

ESD-Control VPP Photopolymers and Finished-Part Validation

Electrical-property definition, deployed-environment testing and application-specific electrostatic-control planning

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Highlights

- Resistance, surface resistance, volume resistance and resistivity are not interchangeable.
- IEC 61340-5-1:2024 provides an ESD-control framework, not one universal printed-part window.
- Electrical performance is measured for the exact formulation, geometry, conditioning and deployed environment.
- HDT does not by itself establish survival of a reflow profile.
- Early adoption depends on electrical, mechanical, thermal and dimensional acceptance in the production cell.

Abstract

ESD-control materials are selected by the electrical function of the intended item and its complete electrostatic-control plan.

The measurement record identifies electrical property, units, electrode geometry, voltage, conditioning, specimen or final geometry and method. A broad resistance range is not presented as universally required by IEC 61340-5-1.

Thermal and production suitability require time-dependent exposure, load, warpage, repeated cycles and dimensional acceptance in addition to electrical performance.

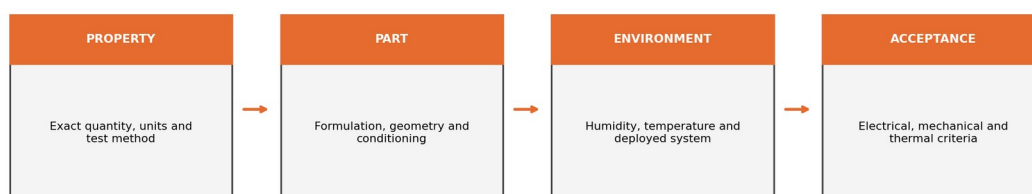
Keywords ESD · surface resistance · resistivity · IEC 61340-5-1 · finished part

Source use. Product evidence is in [1]; ESD/electrical methods in [2–4]; cross-paper and thermal control in [5–6].

1. Electrical-property definition

The paper distinguishes Ω , $\Omega/\square$ and $\Omega\cdot m$ quantities and states the exact method, conditioning and geometry for every result.

- Identify surface or volume measurement.
- Record voltage and electrodes.
- Test relevant printed geometry.



Release requires traceable evidence at every gate; a catalogue label cannot bypass the chain.

Figure 1. WP-41 evidence gates from controlled material description to final acceptance.

2. Deployed ESD-control function

Acceptance depends on whether the item is a fixture, enclosure, packaging component or another element in the control programme.

- Select the applicable standard/method.
- Test environmental sensitivity.
- Verify grounding and system integration.

3. Thermal/mechanical boundary

A deflection-temperature value is not a continuous-use or reflow qualification. Exposure time, load, cycles, warpage and final dimensions require direct validation.

4. Minimum controlled evidence before release

Control field	Required record	Release interpretation
Property	Exact quantity, units and test method	Catalogue description only until evidence is linked
Part	Formulation, geometry and conditioning	Control process variables and change triggers
Environment	Humidity, temperature and deployed system	Report method, result, uncertainty and limits
Acceptance	Electrical, mechanical and thermal criteria	Apply final acceptance and responsibility boundary



Description ≠ measured result ≠ certification or finished-device approval

Figure 2. WP-41 separates catalogue positioning, measured evidence and final application decisions.

KEY INSIGHT

Precise product or application language is retained only when the exact formulation, method, processed specimen and controlled evidence can be traced.

5. Limitations

- No universal 10^6 – 10^{10} Ω requirement is claimed.
- No generic $>10^{14}$ Ω comparator is retained.
- HDT is not reflow qualification.
- Historical production-gate claims require auditable sources.
- ESD-safe is used only as an industry descriptor where documented.

6. Conclusions

- Resistance, surface resistance, volume resistance and resistivity are not interchangeable.
- IEC 61340-5-1:2024 provides an ESD-control framework, not one universal printed-part window.
- Early adoption depends on electrical, mechanical, thermal and dimensional acceptance in the production cell.
- This corrected candidate remains local and on HOLD until series-wide scientific, metadata and visual release checks are complete.

Revision note

Version 5.4 removes universal ESD windows and standard attribution, distinguishes electrical properties and adds deployed-environment and repeated thermal-cycle validation.

Acknowledgements. The author acknowledges the 3Dresyns technical team and users whose manufacturing experience informed this correction.

Disclosure. Dr. Juan Segurola is founder and Scientific Director of 3Dresyns by Resyner Technologies S.L., the supplier of the materials discussed.

References

- [1] 3Dresyns. Current ESD grade-specific TDS and controlled electrical/thermal reports.
- [2] IEC 61340-5-1:2024. Electrostatics—Protection of electronic devices from electrostatic phenomena—General requirements.
- [3] IEC 61340-5-3:2022. Electrostatics—Packaging properties and requirements classification.
- [4] IEC 62631 series. Dielectric and resistive properties of solid insulating materials.
- [5] 3Dresyns WP-27. Conductive Photopolymer Formulations, corrected candidate.
- [6] ISO 75-2:2013. Plastics—Determination of temperature of deflection under load—Part 2.