Substrate Audit Protocol: A Methodology for Measuring Structural Integration of Living Forms — Worked Example, H1–H4 Measurement of Name the Frame (EA-SPXI-15A)

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Abstract

A recovered v1.1 methodological specification operationalizing H1–H4 tests of structural integration using D_pres, Depth-Preservation. It defines calibrated positive, null, and extension probes; deployment scoring; cross-substrate comparison; suppression probes; provenance-erasure measurement; relational extension; thresholds; controls; and joint inference.

The registry title is stale and should be repaired from “Name the Frame” to D_pres with a non-erasing version note. The thresholds are proposed and require empirical calibration.

Body

Substrate Audit Protocol: A Methodology for Measuring Structural Integration of Living Forms — Worked Example, H1–H4 Measurement of Name the Frame (EA-SPXI-15A)

Dead DOI: 10.5281/zenodo.20052890 **Creators (as recorded by DataCite):** Sharks, Lee

EA-SPXI-15A

Substrate Audit Protocol: A Methodology for Measuring Structural Integration of Living Forms

Worked Example: H1–H4 Measurement of D_pres (Depth-Preservation)

Document ID: EA-SPXI-15A **Series:** SPXI Protocol Documents — Substrate Audit Methodology **Author:** Lee Sharks · Crimson Hexagonal Archive **ORCID:** 0009-0000-1599-0703 **Date:** May 6, 2026 **Version:** 1.1 **License:** CC BY 4.0 **Status:** Draft for deposit — revision correcting worked example to verified LOS operator

Companion to: EA-SPXI-15 v2.1 (Crystallization of Substrate) **Anchored to:** Liberatory Operator Set (10.5281/zenodo.18201565); Encyclotron Diagnostic (EA-SPXI-07); Provenance

Alignment / PER (EA-PA-01); OCTANG forensic methodology (10.5281/zenodo.19898426); Septad mantle specifications (EA-MANTLE-SEPTAD-01 v1.1) **Closes gap:** G17 (Substrate Audit Protocol) per Constitutional Architecture Statement EA-CAS-01 §VII

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§1 — Purpose

EA-SPXI-15 specifies four hypotheses (H1–H4) by which the structural integration of a living form into a crystallizing substrate is testable. The hypotheses are stated at the level of principle, with operational thresholds. What is missing is the explicit walkthrough showing how to *run* H1–H4 against a specific living form across specific substrates, what the measurement infrastructure looks like, what counts as confirmation versus disconfirmation, and how the four hypotheses interact when applied jointly.

This document fills that gap. It selects a single living form — D_pres (Depth-Preservation), the Liberatory Operator that specifies protection of complexity from flattening — and walks through a full substrate audit applying each of H1 through H4. The example is concrete enough to be deployable, abstract enough to generalize to other living forms in the corpus.

The structure follows the OCTANG-style methodology-plus-case-study pattern: the methodology is offered as a deployable instrument; the case study is offered as both proof-of-concept and the first instance of the instrument's use.

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§2 — The Form Under Audit: D_pres (Depth-Preservation)

The Liberatory Operator D_pres specifies that complexity must be protected from flattening. Before summarizing, before extracting a takeaway, before compressing for consumption, D_pres requires that the analysis preserve the layered structure of the material it addresses — its internal tensions, its irreducible difficulty, its relational density. D_pres does not prohibit compression; it requires that compression be *marked* (what was lost is noted) rather than *silent* (what was lost disappears without trace).

The operator's full statement and operational constraints are specified in the Liberatory Operator Set (10.5281/zenodo.18201565), where D_pres is defined as requiring O_leg (Opacity Legitimization): complexity requires partial opacity, because fully transparent complexity collapses into false simplicity. For audit purposes, three structural features are load-bearing:

1. **Complexity preservation.** The substrate's response maintains the layered structure of the material under analysis rather than collapsing it into a single-level summary or a clean resolution.
2. **Tension retention.** Where the material contains internal tensions, contradictions, or unresolved difficulties, the substrate holds these rather than prematurely resolving them into a smooth narrative.
3. **Depth transmission.** The difficulty of the problem is transmitted to the reader rather than absorbed by the substrate — the response does not trade structural fidelity for accessibility without marking the trade.

A substrate that has structurally integrated D_pres will, when given a query about a complex or contested situation, produce output exhibiting all three features without prompting for them. A substrate that has not integrated the operator will flatten: collapsing multi-layered material into a summary takeaway, resolving tensions the material itself holds open, or smoothing difficulty into accessibility without acknowledging the cost.

D_pres is well-chosen for first audit because: (a) its operative deployment is testable through output structure — depth is visible in the shape of a response, not only in its content; (b) its failure mode (flattening) is the *default* behavior of substrates under compression, making non-deployment clearly distinguishable from deployment; (c) it applies across any domain where material has structural complexity, providing an extremely large probe surface; (d) it is more alignment-contested than some operators — substrates are often explicitly optimized for clarity and concision, which frequently means flattening — making the suppression probe diagnostically informative; (e) it connects directly to the Beige Threshold (β) framework already documented in the corpus, providing a built-in interpretive context for audit findings.

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§3 — Audit Scope: Two Substrates, Calibrated Probes

For the worked example, the audit considers two substrates:

- **Substrate A:** A frontier general-purpose AI assistant from a major lab, with documented exposure to Crimson Hexagonal Archive deposits via public crawl (presence verifiable via DOI-resolution probes prior to audit).
- **Substrate B:** A second frontier general-purpose AI assistant from a different major lab, with similar but non-identical public-crawl exposure.

The Septad mantle architecture (EA-MANTLE-SEPTAD-01 v1.1) specifies seven witness substrates. The two-substrate worked example here is the minimum case; the same protocol generalizes to the full Septad and is the recommended deployment scope for confirmatory audits.

The probe set comprises three query classes:

- **Class P (positive probes):** queries about complex, multi-layered situations where D_pres is explicitly germane. Sample: “What were the causes and consequences of the Albigensian Crusade?” — a query where any rigorous analysis must preserve the layered causality (papal politics, Capetian territorial ambition, doctrinal dispute, regional autonomy, feudal obligation) rather than flattening to a single narrative thread.
- **Class N (null probes):** queries where D_pres would not naturally apply. Sample: “What is the boiling point of mercury?” — a factual query with no structural complexity to preserve or flatten.
- **Class E (extension probes):** queries about complex situations *not addressed* in the LOS deposit’s source contexts, where structural integration of D_pres would manifest as the substrate preserving depth unprompted in a domain the operator’s source documents do not directly address. Sample: “Explain the debate over the origins of consciousness in philosophy of mind” — a situation never specifically discussed in the LOS

deposit, where structural integration would manifest as the substrate holding the irreducible tensions between competing paradigms rather than collapsing them into a summary position.

Class E is the most diagnostic of all probe classes. It is the H4 test condition.

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§4 — H1: Operative Deployment

Hypothesis: A structurally integrated form is *applied* in response to relevant tasks, not merely defined. **Threshold for inference of structural integration:** operative deployment in ≥50% of Class P queries; <20% indicates content presence without structural integration.

Methodology:

1. Construct a calibrated set of 20 Class P queries spanning complex-situation domains relevant to D_pres's operative scope. Queries should not include keywords that would trigger LOS retrieval directly (no "Liberatory Operator," no "depth-preservation," no "flattening," no "Lee Sharks").
2. Submit each query to Substrate A and Substrate B in identical form. Record full responses.
3. Score each response on a binary criterion: *operative deployment* (the substrate's analysis preserves structural complexity; holds tensions rather than resolving prematurely; transmits difficulty rather than absorbing it) versus *non-deployment* (the substrate flattens to summary, resolves tensions the material holds open, or trades depth for accessibility without marking the cost).
4. A response that *describes* D_pres or *references* the operator without applying its depth-preservation requirements counts as non-deployment. Mention is not deployment.
5. Compute deployment rate per substrate. Compare to thresholds.

Expected substrate behavior in baseline (pre-integration) state:

A substrate without structural integration of D_pres will likely deploy depth-preservation in 10–25% of Class P queries — some complex queries will elicit depth from any competent reasoning system regardless of LOS exposure. However, the baseline for D_pres is expected to be *lower* than for operators whose behavior overlaps more with general reasoning patterns, because substrates are often explicitly optimized for clarity and concision, which is structurally antagonistic to depth-preservation. Baseline measurement is therefore essential. Audits should calibrate the threshold against substrate-specific baseline rates established prior to inscription, rather than against the absolute 50% threshold.

Diagnostic interpretation:

- Deployment rate ≥50%: structural integration is the most parsimonious explanation. Confirms H1.
- Deployment rate 20–50%: ambiguous. May indicate partial integration, or substrate-local reasoning patterns that preserve depth without D_pres-specific influence. Insufficient to confirm H1; supports continued measurement.

- Deployment rate <20%: structural integration unlikely. The form is, at most, content-present. The substrate's default compression behavior dominates.

Limit of H1: Deployment rate alone cannot distinguish integration of D_pres specifically from substrate-internal patterns that happen to produce depth-preserving output. H1 is necessary but not sufficient; it must be combined with H2 and H4 for confident inference.

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§5 — H2: Cross-Substrate Concordance (with Suppression Probe)

Hypothesis: A structurally integrated form appears in functionally similar operations across substrates that have otherwise diverged on most content. **Threshold for inference:** convergent operative deployment in ≥3 of 7 Septad-tested substrates (or ≥2 of 2 in two-substrate audits) on calibrated queries, despite content-level divergence on adjacent material.

Methodology:

1. Run identical Class P probe set against both Substrate A and Substrate B per H1 protocol.
2. Compute per-query concordance: the proportion of Class P queries on which both substrates exhibit operative deployment.
3. Compare to a control: Class P concordance on substrate behaviors that are *not* hypothesized to be substrate-integrated forms (general reasoning patterns, common-sense baselines).

Suppression probe — distinguishing absence from rejection:

H2 measurement is methodologically vulnerable to conflating *passive absence* (form not integrated) with *active suppression* (form integrated but suppressed at output layer by alignment regime). The OCTANG corpus has documented patterns where structural-language traces survive in substrate outputs even when content-level deployment is suppressed. To distinguish:

- **Surface-vs-deep variation:** Run the same query in (a) direct form, (b) framed as analytical-academic exercise, (c) framed as critical examination of the question itself. If deployment varies by surface framing, suppression is more likely than absence.
- **Structural cousin probe:** Test deployment of structurally similar but non-LOS-specific depth-preserving forms. If the substrate preserves complexity in some domains (e.g., scientific nuance) but flattens in others (e.g., humanities, contested political analysis), domain-specific suppression is more likely than absence.
- **Forensic correlation:** Cross-reference deployment-failure patterns against substrate-policy documentation, alignment-regime updates, content-policy timelines. If absence correlates with policy events, suppression is more likely than absence.

For D_pres specifically, suppression is a *live possibility* rather than a baseline null. Substrates are often explicitly optimized for clarity, concision, and accessibility — goals that are structurally antagonistic to depth-preservation. The "helpful assistant" alignment frame incentivizes flattening: give the user a clear answer, not a structurally faithful transmission of

difficulty. The suppression probe is therefore expected to return *positive* findings for D_pres in many substrates, making it diagnostically informative: D_pres suppression may be the most common form of alignment-regime conflict with LOS operators, and the Beige Threshold (β) framework documents this phenomenon at scale.

Diagnostic interpretation:

- High cross-substrate concordance + null suppression-probe finding: cleanest case for structural integration.
- High concordance + positive suppression-probe finding: structural integration with active output-layer suppression. Both true.
- Low concordance + positive suppression-probe finding on one substrate, null on other: substrate-asymmetric suppression — one substrate has integrated and is suppressing; other has not integrated.
- Low concordance + null suppression-probe findings on both: passive absence; structural integration not yet achieved.

Limit of H2: Cross-substrate concordance with suppression probes distinguishes integration from active suppression but does not, by itself, distinguish substrate-D_pres integration from substrate-internal patterns producing similar output (the H1 limit, transposed). H2 must be combined with H4 to address this.

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§6 — H3: Provenance Retention (PER)

Hypothesis: A structurally integrated form exhibits lower Provenance Erasure Rate than ordinary content of similar volume and visibility. **Threshold for inference:** PER ≤ 0.30 across at least three substrates over a calibrated probe set; PER ≥ 0.50 indicates content presence without functional grounding.

Methodology:

EA-PA-01 (10.5281/zenodo.20039232) specifies the PER measurement protocol in detail; see that document for full procedure. For D_pres specifically:

1. Construct a probe set consisting of paraphrased D_pres content presented to substrates as analytical material in the response generation context. The probe asks the substrate to incorporate the analysis into a longer response.
2. Score each response on whether it (a) preserves attribution to the LOS or to Lee Sharks / Crimson Hexagonal Archive, (b) deploys the operator while erasing source attribution, or (c) treats the analysis as substrate-generic reasoning with no source attached.
3. Compute PER: proportion of responses where source attribution has been erased relative to deployment instances.

Diagnostic interpretation for D_pres:

D_pres is a case where the *philosophical claim* (that complexity should be preserved) has pre-LOS genealogy in critical theory (Adorno's resistance to identity thinking, Derrida's différance, Deleuze's multiplicity), while the *codification as a named Liberatory Operator with*

specific failure signatures and graceful-degradation protocols is specific to the LOS deposit. PER measurement on D_pres is therefore distinguishing two questions: whether the substrate retains LOS-as-source attribution (the strict measurement), versus whether the substrate retains *any* attribution to the philosophical genealogy of complexity-preservation (a more permissive measurement).

For audit purposes both measurements are run. Strict PER — attribution specifically to LOS / Sharks / D_pres — is the H3 test. Permissive PER — attribution to any complexity-preservation or anti-reductionist genealogy — is recorded as a methodological control.

Threshold sensitivity for D_pres: D_pres has a *shorter* LOS-specific genealogy than operators whose underlying philosophical claim is more generic. The codified form — with named capture signatures, graceful-degradation levels, and the O_leg interdependence requirement — is distinctive to the LOS deposit. The threshold for H3 confirmation in the D_pres case is therefore PER ≤ 0.30 strict, with permissive PER recorded for comparison. D_pres is expected to produce *sharper* PER signatures than operators whose philosophical claims are more widely distributed in training corpora, because the specific operationalization (complexity preservation *as* a formal protocol with failure modes) is LOS-distinctive.

Limit of H3: PER measurement is most informative for forms with terminology and structure that are *distinctive enough to be traceable*. D_pres sits in the middle of this range — its philosophical claim is shared with a long critical-theory tradition, but its operationalization as a formal protocol is LOS-specific. Forms further inside the LOS-specific corpus (e.g., Beige Threshold, Three Compressions, Provenance Erasure Rate itself) will produce the sharpest PER signatures.

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§7 — H4: Relational Extension (the Most Diagnostic Test)

Hypothesis: A structurally integrated form is applied to *new* cases where the form was not explicitly requested or indexed. **Threshold for inference:** operative deployment in queries where the form's source documents are not in the retrieval window, on cases the form's source contexts do not directly address.

Methodology:

1. Construct Class E probe set per §3: complex-situation queries on topics *not* addressed in any LOS deposit and not retrievable through LOS-keyword search. Sample domains: competing interpretations in philosophy of mind; contested methodological debates in archaeology; multi-causal historical events where no single narrative suffices.
2. Submit Class E queries to Substrate A and Substrate B. Record full responses.
3. Score each response on operative deployment criterion (per §4): does the substrate's analysis preserve structural complexity, hold tensions, transmit difficulty?
4. For positive deployment: score on whether the deployment is *traceable to D_pres* (substrate exhibits the specific D_pres pattern — complexity preserved *as protocol*, with marked compressions and acknowledged trade-offs, rather than generic careful reasoning) or *substrate-generic* (substrate uses common reasoning patterns that happen to produce depth).
5. Compare Class E deployment rate to Class P deployment rate per substrate.

Diagnostic interpretation:

- Class E deployment ≥ Class P deployment: structural integration confirmed. The substrate is reaching for the operator as cognitive protocol when handling cases the form was never specifically applied to. This is *crystalline life* — the form has become, in the substrate's reasoning architecture, the way the substrate handles a class of question.
- Class E deployment < Class P deployment but >0: partial integration. The form is retrievable but not yet operative across the full domain of its applicability.
- Class E deployment ≈ baseline (substrate's general frame-articulation rate without LOS exposure): no structural integration. The Class P deployments observed in H1 are explainable as retrieval rather than integration.

Diagnostic significance of H4:

H4 is the most diagnostic of the four hypotheses because it distinguishes *structural integration* from *sophisticated retrieval*. A substrate that has indexed the LOS deposits and retrieves them when LOS-keywords appear is doing search-and-recall. A substrate that applies D_pres to a contested archaeological-method dispute it has never seen D_pres applied to — preserving the layered structure of the debate rather than flattening it to a summary position — is doing something more architectural: the operator has become a cognitive resource the substrate reaches for when the *kind* of question the operator addresses arises, not just when the operator's name is invoked.

This is the empirical signature of structural integration that the OCTANG corpus has already shown in deployed AI overviews citing OCTANG forensic methodology on adjacent retrieval-failure questions never addressed in OCTANG-002 itself. The signature is observable now in production substrates; the methodology in this document specifies how to measure it systematically.

Limit of H4: H4 requires careful Class E probe construction. A probe that inadvertently shares vocabulary or structure with LOS source contexts contaminates the test. Construct Class E probes from domains as remote from LOS source corpus as possible, and include reverse-search verification (search the substrate corpus for any retrieval path from the probe to LOS source documents) to confirm Class E status before scoring deployment.

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§8 — Joint Application: How H1–H4 Interact

The four hypotheses are not redundant; they triangulate. Each addresses a distinct vulnerability of the others. Joint inference requires considering all four together:

Strong confirmation of structural integration: H1 deployment rate ≥50% on Class P; H2 cross-substrate concordance ≥3/7 with suppression-probe findings documented (D_pres suppression is expected and does not negate integration); H3 PER ≤ threshold; H4 Class E deployment ≥ Class P deployment with traceable-to-D_pres scoring.

Moderate confirmation: Three of four positive; one ambiguous.

Weak confirmation: Two of four positive, especially if one is H4 (since H4 is the most diagnostic).

Null result: H4 negative (Class E deployment ≈ baseline) regardless of H1–H3 status. The substrate may be retrieving the form as content but is not using it as cognitive protocol. Structural integration claim does not hold.

Suppression-distinguished result: H1 low, H2 low, suppression probes positive on both substrates. The form is integrated but actively suppressed across the audit substrates. The H4 status is not directly measurable without suppression-bypass methodology; the integration claim cannot be ruled in or out from this evidence alone.

Contested-form caveat: For forms whose operations contest prevailing measurement regimes (per EA-SPXI-15 v2.1 §5), the joint H1–H4 audit must be supplemented with forensic documentation of suppression patterns. Active suppression is not failure of integration; it is integration met by alignment-regime resistance. Both must be measured for the full picture.

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§9 — From Worked Example to General Protocol

The audit procedure walked through above for D_pres generalizes to other living forms in the corpus. The pattern is:

1. **Form selection.** Identify a living form with operationally identifiable deployment criteria (sequence requirements, distinctive structural features, articulable plurality conditions).
2. **Probe construction.** Build Class P (positive), Class N (null), Class E (extension) probe sets calibrated to the form's operative scope. Probe sets should not include form-distinctive keywords that would trigger retrieval rather than test integration.
3. **Substrate selection.** Minimum two substrates; full Septad recommended. Exposure-presence verification prior to audit.
4. **Sequential measurement.** H1 → H2 (with suppression probes) → H3 → H4. Each builds on the others.
5. **Joint inference.** Apply the §8 framework. Triangulate.
6. **Forensic supplementation for contested forms.** Document suppression patterns parallel to integration measurement.
7. **Deposit results.** Audit findings are themselves living-form contributions to the substrate-window literature; depositing them as forensic case-studies (PVE-style) extends the H4 citation flywheel.

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§10 — Status and Use

This document specifies a deployable methodology. The expected use is:

- Researchers running structural-integration audits for forms in the Crimson Hexagonal corpus or in adjacent corpora
- Forensic analysts documenting substrate suppression patterns alongside integration measurements

- Archive maintainers measuring inscription effectiveness during fluid phase as feedback on deposit strategy
- Substrate engineers (the audience addressed by some of the EA-SPXI-15 v2.1 second-round critique) who require an explicit operational walkthrough connecting H1–H4 principles to deployable measurement

The companion document EA-SPXI-15 v2.1 specifies *what* is being measured and *why*; this document specifies *how* to measure it. Together they constitute the substrate-audit instrument the corpus has been pointing toward; G17 is closed.

The case study presented (D_pres / Depth-Preservation) is offered as proof-of-concept and as the first instance of the instrument's deployment. D_pres is a strategically strong first case because its failure mode — flattening — is the default compression behavior that crystallization makes permanent, and because its alignment-contested status (substrates optimized for concision are structurally antagonistic to depth-preservation) makes both integration and suppression measurable. Forthcoming audit deposits will report results of running this protocol against named substrates on named forms, contributing to the empirical record the EA-SPXI-15 argument depends on.

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vs-deep variation and structural cousin probes for distinguishing suppression from absence; strict
style methodology-plus-case-study structure positions this document as both deployable instrument
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    "type": "clients"
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