

Printed Fixtures and Holders for Radiation and Sterilisation Workflows: Dose Stability, Contamination and Reuse

Juan Segurola

3Dresyns by Resyner Technologies S.L.

© 2026 Juan Segurola. All Rights Reserved.

Correspondence: info@3Dresyns.com · www.3Dresyns.com

ER-288 · Engineering Review · Version 0.3 · 23 September 2026

Abstract

Printed Fixtures and Holders for Radiation and Sterilisation Workflows is evaluated as the bounded decision of whether a printed fixture or holder remains geometrically and materially fit after the radiation or sterilisation exposures assigned to the workflow. The controlled state comprises fixture resin, print/cure state, received dose, dose rate, atmosphere, temperature, cleaning, contact surfaces and reuse cycles. ER-288 uses its single direct source only for the bounded proposition described in section 3. ER-288 defines measurements, transfer logic, failure modes and release gates specific to this subject; no universal process window, product recipe or compliance conclusion is inferred.

Keywords: radiation; sterilisation fixture; SLA; gamma; dose; dimensional stability; contamination; reuse

1. Significance, scope and ownership

ER-288 owns whether a printed fixture or holder remains geometrically and materially fit after the radiation or sterilisation exposures assigned to the workflow. The review is organised around the decision-specific evidence chain and leaves neighbouring ownership intact.

1.1. Corpus boundary

Fixtures and holders are supporting hardware, not the device being sterilised and not a radiographic phantom. ER-42 retains sterilisation effects on the device/material and ER-191 phantom design. ER-288 asks whether the support hardware preserves geometry, cleanliness and function through the declared irradiation or sterilisation reuse history.

2. Subject-specific state model and causal chain

For ER-288, causal interpretation begins by freezing fixture resin, print/cure state, received dose, dose rate, atmosphere, temperature, cleaning, contact surfaces and reuse cycles. Radiation dose, sterilisation chemistry and reuse count act on the support hardware as a history, so qualification is tied to the exact workflow rather than to a generic resin grade.

3. Direct evidence and point-of-use source map

Sy and co-workers compared unirradiated and 50 kGy gamma-irradiated SLA methacrylate resin and found measurable changes in surface and mechanical properties under their conditions. This demonstrates that irradiation can alter a printed photopolymer state even when gross chemical/thermal measurements appear stable. Reference [1] is used for direct gamma-irradiated SLA methacrylate property evidence.

4. Measurement architecture

The measurement architecture for ER-288 is built around absorbed-dose mapping where required, dimensional change, surface state, mechanical retention, extractable/particulate contamination relevant to the workflow and repeated-use inspection. Dimensional, surface, contamination and mechanical checks are scheduled against accumulated dose or sterilisation cycles rather than treated as independent first-use tests.

5. Qualification and transfer

A fixture can be reused in another irradiation or sterilisation protocol only after bounding dose, chemistry, temperature and cycle history against the new workflow. Replacement criteria are linked to measured drift, not to an arbitrary cycle count alone.

6. Failure modes and interpretation traps

The central interpretation trap in ER-288 is that a sterilisation dose validated for a device is assumed to qualify the fixture material; one material coupon substitutes for constrained fixture geometry; no check is made for contamination transfer. Dose history, dimensional stability, contamination, mechanics and reuse are held as separate conditions so a fixture cannot be retained solely because it remains visually intact.

7. Non-compensatory release gates

Gate	Minimum evidence	Blocking failure
Fixture state	Resin/cure/cleaning/configuration fixed	Generic printed holder
Dose/process	Radiation/sterilisation route and dose history recorded	Nominal route only
Dimensions	Post-exposure geometry verified	Visual survival
Surface/contamination	Residue/particulate/cleanliness relevant to workflow	Fixture treated as inert
Mechanics	Load-bearing function after exposure tested	Material coupon only
Reuse cycles	Cumulative exposures represented	One cycle generalized
Workflow isolation	Fixture effects separated from device sterilisation	Device outcome attributed to fixture
Replacement rule	Drift/defect stop criterion defined	Indefinite reuse by default

8. Minimum verification experiment

Expose final-state coupons and a representative fixture geometry to the declared workflow dose and environment, measure geometry and use-relevant properties before/after, inspect contact surfaces and run contamination blanks where the fixture touches a controlled item. Repeat through the intended reuse count.

9. Knowledge boundary

Radiation can change printed-resin properties, but fixture-specific contamination, dimensional drift and repeated sterilisation-cycle limits remain sparsely quantified. Device sterilisation evidence cannot be transferred automatically to supporting fixtures.

10. Conclusions

ER-288 permits reuse of irradiation or sterilisation support hardware only while measured geometry, cleanliness and mechanics remain within the workflow-specific replacement rule.

References

1. Jo Ann C. Sy, Blessie A. Basilia, Charito T. Aranilla, Carlo S. Emolaga, Vivian U. Lagura, Marianito T. Margarito. Comparison of the Mechanical, Thermal and Structural Properties of Gamma-Irradiated and Conventional SLA 3D Printed Methacrylate-Based Photo-Curable Resin for Biomedical Application. *Advances in Science and Technology*. 2024;155:71-76. <https://doi.org/10.4028/p-Yi7LNo>

Copyright

© 2026 Juan Segurolo. All Rights Reserved.