“Working from Home” Webinar Series: How to Waterproof Your electronics
THANK YOU FOR JOINING US

Presenters

• Edward Hughes  CEO
• Mario Gattuso  Sr. Business Development Mgr

Logistical

• Recorded
• Ask questions via chat
Hope everyone is well and safe

Pandemic – scope, speed, stakes

Ability to adapt – ”WFH”

Essential company

Be there for you when we come out of this
OUR GOAL

Aculon enables customers to make better products by being an innovative, responsive and fast developer and producer of best in class surface modification technologies.

Together we create winning products!
AGENDA

• Aculon Overview
• PCB Waterproofing
• Introducing NanoProof Series
• Testing
• Bonus Material
• Q&A
ACULON OVERVIEW

Founded 2004

- **Expertise**: Develop & produce surface solutions to modify a broad variety of surfaces (metals, glass, polymers).
- **Functionality**: Hydrophobic, superhydrophobic, oleophobic, hydrophilic, anti-fingerprinting, adhesion promotion
- **Treatments**: Thin, easy to apply (no vacuum chambers), often no cure, safe, non-toxic and offer green options.
- **Differentiation**: Create proprietary innovative treatments & willingness to work with customer to solve problems.
- **Focus areas**: Electronics, Oil & Gas, Specialty (Medical +other)
- **Business Model**: Produce chemistry & treat parts
- **IP**: Over 35 Patents granted. Worked with 1000’s applications, invested 100,000’s hours
- **Products**: > 100
- **People**: Smart (numerous Chemists with PhD’s & Masters Degrees, Electrical & Mechanical Engineers)
- **Global**: Locations San Diego (HQ, Lab & Manufacturing) Shanghai, Singapore, Dallas, Amsterdam, Distributors > 12 in Asia

Aculon, Inc. @ 2020
MANY SURFACE MODIFICATION PLATFORMS

- Hydro/Oleophilic
- Surface Polymer Growth
- Transition Metal Complexes
- Polymeric Organometallics
- SAMP & Organometallic
BROAD PORTFOLIO

PRODUCT GROUPS
- Repellency treatments
- Attraction treatments
- Anti Fingerprinting Treatments
- Surface Primers
- Waterproofing Treatments
- Hard Coats
- Surface Cleaners

FUNCTIONALITIES
- Hydrophobic
- Superhydrophobic
- Oleophobic
- Hydrophilic
- Superhydrophilic
- Anti-fingerprinting
- Adhesion promotion
The application process depends on the application but can include:

- Dip Applied
- Spray Applied
- Wipe Applied
- Roll to Roll

Parameters:
- Concentrations
- Solvent
- Coverage
- Temperature
ACULON FOCUSES

1. Electronics

2. Oil & Gas

3. Specialty
Applications include:

- **NanoProof®** Award Winning PCB Protection, moisture barrier, silver migration prevention, underfill repellent dam, connector coating
- **Epoxy Control** Semiconductor packages, leadframe mold flash
- **Anti-Fingerprinting** Laptop / tablets, smartphones, appliances, packaging
- **NanoClear®** #1 Global Stencil Coating
- **Acustamp** Semiconductor test pins & fixtures
In real life, electronic devices are often damaged

- Device dropped in pool or even toilet
- Unit exposed to outdoor environment – rain, humidity
- Household appliances exposed water during operations
- Equipment (industrial and medical) exposed to wet working environment
WATERPROOF MARKET

The 2020 projection that 1.7 billion smartphones will be shipped at a value of $398 billion.

But more than 900,000 smartphones per day are damaged by liquids globally!
Aculon NanoProof® Series provides water protection from humidity to full water immersion

• Utilize proprietary technology
• Application equipment affordable and readily available
• Range of treatments available to meet performance, thickness, application and economic needs. From IPX3 to IPX8
WHAT LEVEL OF WATERPROOFING IS REQUIRED

The IPX standards provide a waterproofing scale and possibly design changes.

<table>
<thead>
<tr>
<th>IPX Level</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Protected against continual water submersion in under water conditions.</td>
</tr>
<tr>
<td>7</td>
<td>Protected against water immersion for 30 minutes at a depth of up to 1 meter.</td>
</tr>
<tr>
<td>6</td>
<td>Protected against high pressure water stream from any angle.</td>
</tr>
<tr>
<td>5</td>
<td>Protected against low pressure water stream from any angle.</td>
</tr>
<tr>
<td>4</td>
<td>Protected against splashing water from any angle.</td>
</tr>
<tr>
<td>3</td>
<td>Protected against spraying water when tilted up to 60 degrees vertically.</td>
</tr>
<tr>
<td>2</td>
<td>Protected against spraying water when tilted up to 15 degrees vertically.</td>
</tr>
<tr>
<td>1</td>
<td>Protected against condensation or dripping water falling vertically.</td>
</tr>
<tr>
<td>0</td>
<td>No Protection</td>
</tr>
<tr>
<td>NanoProof</td>
<td>IPX</td>
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<tr>
<td>-----------</td>
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</tr>
<tr>
<td>1</td>
<td>3</td>
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<td>12</td>
<td>8</td>
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<tr>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>
1. Reduce Product returns due to water damage
2. Improve yields as rework is possible after coating
3. No or minimal masking required
4. Coatings are safe, non-toxic and can be used in factory environment
5. Affordable
The coating process depends on the treatment selected but could include:

- Spray
- Jet or Dispense
- Dip
Equipment required meets a variety of needs. From handheld to batch to inline to high volume automation.
NanoProof material can be inspected by automated or handheld UV inspection system
• New Technical Paper available now! All attendees to receive downloadable link by email.

• Enabling IPX Level 7/8 PCB Waterproof Protection
Types of Treatment  Aculon Treatments 7.0, 8.4

Voltages Tested: 18v, 50v

Time:  60 minutes i.e. 2X IPX-7

Conditions: Water and Salt Water

Board:  IPC Multi-Purpose Test Board

Additional Testing for MIR, Salt Spray & Sweat Solutions

Measurements: Leakage Current measured utilizing
Picoammeter gathering data points every two seconds
Uncoated Control Results

**Uncoated Before Immersion**

**Uncoated Post Immersion**

**Significant Corrosion**

**Uncoated Test Board**

<table>
<thead>
<tr>
<th>Test Board</th>
<th>Average Current (A)</th>
<th>Maximum Current (A)</th>
<th>Minimum Current (A)</th>
<th>Average Resistance (Ω)</th>
<th>Voltage Bias (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncoated</td>
<td>2.37E-3</td>
<td>2.68E-3</td>
<td>2.35E-3</td>
<td>7.59E+3</td>
<td>18 VDC</td>
</tr>
</tbody>
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NanoProof 7.0 performs well even at 18 Volts!

NanoProof 7.0 Pre-Test  NanoProof 7.0 Post Test

No Observed Corrosion

Figure 4A

NanoProof® 7.0 at 18 VDC

500 nA Fail Threshold

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NANOPROOF® IPX TESTING

NanoProof 8.4 performs well even at 18 Volts!

NanoProof 8.4 Pre-Test

NanoProof 8.4 Post Test

No Observed Corrosion

Aculon, Inc. @ 2020
# NANOPROOF® IPX TESTING

## Current Data: Control / 7.0 / 8.4

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</table>

<table>
<thead>
<tr>
<th>Test Number</th>
<th>Average Current (Amp)</th>
<th>Max Current (Amp)</th>
<th>Min Current (Amp)</th>
<th>Average Resistance (Ω)</th>
<th>DC Voltage (Volt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NanoProof 7.0 #1</td>
<td>4.89E-08</td>
<td>2.04E-07</td>
<td>2.96E-08</td>
<td>3.68E+08</td>
<td>18</td>
</tr>
<tr>
<td>NanoProof 7.0 #2</td>
<td>1.69E-08</td>
<td>1.59E-07</td>
<td>-9.31E-10</td>
<td>1.06E+09</td>
<td>18</td>
</tr>
<tr>
<td>NanoProof 7.0 #3</td>
<td>3.36E-11</td>
<td>2.99E-10</td>
<td>-1.24E-10</td>
<td>5.36E+11</td>
<td>18</td>
</tr>
<tr>
<td>NanoProof 8.4 #1</td>
<td>5.35E-09</td>
<td>9.99E-09</td>
<td>4.24E-09</td>
<td>3.36E+9</td>
<td>18</td>
</tr>
<tr>
<td>NanoProof 8.4 #2</td>
<td>6.27E-08</td>
<td>2.18E-07</td>
<td>5.96E-09</td>
<td>2.87E+8</td>
<td>18</td>
</tr>
<tr>
<td>NanoProof 8.4 #3</td>
<td>1.13E-07</td>
<td>1.84E-07</td>
<td>2.50E-08</td>
<td>1.59E+8</td>
<td>18</td>
</tr>
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The standard Aculon IPX8 modified test calls for the IPC-B-25A board to be polarized with 18 VDC. To demonstrate the insulation properties provided by the NanoProof 7 and 8 Series, the boards were also biased with 50 VDC. NanoProof coatings were compared to two traditional notable conformal coatings, acrylic-based Humiseal 1B315 and polyurethane-based Conathane CE-1164 were chosen for electrical testing.

As evidenced from the data above, all four coatings exhibited the same performance on the IPC test boards.
The IPC-B-25A multipurpose test board is a well-regarded process qualification vehicle to test coatings, but the complexities of printed circuit boards vary in element size, design and purpose. As a true functional test, some flexible LED strips were coated and performed a very similar test to the Aculon IPX8 test:

• LED strips were powered with 12 VDC, rather than 18 VDC. The deviation was due to the inherent design of the strips.
• The circuitry was still immersed in the same “Instant Ocean” salt water mix for 60 minutes
• Evaluated for corrosion/functionality post testing.
LED TESTING - UNCOATED CONTROL - FAIL

Pre-Immersion

Post Immersion

Significant Corrosion!
LED TESTING – POLYURETHANE CONFORMAL - FAIL

- Passes Traditional IPC Board Testing
- Fails Testing on LED Strip
- Very thick at 100uM
- Does not coat sharp angles
- Not real world IPX7

Significant Corrosion!
• Passes Traditional IPC Board Testing

• Fails Testing on LED Strip

• Does not coat sharp angles

• Not real world IPX7

LED TESTING – ACRYLIC CONFORMAL- FAIL
LED TESTING – NANOPROOF 7 - PASS

- Passes Traditional IPC Board Testing @ 18 & 50 VDC
- Passes Testing on LED Strip
- Successfully coats sharp angles
- After process optimization real world IPX7 performance possible

No Corrosion Observed!
• Passes Traditional IPC Board Testing @ 18 & 50 VDC

• Passes Testing on LED Strip

• Successfully coats sharp angles

• After process optimization real world IPX7 performance possible

No Corrosion Observed!
ANTI-FINGERPRINT (AFP) TECHNOLOGIES

Aculon offers several easy clean and Anti-Fingerprint (AFP) treatments for electronics and other applications.
AFP COATINGS – HIDING POWER

Extremely thin optically clear AFP – Hiding Power treatments are applied to the surface which:

- **Hide the oil of the fingerprint**
  - Allow light to pass, significantly reducing its appearance

- **Offer Easy Clean Properties**
  - Hydrophobic behavior assists with making it easier to clean fingerprints without chemicals

- **Durable**
  - Robust coatings offer ongoing AFP performance after normal handling
AFP COATINGS – EASY CLEAN

Extremely thin optically clear easy clean treatments are applied to the surface which:

• **Increase oleophobicity & hydrophobicity**
  • Significantly improves the ease of cleaning fingerprint contaminated surfaces

• **Allow for cleaning with no solvents**
  • Remove fingerprints with dry cloth wipe

• **Durable**
  • Robust coatings offer ongoing AFP performance after normal handling

Aculon, Inc. @ 2020
1. Improve Quality
   - Higher yields
   - Better transfer effectiveness

2. Boost Productivity
   - Less underwiping
   - Less downtime for paper changes

3. Reduce Costs
   - Less rework
   - Lower paper and solvent consumption

Nanoclear is a SAMP Coating
(Self-Assembling Monolayer Phosphonate)

Extremely thin flux-repellent film applied to stencil underside & aperture walls
NANOCLEAR SUMMARY

#1 Globally

- Not just for fine pitch stencils
- Easy to calculate benefits:
  - Improved Quality
  - Boost productivity
  - Reduced Costs
- Coats the aperture walls
- Techniques to enhance durability – Soft wipes & clean better!
- Continue to innovate to meet customer demand
- Testing Spray version with Apple

Nanoclear enables higher quality, more cost-effective stencil print process
Aculon is committed to offering a range of environmentally friendly products and follow good sustainable business practices. We help our customers support their sustainability goals and help protect the environment.

**VOC-Exempt Options**

**PFOA-Free Products**

**Eco-Packaging & Waste Reduction**
- Nearly all Aculon packaging (shippers, pails, bottles) is reusable or recyclable
- Green alternatives are utilized wherever possible
- From paper to pens, reusable or recyclable office supplies are used throughout our business operations

**Reduced Transportation-Related Emissions**
- Reduced material used → reduced transportation of material & wastes
- Localization with suppliers & distributors in Europe & Asia
- Utilize carbon-neutral shipping options when using UPS

**Sustainable Energy & Increased Efficiency**
- Retrofitted LED Lighting Throughout our HQ (>800 LEDs) & Utilize Extensive Natural Light
- Switched to Energy Efficient Equipment
CONCLUSION

• Platform technology company that make customers products better!
• Surface solution experts
• Strong history of working with customers to solve problems
• Broad portfolio of products, including more sustainable options
• Strong IP, testing capabilities and in-house expertise
THANK YOU