needle dispenser to get into small spaces.
- Designate these areas as “manual touchup”
Standard Settings

All parameters (both operator controlled parameters as well as those controlled in the spray program) that significantly influence the final coating thickness must be defined and monitored.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Humiseal 1B31</th>
<th>Humiseal 1B73</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs – operator controlled*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow Rate, g/5 sec</td>
<td>0.78 – 0.88</td>
<td>0.78 - 0.88</td>
</tr>
<tr>
<td>Viscosity (#2 Zahn Cup Seconds)</td>
<td>17.0 – 17.8</td>
<td>17.0 – 17.8</td>
</tr>
<tr>
<td>Spray Pressure, psi</td>
<td>3½ - 4</td>
<td>3½ - 4</td>
</tr>
<tr>
<td>Tank Pressure, psi</td>
<td>16½ +/- ½</td>
<td>16½ +/- ½</td>
</tr>
<tr>
<td>Inputs – controlled in program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head Speed, in/sec</td>
<td>1.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Spray Height (field), inches</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Spray Height (edges), inch</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Spacing between lines (area fill), inch</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Outputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness (average of 10 measurements on coupon)*</td>
<td>1.5 – 1.9</td>
<td>1.5 – 1.9</td>
</tr>
<tr>
<td>Thickness (lowest individual reading)**</td>
<td>1.05</td>
<td>1.05</td>
</tr>
<tr>
<td>Smooth appearance</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Lines and ridges</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Skips</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Bubbles</td>
<td>None between conductors</td>
<td>None between conductors</td>
</tr>
</tbody>
</table>

* Charted daily and at material changes/adds
** Logged daily and at material changes/adds
Cleanliness

Clean vs. No Clean

Some companies spray conformal coating over no clean fluxes, but flux residues and Kapton tape residues do make a difference in the adhesion and final appearance of the product.

Shadow outline of Kapton tape
Cleanliness

Clean vs. No Clean

• Gloves should be worn when handling the product before and after spraying

• If the flux is water soluble, the last process should be a wash followed by an adequate drying process (several options available – must experiment)
Daily Setup Steps

**Setup**

1. Mix material and verify viscosity
2. Set tank pressure
3. Perform flow test and adjust flow rate
4. Affix air cap to nozzle
5. Set spray pressure
6. Run daily test coupon (for thickness verification after dry)
7. Set up fixtures for board to be run
8. Load program and run

Averages 30 – 40 minutes
Daily Setup/Cleanup Steps

Cleanup

1. Remove material from tank and purge lines
2. Load solvent into tank and run through lines, purge several times
3. Remove solvent from tank and purge lines until air runs free
4. Clean up touchup/inspection station – put away all materials
5. Sweep floor

Averages about 20 minutes
In Summary...

• Determine what are you trying to protect the assembly from
  – (i.e. Select the Material)

• Ensure that the assembly can be coated
  – (Surface Energy Testing etc.)

• Develop the requirements
  – (Determine required thickness, keep out areas, materials, acceptance criteria, etc.)

• Develop the process
  – (Spray Patterns, Tooling, Machine Programs, Cure Process & Times, Viscosity, Test Coupons, Humidity Controls, etc.)

• Clean the assembly
• Mask non-coating areas
• Apply coating
• Unmask board before or after curing
• Cure coating
• Repair/Touchup
• Inspect
• Keep consistent controls for the process
Questions??

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