

Requirement Traceability for Additively Manufactured Photopolymer Parts: Allocation, Verification and Change Impact

Juan Segurola

3Dresyns by Resyner Technologies S.L.

© 2026 Juan Segurola. All Rights Reserved.

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

ER-292 · Engineering Review · Version 0.3 · 23 September 2026

Abstract

Requirement Traceability for Additively Manufactured Photopolymer Parts is evaluated as the bounded decision of whether every accepted part requirement has an owned verification route and every change exposes its affected evidence. The controlled state comprises stakeholder need, system/part requirement, allocated characteristic, verification method, acceptance result, deviation and change revision. For ER-292, the three cited sources are used only for the evidence roles stated below and only within their demonstrated scope. ER-292 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: requirements traceability; verification; validation; allocation; change impact; additive manufacturing

1. Significance, scope and ownership

ER-292 owns whether every accepted part requirement has an owned verification route and every change exposes its affected evidence. The review is organised around the decision-specific evidence chain and leaves neighbouring ownership intact.

1.1. Corpus boundary

Traceability is narrower than the complete digital thread and broader than a single test report. ER-291 retains end-to-end digital lineage, ER-293 change/requalification, and ER-297 calibration validity. ER-292 requires each allocated requirement to point to a verification method, acceptance rule and evidence object that survives controlled change.

2. Subject-specific state model and causal chain

For ER-292, causal interpretation begins by freezing stakeholder need, system/part requirement, allocated characteristic, verification method, acceptance result, deviation and change revision. A requirement is not traceable merely because its identifier exists; the allocation, method, criterion, evidence and change consequence must remain connected as one auditable chain.

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

Systems engineering and configuration-management standards separate requirement definition, configuration identity and change control. ISO/ASTM 52920 adds AM-process qualification context. ER-292 focuses on the bidirectional requirement-to-evidence map rather than the broader digital thread. Reference [1] is used for requirement/system life-cycle architecture. Reference [2] is used for configuration-management and change identity. In ER-292, reference [3] supplies the industrial additive-manufacturing qualification context used at this point.

4. Measurement architecture

The measurement architecture for ER-292 is built around coverage matrix, unique requirement identifiers, verification-method suitability, acceptance-result linkage, orphan requirements, orphan tests and change-impact completeness. Coverage is tested by walking requirements forward to verification and backward from evidence to the originating requirement, including the effect of a controlled change.

5. Qualification and transfer

Requirement-traceability structures transfer only when decomposition depth, verification semantics and change-impact links remain interpretable in the new programme or toolchain. A migrated identifier list without evidence links is not equivalent.

6. Failure modes and interpretation traps

The central interpretation trap in ER-292 is that requirements exist only in prose; one test is assumed to verify several unrelated claims; changed inputs do not trigger review of affected verification evidence. Requirement, allocation, method, criterion and evidence-link gates make missing traceability explicit instead of allowing a large document set to stand in for coverage.

7. Non-compensatory release gates

Gate	Minimum evidence	Blocking failure
Requirement identity	Unique requirement and source	Ambiguous requirement
Allocation	Owner/component/process allocation explicit	Requirement has no owner
Verification method	Method capable of testing requirement	Generic inspection label
Acceptance criterion	Predeclared pass/withhold rule	Post-hoc interpretation
Evidence link	Result linked bidirectionally to requirement	Detached report
Change impact	Affected requirements/evidence enumerated	Change reviewed only locally
Unresolved state	Open/deferred requirements visible	Missing evidence treated as pass
Release completeness	All load-bearing requirements dispositioned	Partial matrix called complete

8. Minimum verification experiment

Build a requirement-verification matrix for one representative photopolymer part, then trace each result back to the requirement and configuration it supports. Inject one controlled requirement or process change and demonstrate that the impact analysis identifies every dependent drawing, process parameter, test and release decision.

9. Knowledge boundary

Traceability completeness is not the same as requirement correctness. The field lacks a universal granularity for decomposing photopolymer requirements or a single evidence-link schema that survives every toolchain change.

10. Conclusions

ER-292 closes traceability only when every controlled requirement can be followed to its verification evidence and back again through subsequent change.

References

1. International Organization for Standardization, International Electrotechnical Commission, Institute of Electrical and Electronics Engineers. ISO/IEC/IEEE 15288:2023 Systems and software engineering — System life cycle processes. 2023.
2. International Organization for Standardization. ISO 10007:2017 Quality management — Guidelines for configuration management. Geneva: ISO; 2017.
3. International Organization for Standardization and ASTM International. ISO/ASTM 52920:2023 Additive manufacturing — Qualification principles — Requirements for industrial additive manufacturing processes and production sites. 2023.

Copyright

© 2026 Juan Segurola. All Rights Reserved.