

From Individual Reviews to a Second Qualification Corpus

Evidence Architecture Across Engineering Reviews ER-101 to ER-199, State Variables, Scope Boundaries, Cross-Paper Couplings and Research Priorities

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Statement of Significance

The second hundred-numbered block of the Engineering Review series is complete only when its separate papers can be read as one controlled qualification system. ER-200 audits identifiers ER-101 to ER-199 without converting title continuity into scientific equivalence or publication status. It fixes the edition boundary, maps five editorial-technical layers and six directed coupling chains, separates evidence depth from authority to act, and defines fourteen minimum reporting fields. Its most important conclusion is structural: **the engineering object is not a resin name, a printer setting or a test result in isolation, but a versioned material-process-workflow-decision state whose transfer boundary remains explicit.**

Abstract

Engineering Reviews ER-101 to ER-199 extend the first corpus from material-family chemistry through industrial process selection, part and factory controls, radiation-curing applications, circularity evidence and programmed material states. This paper treats the sequence as a bounded second qualification corpus. The controlled enumeration contains **99 contiguous identifiers, 99 non-empty controlling titles and 99 named title-source documents**, with no duplicate identifier. Forced single-cluster coding assigns 38 identifiers to material, macromer and network families; 24 to industrial process-family and material-selection architecture; 22 to part, factory and qualification controls; 12 to radiation-cure extensions and application-specific qualification; and 3 to terminal evidence architectures and programmed material states. These counts describe editorial topology, not evidence quantity or scientific weight. Six recurrent coupling chains show why upstream identity, optical or energy input, cure and network state, post-processing, conditioning, geometry, interfaces, recovery history and decision authority cannot be collapsed. A six-level evidence ladder and fourteen-field minimum reporting set are proposed. The paper is a controlled qualitative corpus synthesis, not a systematic review, bibliometric analysis, pooled property database, product comparison or confirmation that every scientific claim has equal source depth.

Keywords: qualification corpus; vat photopolymerisation; additive manufacturing; radiation curing; evidence architecture; material-process-workflow state; scope ownership; provenance; change control.

1. Purpose and corpus boundary

ER-200 is the terminal synthesis for ER-101 to ER-199. ER-100 retains the corresponding role for ER-01 to ER-99 [1]. ER-200 neither republishes the conclusions of ninety-nine papers nor promotes their individual evidence to a common level. Its unit of analysis is the controlled ER identifier, its controlling title, its declared ownership and boundary statements, and the edition state fixed before this draft.

The sequence has 99 consecutive identifiers. The freeze preflight records 99 non-empty titles and 99 named title-source documents [5]. That is an identity and custody result. It is not a claim that all 99 public repository objects share one release state, licence, DOI status, review history or file format. Scientific manuscript, independent review, author countersignature, public PDF, DOI, deposit and publication remain separate gates.

The boundary excludes ER-100 and earlier papers except when a second-corpus paper explicitly inherits or hands back ownership. It also excludes future reserve topics. Cross-boundary references to ER-017, ER-024, ER-043, ER-063, ER-072, ER-100 and ER-139 are ownership links, not a hidden enlargement of the counted corpus.

2. Methods and audit rules

2.1 Source hierarchy

The controlling title hierarchy was fixed before prose was written. ER-101 to ER-138 derive from ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv; ER-139 to ER-196 derive from ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md; and ER-197 to ER-199 derive from the independently accepted allocation v0.5 [2] [3] [4] [5]. The appendix prints each identifier, title and source document so that a title cannot silently drift during layout. It reproduces each named source character-exactly, including inherited typographic artefacts; it does not silently normalise source titles.

ER-100 v0.3 was read only as a structural analogue [1]. None of its cluster counts, retired-record treatment, public-repository counts or first-corpus conclusions was transferred automatically. The final-band articles ER-197, ER-198 and ER-199 were preserved as exact PDFs and read as distinct scope anchors [10-12]. The final scientific states of ER-167, ER-171, ER-172 and ER-178 were checked at their exact manuscript hashes because they remained moving states during preflight [6-9].

2.2 Counting and coding rules

Every identifier receives exactly one primary cluster. The assignment describes the principal editorial function of a paper; secondary couplings are represented by directed links rather than double counting. A range count therefore cannot be read as a count of studies, sources, findings, standards or released records.

The corpus synthesis uses controlled title and ownership records before narrative recollection. A title is sufficient to establish identifier and title identity, but not to invent a scientific conclusion. Where evidence-state vocabularies were encoded differently across production waves, no retrospective percentage is calculated. Missing denominators are preserved as missing rather than normalised away.

2.3 Negative controls

The analysis prohibits five shortcuts: treating a trade name as a material state; treating a standard method as product qualification; treating a bibliographic record as read evidence; treating a public PDF as proof that scientific review and deposit gates coincide; and treating the same observation repeated across papers as independent replication.

3. Corpus topology

The second corpus has five primary layers.

Code	Principal range	Primary function	Identifiers
C1	ER-101-ER-138	Material, macromer and network families	38
C2	ER-139-ER-162	Industrial process-family and material-selection architecture	24
C3	ER-163-ER-184	Part, factory and qualification controls	22
C4	ER-185-ER-196	Radiation-cure extensions and application-specific qualification	12
C5	ER-197-ER-199	Terminal evidence architectures and programmed material states	3

C1 expands chemical specificity. It distinguishes elastomeric, high-temperature, bio-derived, degradable and hydrogel-forming systems by macromer identity, functionalisation, network route, process state and qualification burden. C2 changes scale: the question becomes which additive-manufacturing process and material state fit an industrial decision, including polymers, metals, ceramics and functional particulates. C3 moves downstream into supports, inspection, joining, loading, machining and the controlled factory chain from incoming material through storage, exposure and waste. C4 extends the logic into thick sections, adhesives, security features, electron-beam curing, waterborne systems, controlled undercure, specialised devices and thin pigmented films. C5 closes with three non-interchangeable architectures: photochemical material-state addressing, proof of material-loop closure and programming of LCE anisotropy [10-12].

4. The corpus-level state object

Across the second corpus, a defensible claim can be represented as a state vector rather than a material label:

S = {Document identity; Material identity; Material prehistory; Process platform; Optical/energy input; Geometry and orientation; Post-processing; Conditioning and environment; State measurement; Test and metrology; Population and statistics; Evidence boundary; Change control; Authority state}.

This representation is deliberately operational. Two results may be scientifically compatible while numerically different because they refer to different states. A polyurethane-acrylate label does not fix segment architecture or hydrolysis state; a nominal exposure does not fix absorbed dose or spatial conversion; a post-cure label does not fix dose delivery, shadowing, atmosphere or thermal coupling; a mean does not become a design value without a defined population [8]; and a machined feature does not inherit a process window from an adjacent polymer family [7].

The state vector also prevents a common documentary error. Review closure fixes scientific bytes. A public derivative, DOI reservation and deposit are later operations over related but distinct objects. ER-200 therefore records authority state as part of the engineering object rather than as administrative decoration.

5. Six recurrent coupling chains

5.1 Feedstock identity to qualified property

ER-101 to ER-138 show that family names contain multiple chemically and physically distinct networks. ER-172 then moves the same problem into incoming control: identity, inhibitor level, functionality distribution, impurity and lot equivalence are not interchangeable attributes [6]. ER-182 supplies the downstream state-measurement boundary. The direction is **identity -> formulation and prehistory -> cure/network state -> measured property -> bounded decision**.

5.2 The factory handling chain

ER-172 to ER-180 form an unusually explicit process chain: receipt, batch compounding, equipment optical/consumable state, changeover and contamination, reactive-process safety, exposure verification, waste management, packaging/storage excursion and returned-part analysis [6] [9]. A control failure can propagate forward while its diagnostic signal appears later. Qualification therefore requires both local acceptance criteria and custody across hand-offs.

5.3 Post-cure, ageing, design values and secondary operations

ER-181 treats post-cure as dose delivery coupled to chamber geometry, atmosphere and temperature. ER-182 separates conversion, insolubility, gel fraction, effective crosslink density and modulus. ER-170 governs time extrapolation; ER-171 governs population inference; ER-167 governs removal of material from the resulting part [7,8]. A property table or machining instruction that omits this chain has lost the state it claims to represent.

5.4 Interfaces and thin layers

Joining, coating, bondline cure, cure-shrinkage stress, oxygen inhibition and photon competition occupy different ownerships across ER-165, ER-168, ER-186, ER-195 and ER-196. Their shared rule is that bulk-resin performance cannot qualify an interface or thin layer. Surface state, optical access, local conversion, stress development, adhesion or barrier function and service environment must be measured at the relevant geometry.

5.5 Recovery and loop closure

ER-111 to ER-113 describe chemistry-specific exchange, degradation, recovery or reprinting routes. ER-183 owns mechanical recycling. ER-198 owns the evidence that a claimed loop closes across targeted-material mass balance, recovered-feedstock identity, reprinting and retained performance [11]. No step licenses an environmental conclusion; life-cycle assessment remains outside this paper and with ER-017.

5.6 Photochemical addressing to programmed transformation

ER-197 asks whether light inputs create separable local material states, with selectivity, reaction orthogonality and crosstalk measured rather than assumed [10]. ER-199 asks whether anisotropy and director alignment are encoded, retained and verified so that transformation remains repeatable and stable [12]. The chain is **addressing input -> local reaction state -> anisotropy/orientation -> actuation or transformation -> fidelity, repeatability and drift**. Device-level function remains outside this chain where owned by ER-024.

6. Evidence-to-decision architecture

The second corpus supports a six-level ladder. Moving upward requires a new evidence object; stronger wording cannot substitute for it.

Level	Required object	Permitted use	Prohibited promotion
0	Verified identity and provenance	Establishes what document, material or batch is being discussed	No scientific finding
1	Mechanistic rationale or bounded adjacent evidence	Defines hypotheses and credible failure modes	No direct material or safety claim
2	Direct material-state evidence with declared preparation and conditioning	Supports the measured response for that state	No cross-formulation or cross-platform equivalence
3	Process evidence with machine, energy input, geometry and workflow	Supports a bounded operating window	No automatic component qualification
4	Representative component or interface evidence in a declared environment	Supports defined functional performance	No universal intended-use approval
5	Risk-managed, standard-linked and production-controlled intended-use evidence	Supports the declared decision within its envelope	No transfer outside the qualified state or jurisdiction

Resolved-not-read evidence cannot rise above level 0 for content. A standard catalogue page can establish identity, edition and stated scope while remaining insufficient for clauses not read. Supplier evidence may document identity or implementation context but cannot silently become independent performance evidence.

7. Standards pattern

The corpus uses standards in four roles: vocabulary and process-family definition; test and specimen preparation; production-site or quality-system qualification; and application- or jurisdiction-specific decision control. These roles must remain separate. ISO/ASTM 52900 supplies common terminology [13], while ISO/ASTM 52920 addresses qualification principles for industrial additive-manufacturing processes and production sites [14]. Neither supplies a material allowable, a machining envelope, a waste classification or an intended-use approval.

Across the corpus, the transfer boundary recurs: a method can specify how to measure while leaving material identity, cure state, orientation, washing, post-cure, conditioning, geometry and acceptance criteria open. The report must therefore state both **what the standard controls** and **what remains controlled by the local qualification**. Standards found only at metadata or catalogue depth retain that limitation.

8. Provenance, boundaries and maintenance

8.1 One-way boundaries

A later paper may place a clear one-way boundary toward an earlier owner without forcing a retroactive edit, provided the earlier text is not made materially false. Reciprocal maintenance is required when ownership conflicts, a previous absence claim becomes false, or omission creates a practical qualification risk.

8.2 Closure mechanisms

Findings should retain how they closed: source recovery and reading; correction; narrowing; removal; reviewer verification; author acceptance as a non-blocking limitation; or documentary/package repair. These mechanisms are not equivalent and must not be flattened into a single closed label.

8.3 Edition maintenance

An ER-200 update is triggered by a controlling-title change, retirement/merge, materially changed ownership boundary, new evidence that invalidates a corpus-level statement, or a change to the edition's evidence/authority model. Routine PDF formatting, DOI reservation or repository metadata repair does not reopen scientific corpus conclusions unless it changes the content or identity relied upon.

9. Research priorities retained by the second corpus

1. **State-resolved, interlaboratory evidence.** Representative datasets must separate formulation, lot, build, machine, orientation, post-cure, conditioning and method variation before design values or broad transfer can be defended.
2. **Direct evidence for factory and downstream operations.** Machining, contamination control, exposure verification, waste streams, packaging excursions and returned-part forensics need direct known-state studies rather than transfer from adjacent materials or generic guidance.
3. **Post-cure and ageing as coupled processes.** Dose delivery, spatial conversion, thermal history, continued cure and degradation require measurements that support time extrapolation rather than end-point comparison alone.
4. **Interfaces in their real geometry.** Bondlines, coatings, thin pigmented films, inserts and machined features require local state and damage measurements; bulk coupons are insufficient.
5. **Closed-loop evidence.** Recovery claims need targeted-material mass balance, recovered-feedstock identity, documented reprinting and retained performance before circularity is claimed, and life-cycle evidence before environmental benefit is claimed.
6. **Program fidelity and drift.** Multimaterial addressing and LCE programming require independent measures of selectivity, crosstalk, orientation, repeatability, cycling and temporal drift.
7. **Application-specific final-state evidence.** Pharmaceutical, food, hearing, radiographic and other specialised applications require the relevant finished-article, exposure, risk and jurisdictional controls.

10. Minimum reporting set

A transferable second-corpus claim should report fourteen fields: Document identity; Material identity; Material prehistory; Process platform; Optical/energy input; Geometry and orientation; Post-processing; Conditioning and environment; State measurement; Test and metrology; Population and statistics; Evidence boundary; Change control; and Authority state. The complete field definitions are preserved in ER200_MINIMUM_REPORTING_SET_v0.1_20260915.csv.

Completeness does not imply relevance. A field may be marked not applicable only with a reason. Unknown values remain unknown; they are not replaced by a product name, default printer profile or generic statement such as “post-cured”.

11. Limitations

This is a controlled qualitative synthesis of one edition, not a systematic review of the external literature. The 99-row appendix establishes identifier and title custody; it does not measure scientific quality. The five clusters are forced primary assignments and therefore suppress legitimate secondary overlap. Coupling chains are directional engineering maps, not universal causal coefficients.

ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv identifies itself as an early-screening index and directs final collision decisions to the full article text. ER-200 therefore uses that register only for title custody and primary editorial topology. No scientific conclusion in this paper is inferred from its short ownership field alone.

Evidence-state and closure vocabularies changed across production waves. This paper therefore reports no corpus-wide percentage for full-text access, independent verification, standards coverage or public release. Absence of a uniform denominator is a limitation, not permission to infer one.

The standards roles in §7 are carried from the controlled first-corpus synthesis and second-corpus ownership records. ER-200 did not perform a new catalogue-currentness or clause-level audit on 15 September 2026. It therefore makes no claim about revisions after the dates recorded by the cited corpus sources.

The final scientific states of ER-167, ER-171, ER-172 and ER-178 are represented by exact countersigned manuscript bytes [6-9]. Their public PDF, licence, DOI, repository and publication states remain separate. ER-199 travels only as a scientific scope anchor; ER-179 does not travel. This synthesis makes no claim about either paper's countersignature, public-PDF, DOI, deposit or publication state.

12. Conclusions

1. ER-101 to ER-199 form a contiguous 99-identifier second corpus with 99 controlling titles and 99 named title-source documents.
2. The corpus is best read in five layers: material/network families; industrial process selection; part/factory qualification; radiation-cure and specialised applications; and terminal state-addressing, circularity and anisotropy architectures.
3. The controlling engineering object is a versioned material-process-workflow-decision state, not a trade name or isolated value.
4. Six coupling chains show where local results lose validity when feedstock, energy input, cure, post-processing, conditioning, interfaces, recovery history or authority state is omitted.
5. Evidence progresses from identity through mechanism, material state, process, component and intended-use qualification. Each transition requires a new evidence object.
6. Standards define vocabulary, methods or organisational controls within stated scopes; they do not erase unreported VPP-specific state variables.
7. A fourteen-field minimum reporting set makes both scientific transfer and documentary authority auditable.
8. Scientific freeze, public-PDF production, DOI, deposit and publication remain separate gates. A complete numbered series is not permission to collapse them.

References

- [1] Segurola, J. *From Individual Reviews to a Qualification Corpus: Evidence Architecture Across Engineering Reviews ER-01 to ER-99*. ER-100 v0.3 (2026). Controlled public PDF SHA-256 9d68123600a1800adaeac2f130c7aa54ae321bacba5ec7e28e1b651f99194838.
- [2] ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv. Controlled title and ownership register for ER-001 to ER-166.
- [3] ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md. Controlled master sequence for ER-139 to ER-200.
- [4] ER197_ER200_CONSOLIDATED_ALLOCATION_v0.5_20260915.md. Independently accepted terminal allocation; SHA-256 5c523d1bdade4ad6c97d3328e758ae23847e54c1f520f1f5d08ad7dfabeba700.
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- [6] Segurola, J. *Incoming Photoresin Raw Materials: Identity, Inhibitor Level, Functionality Distribution, Impurity and Lot Equivalence*. ER-172 v0.3 countersigned manuscript (2026). SHA-256 2fc1c00e2bd979244d2d8c6c8c4593eaa2c8ebe5f81e743805fbc4ff3398fa02.
- [7] Segurola, J. *Secondary Machining of Vat-Photopolymerised Parts*. ER-167 v0.6 countersigned manuscript (2026). SHA-256 fd2af3b649f1d20dcd383e6d23948a4520363303349698aa87c1bd48cd9eb8cc.
- [8] Segurola, J. *Design Values for Printed Photopolymers: Why Classical Allowables Methodology Does Not Transfer, and What Does*. ER-171 v0.1 countersigned manuscript (2026). SHA-256 cbe9df604a10fcb7f4fece7ff1006e56fcc6fc2ad3209262d91ff68361dd1bc7.
- [9] Segurola, J. *Solvent, Wash-Water and Contaminated-Waste Management*. ER-178 v0.1 countersigned manuscript (2026). SHA-256 26deddc10544672f4c271c42315e253016a58eae8c3ba26c508c073aa2ade01.
- [10] Segurola, J. *Single-Vat Multimaterial Vat Photopolymerisation by Photochemical Addressing: Wavelength Selectivity, Dose Encoding, Reaction Orthogonality and Crosstalk*. ER-197 v0.2 public PDF (2026). SHA-256 4a8a95b48772318cd0b8941c889fa32ed121dc52659ad6bac9a4d2bb21bd434b.

[11] Segurola, J. *Evidence for Material Circularity in Photopolymer Additive Manufacturing: Material-Loop Closure, Recovery Mass Balance, Recovered-Feedstock Identity and Property Retention*. ER-198 v0.1 public PDF (2026). SHA-256 0fb9d8407a33d06ec3df1f67633f7844ff025a8cbb56bb8f21fbc90204dfc437.

[12] Segurola, J. *Programming Anisotropy in 4D-Printed Liquid-Crystal Elastomers: Director Alignment, Vat-Photopolymerisation Routes, Actuation Fidelity and Drift*. ER-199 v0.2 public PDF (2026). SHA-256 27f4e6b46ef1aa12d3d036b28ca8dff1211fe9e842ef8469df3799e4909ba9c5.

[13] ISO/ASTM 52900:2021. *Additive manufacturing - General principles - Fundamentals and vocabulary*. Edition 2. <https://www.iso.org/standard/74514.html>

[14] ISO/ASTM 52920:2023. *Additive manufacturing - Qualification principles - Requirements for industrial additive manufacturing processes and production sites*. <https://www.iso.org/standard/76911.html>

Auditable appendix: ER-101 to ER-199 controlling titles and sources

ER	Controlling title	Exact title-source document
ER-101	Elastomeric and Rubber-Like Photopolymers for Vat Photopolymerisation: Network Design, Tear Resistance, Creep, Compression Set and Cyclic Durability	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-102	Silicone and Silicone-Like Elastomers in Vat Photopolymerisation: Polysiloxane Chemistry, Silicone-Free Functional Analogues, Thermal-Service Limits and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-103	Polyurethane, Polyurea and Urethane-Acrylate Photopolymers for Vat Photopolymerisation: Chemical Identity, Segment Architecture, Hydrogen Bonding, Hydrolysis and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-104	Fluorinated and Fluoropolymer-Derived Photopolymers for Vat Photopolymerisation: Chemical Identity, Surface Energy, Optical-Cure Trade-Offs, Chemical Resistance, PFAS Boundaries and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-105	Polyimide and Polyimide-Precursor Photopolymers for Vat Photopolymerisation: Chemical Identity, Organogel Formation, Imidisation, Shrinkage, Void Formation and High-Temperature Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-106	Cyanate-Ester, Maleimide/Bismaleimide and Benzoxazine Photopolymers for Vat Photopolymerisation: Photo-Triggered Networks, Thermal Post-Cure and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-107	Phenolic, Lignin-Derived and Bio-Aromatic Photopolymers for Vat Photopolymerisation: Native Polycondensation, (Meth)acrylate Functionalisation, Optical Attenuation, Volatile Evolution and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-108	Furan, Furfuryl, Tetrahydrofurfuryl and FDCA-Derived Materials for Vat Photopolymerisation: Chemical Identity, Radical and Diels-Alder Routes, Dynamic Networks and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-109	Isosorbide-Derived Photoresins for Vat Photopolymerisation: Methacrylate and Thiol-Yne Routes, Rigidity, Toughening, Thermal State and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-110	Itaconic-Acid-Derived Photoresins for Vat Photopolymerisation: Unsaturated Polyesters, Poly(ester amide)s, Itaconamides, Reactive Diluents and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-111	Dithiolane and Lipocate Photoresins for Vat Photopolymerisation: Ring-Opening Disulfide Networks, Dynamic Exchange, Depolymerisation, Reprinting and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-112	Thioester-Containing Photoresins for Vat Photopolymerisation: Thiol-Thioester Exchange, Controlled Degradation, Filler Recovery, Oligomer Reuse and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-113	Hemiacetal-Ester and N,O-Acetal Photoresins for Vat Photopolymerisation: Acid-Triggered De-crosslinking, Hydrolysis, Reprocessing, Polymer Recovery and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-114	Poly(β -amino ester) Photoresins for Projection Micro- Stereolithography: Aza-Michael Macromer Identity, Hydrolytic Degradation, Surface-to-Bulk Transition, Resolution and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-115	Poly(propylene fumarate) Photoresins for Stereolithography: Oligomer Identity, Reactive-Diluent Control, Temperature- Viscosity Coupling, Pulsed-UV Cure and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-116	Poly(trimethylene carbonate) Photoresins for Stereolithography: Macromer Identity, Non-Reactive Diluent, Elastic Networks, Perfusable Channels, β -TCP Composites and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-117	Poly(ϵ -caprolactone) Photoresins for Stereolithography: Macromer Identity, Temperature-Assisted Processing, Methacrylation, Degradation, Hybrid Networks and Filled- Gyroid Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-118	Polylactide Photoresins for Stereolithography: Stereochemical and Molar-Mass Identity, Urethane-Methacrylate and Triacrylate Routes, Laser-Modality Dependence, Upcycling and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-119	Glycerol-Derived Acrylate Photoresins: Polyglycerol-Acrylate versus Poly(glycerol sebacate) Acrylate, CAL, DLP, Extrusion, Post-Cure, Degradation and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-120	POMaC Citrate-Containing Photocurable Elastomers: Dual Crosslinking, LCD Vat Printing, Porogen Extraction, Granular Composite Bioinks and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-121	Methacrylated Silk-Fibroin Photoresins: Protein Source, GMA Functionalisation, Aqueous DLP, Hydration, Mechanics, Biological State and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv

ER	Controlling title	Exact title-source document
ER-122	Collagen Methacryloyl Photoresins: Collagen Source, Methacrylation, Triple-Helix State, Low-Temperature DLP, Hydration, Enzymatic Degradation and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-123	Chitosan-Derived Photocurable Hydrogels: Molecular Weight, Degree of Deacetylation, Methacrylation, Acid-Neutral State, Hybrid PEG Networks, SLA/4D Printing and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-124	Hyaluronic-Acid Methacrylate/Methacryloyl Photoresins: Source, Molecular Weight, Substitution, DLP Hybrid Networks, Hydration, Hyaluronidase Degradation and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-125	Alginate-Methacrylate Photoresins: Source, M/G Composition, Methacrylation Route, Covalent-Ionic Dual Networks, Hydration, Degradation and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-126	Dextran-Methacrylate Photoresins: Molecular Weight, Degree of Substitution, Solvent State, DLP Hybrid Networks, Washing, Degradation and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-127	Methacrylated-Starch Photoresins: Botanical Source, Amylose/Amylopectin Composition, Gelatinisation, Substitution, Aqueous DLP, Hybrid Bioinks and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-128	Photocurable Cellulose-Derived Photoresins: Cellulose and CMC Identity, Carboxymethyl and Methacrylate Substitution, Nanocrystal Functionalisation, Aqueous DLP/TPP, Hydration and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-129	Photocurable Pectin-Derived Hydrogels: Botanical Identity, Esterification, Methacrylation and Norbornene Routes, Ionic- Photo Dual Networks, Hydration, Degradation and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-130	Methacrylated Kappa-Carrageenan Photoresins: Algal Source, Sulfation, Methacrylation, Thermo-Ionic-Photo Networks, Extrusion and DLP, Hydration and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-131	Methacrylated Gellan-Gum Photoresins: Microbial Identity, Acyl State, Methacrylation, Thermo-Ionic-Photo Networks, Extrusion, Hydration and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-132	Photocurable Pullulan-Derived Photoresins: Microbial Identity, Methacrylate and Norbornene Routes, Inkjet, SLA- TPP, DLP, Hydration and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-133	Methacrylated Konjac-Glucomannan Photoresins: Botanical Identity, Acetylation, Oxidation, Substitution, Extrusion, Microspheres, Wound Composites, Hydration and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-134	Xanthan-Gum-Enabled Photocurable Bioinks: Microbial Identity, Unsaturated Derivatives, Rheology, Methacrylated Xanthan, Extrusion, Hydration, Network Attribution and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-135	Photocurable Guar-Gum-Derived Hydrogels: Botanical Identity, Hydroxypropylation, Methacrylation, Dual Networks, Extrusion, Hydration and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-136	Agarose and Methacrylated Agarose in Photocurable Biofabrication: Algal Identity, Gelation Hysteresis, Derivatization, Microgel Photoannealing, Support Baths, Network Attribution and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-137	Locust-Bean-Gum-Derived Photocurable Hydrogels: Carob Identity, Galactomannan Structure, Methacrylation, Oxidation, Network Attribution, Injectability, Hydration and Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-138	Gum-Arabic-Derived Crosslinkable Hydrogels: Acacia Identity, Methacrylation, Periodate Oxidation, DIW Network Attribution and Photocure Qualification	ER001_ER166_OWNERSHIP_REGISTER_v0.1.csv
ER-139	State-Resolved Industrial Additive Manufacturing Technology Selection Framework	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-140	Polymer Material Extrusion for Industrial Production	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-141	Polymer Powder-Bed Additive Manufacturing	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-142	Industrial Vat-Photopolymerisation Architectures	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-143	Material Jetting and Inkjet Additive Manufacturing	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-144	Direct Ink Writing and Paste Extrusion	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-145	Metal Laser Powder-Bed Fusion	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-146	Electron-Beam Powder-Bed Fusion of Metals	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-147	Metal Binder Jetting	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-148	Bound-Metal Material Extrusion	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-149	Lithography-Based Metal Manufacturing	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md

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ER-150	Directed Energy Deposition and Wire Arc Additive Manufacturing	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-151	Vat Photopolymerisation of Ceramics	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-152	Ceramic Direct Ink Writing and Robocasting	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-153	Ceramic and Sand Binder Jetting	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-154	Bound-Ceramic Material Extrusion	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-155	Polymer-Binder Powder-Bed Routes for Metals, Ceramics and Unusual Powders	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-156	Nano- and Micron-Scale Raw Materials for 2D and 3D Advanced Materials	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-157	Electrically and Thermally Functional Nano- and Micron-Scale Materials	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-158	Dielectric, Ferroelectric, Piezoelectric and Magnetically Functional Materials	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-159	Optical, Photonic, Luminescent, High-Refractive-Index and Radiation-Functional Materials	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-160	Extreme-Service Specialty Resins	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-161	Adaptive, Soft and Application-Specific 3D Resins	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-162	Factory Decision Matrix for Industrial Additive Manufacturing	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-163	Support Strategies for Internal Channels and Sacrificial Geometries	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-164	Non-Destructive Evaluation of Vat-Photopolymerised Parts	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-165	Adhesive Bonding and Structural Joining of Printed Photopolymers	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-166	Load Introduction into Vat-Photopolymerised Parts: Inserts, Threads, Press Fits and Overmoulded Interfaces	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-167	Secondary Machining of Vat-Photopolymerised Parts	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-168	Coating and Encapsulation of Reactive Photopolymer Substrates: Surface Cure State, Residual-Species Migration, Adhesion and Barrier Qualification	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-169	Embedded Components and Hybrid Functional Assemblies	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-170	Accelerated Ageing and Life-Claim Validity for Printed Photopolymers: Acceleration Factors in a Material Whose State Is Still Evolving	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-171	Design Values for Printed Photopolymers: Why Classical Allowables Methodology Does Not Transfer, and What Does	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-172	Incoming Photoresin Raw Materials: Identity, Inhibitor Level, Functionality Distribution, Impurity and Lot Equivalence	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-173	Batch Compounding, Homogenisation, Filtration and Filling of Photoresins	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-174	Optical and Consumable State of Vat-Photopolymerisation Equipment: Light-Engine Output, Panel and Film Ageing, and Drift Detection	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-175	Printer Changeover, Cleaning Validation and Cross-Contamination Control	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-176	Reactive Process Safety, Exotherm and Fire Risk in Photoresin Manufacture and Use	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-177	Exposure Verification in Industrial Photopolymer Operations: Air and Dermal Sampling, Analytical Methods, Barrier Performance and Control Confirmation	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-178	Solvent, Wash-Water and Contaminated-Waste Management	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-179	Packaging and Storage-Excursion Qualification for Photoresins: Container Material, Headspace Oxygen, Light Transmission and Excursion Disposition	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-180	Returned-Part Analysis for Printed Photopolymers: Reconstructing Cure State, Exposure History and Contamination from a Failed Component	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md

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ER-181	Post-Cure Process Engineering for Vat-Photopolymerised Parts: Dose Delivery, Chamber Geometry, Shadowing, Atmosphere and Thermal Coupling	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-182	Network-State Metrology in Photopolymers: Gel Fraction, Effective Crosslink Density and the Non-Equivalence of Conversion, Insolubility and Modulus	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-183	Mechanical Recycling and Reuse of Cured Photopolymer Waste: Size Reduction, Resin Reincorporation and Requalification	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-184	Diagnostic Inference in Vat Photopolymerisation: Discriminating Between Competing Defect Mechanisms Under Uncertainty	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-185	Thick-Section Photocuring of Putties, Gels, Sealants and Potting Compounds: Attenuation, Frontal Cure, Exotherm and Through-Cure Qualification	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-186	Formulation and Cure of Light-Curable Adhesives Across 2D, 2.5D and 3D Assemblies: Optical Access, Bondline Kinetics and Dark-Zone Control	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-187	Independence and Verification of Multimodal Authentication Features in Photocurable Inks and Coatings	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-188	Electron-Beam versus Photoinitiated Curing of Acrylate Formulations: Network Formation Without a Photoinitiator, Depth-Dose Coupling and Requalification Boundaries	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-189	Waterborne UV-Curable Dispersions: Water Removal, Coalescence, Photocure and Film-Formation Coupling	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-190	Controlled Undercure in Radiation-Curable Pressure-Sensitive Adhesives: The Conversion Window, Residual Unsaturations as a Specification, and Migration from a Permanently Soft Layer	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-191	Radiographic-Contrast Photopolymers for Phantoms, Sample Holders and X-Ray Workflows: Attenuation, Artefact and Dimensional Qualification	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-192	Photopolymers for Otoplastics and Hearing Devices: Shell and Earmould Mechanics, Skin-Contact State, Biofilm, Acoustics and Fit	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-193	Vat-Photopolymerised Drug-Delivery and Pharmaceutical Devices: Resin Identity, Dose Incorporation, Release, Residuals and Qualification	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-194	Photocurable Scaffolds for Cultured Meat and Food Biofabrication: Food-Grade Chemistry, Mass Transport, Texture and Process Qualification	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-195	Cure-Shrinkage Stress at the Coating-Substrate Interface: Substrate Modulus, Thermal Mismatch and Adhesion Failure in Radiation-Curable Coatings	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-196	Oxygen Inhibition and Photon Competition in Thin Pigmented Radiation-Curable Films: Why Surface Cure Governs Graphic Ink Performance	ER139_ER200_MASTER_SEQUENCE_POST_GATE2_20260905.md
ER-197	Single-Vat Multimaterial Vat Photopolymerisation by Photochemical Addressing: Wavelength Selectivity, Dose Encoding, Reaction Orthogonality and Crosstalk	ER197_ER200_CONSOLIDATED_ALLOCATION_v0.5_20260915.md
ER-198	Evidence for Material Circularity in Photopolymer Additive Manufacturing: Material-Loop Closure, Recovery Mass Balance, Recovered-Feedstock Identity and Property Retention	ER197_ER200_CONSOLIDATED_ALLOCATION_v0.5_20260915.md
ER-199	Programming Anisotropy in 4D-Printed Liquid-Crystal Elastomers: Director Alignment, Vat-Photopolymerisation Routes, Actuation Fidelity and Drift	ER197_ER200_CONSOLIDATED_ALLOCATION_v0.5_20260915.md

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